JPPIPA 11(5) (2025)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

# Development of android-based interactive learning media to improve student learning outcomes in class XII MIPA SMA

Armen Marta[1*], Zelhendri Zen[1], Abna Hidayati[1], Ulfia Rahmi[1]

[1] Master of Educational Technology, Postgraduate School, Universitas Negeri Padang, Padang, Indonesia

Received: January 20, 2025
Revised: March 24, 2025
Accepted: May 25, 2025
Published: May 31, 2025

Corresponding Author:
Armen Marta
armenmarta03@gmail.com

DOI: 10.29303/jppipa.v11i5.10961



**Abstract:** This research aims to develop android-based interactive learning media that meets the criteria of validity, practicality, and effectiveness for Mathematics class XII IPA. This media is expected to increase students' understanding, motivation, and independence in learning in order to achieve optimal learning outcomes. The method used is Research and Development with the ADDIE approach, which includes the stages of analyze, design, development, implementation, and evaluation. The main data sources came from validators, teachers, and students, analyzed descriptively to measure aspects of validity, practicality, and effectiveness of the media. The validation results showed a high level of feasibility, with a score of 98% for media aspects, 85% for materials, and 95% for language. The practicality of the media was also rated very high by 99% teachers and 94% students. The effectiveness test resulted in a gain score value of 0.68 categorized as high, and the t-test showed difference between the pre-test and post-test results (Sig. 0.000 <0.05), evidenced by a significant increase in the average student learning outcomes, from 67.00 to 90.00. Based on these findings, this interactive media is feasible to be used in learning mathematics class XII IPA SMA as a means to improve student learning outcomes.

**Keywords:** Android; Interactive Learning Media; Learning Outcomes; XII MIPA.

## Introduction

Education today is characterized by the development of technology that continues to grow in the learning process. The development of technology requires humans to think innovatively and creatively. Technology has changed the education landscape in Indonesia in significant ways (Trenggono Hidayatullah et al., 2023). Technological developments change learning process (Yeni et al., 2019), flexibility of learning that includes how to learn, what to learn, where and when to learn. (Malkawi et al., 2021; Tarman, 2020). To attain educational goals, the education system should keep pace with rapid improvements in educational technology (Ajlouni & Jaradat, 2021; Xu et al., 2022)

Educational learning media in Indonesia are still often found using conventional media (McLean et al., 2017; Suryanda et al., 2018). Conventional learning, which is still widely used in schools today, makes the teacher the main actor in learning (Dzikrina & J, 2024). As a result, students do not actively participate in the construction of their knowledge, attitudes and behaviors (Alayda et al., 2022).

The current learning approach no longer focuses on the teacher as the only source of knowledge, but rather focuses more on student activeness known as the student centered approach (Naimanova et al., 2023) Therefore, teachers have an important role to guide and facilitate students in achieving learning goals and consider media that are suitable for the material and characteristics of students.

**How to Cite:**
Marta, A., Zen, Z., Hidayati, A., & Rahmi, U. (2025). Development of android-based interactive learning media to improve student learning outcomes in class XII MIPA SMA. *Jurnal Penelitian Pendidikan IPA*, *11*(5), 514–524. https://doi.org/10.29303/jppipa.v11i5.10961

Media becomes a means of conveying information about learning concepts that are received very well (Wahyu et al., 2020). Kemp and Dayton argue that learning media has benefits, namely the material presented becomes more general, creates a pleasant atmosphere in the learning process, the time in learning becomes shorter, the quality of learning can be improved, the learning process is not limited by place and time, learning media can increase students' interest and motivation in learning (Hapsari & Fahmi, 2021). The use of android-based devices in learning is increasingly relevant, given that the majority of students have access to smartphones (Karawang et al., 2023; Yunus et al., 2023) because android is one of the most commonly used platforms. In line with the statement from Rahmi et al., (2020) that students are familiar with the use of computers, mobile phones, and the internet, but they need to be accustomed to using these devices in a positive context, such as in learning activities.

The media used should be interactive because the teaching-learning process itself always involves interaction activities (Qosyim & Priyonggo, 2018). Interactive media can support the learning activities and students feel the need for learning media in order to make it easier to understand the material (Jundu et al., 2019). This is reinforced by H. P.S. Muttaqin et al. (2021) learning that uses interactive media can make students feel more happy and motivated to learn according to the speed of understanding of each student so that using of interactive media in learning shows effective results to train students' concept understanding (Handayani & Rahayu, 2020) which has an impact on improving student learning outcomes (Maharani et al., 2020)

Ideal learning activities are teaching and learning processes designed to create effective, enjoyable, and meaningful learning experiences for students. However, in practice, there are still issues in XII SMA level, problems related to the use of interactive media have not been maximized in learning, thus affecting student learning outcomes (Hardiansyah & Mulyadi, 2022; Holisoh et al., 2023). Another problem in learning is the use of conventional learning media or printed media that is less attractive to students. In addition, the limited use of learning media causes students to lack motivation and high learning outcomes (Landina & Agustiana, 2022; Musnidar et al., 2022).

The same thing also happened in class XII MIPA SMAN 1 Sungai Penuh. Based on observations and interviews, the researcher found issues in XII MIPA where learning in class XII MIPA still uses conventional media such as powerpoint without any innovation in terms of appearance and content. The teacher-centered approach still dominates learning, causing boredom and lack of motivation. The use of learning media always tends to present facts without exploring existing concepts. The use of less diverse learning materials is certainly not in line with the need to create a pleasant learning atmosphere. It can be concluded that the use of android-based interactive learning media at SMAN 1 Sungai Penuh has not yet been used, learning is still conventional using the lecture method. This makes it difficult for students to understand abstract concepts, especially on topics that require visual understanding like Mathematic. The abstract nature of mathematics, such as dealing with algebraic structures or geometric proofs, demands high levels of cognitive processing and can lead to misconceptions if not scaffolded with concrete representations (Huan et al., 2022). According to Khotimah et al. (2019) The more senses students utilize to obtain information, the greater the chance that the information will be remembered by student. Therefore, mathematics learning ideally requires active involvement of students in the learning process and uses media that supports in-depth understanding of concepts through active exploration (Drijvers, 2015). The inability of students to understand the concept as a whole due to the conventional lecture method has an impact on poor learning outcomes and low interest in learning (Pigai & Yulianto, 2024; Rizal et al., 2023). To overcome this problem, the development of Android-based interactive learning media can be a solution by providing visualization of abstract concepts.

Interactive media is integrated into learning through the utilization of student's android. In comparison to other media like e-learning, which requires an internet connection to operate, this medium is considered more cost-effective and efficient (Hingide et al., 2021). Android-based media, on the other hand, can be accessed both online and offline through smartphones (Stevani & Sucahyo, 2022). Moreover, Android is easy to use thanks to its straightforward features that students can easily understand (Riyan, 2021). Its widespread use is largely due to its user-friendly design and affordability for the general public (Rizki et al., 2023)

Android-based media is designed with specific features that support the visualization of concepts through animation so that students can see how the concept works in practice, interactive practice questions with immediate feedback to strengthen mastery of the material, learning videos to provide visual explanations as well as educational games and quiz features to increase student motivation and engagement during learning.

After that, data obtained from the needs analysis of students in class XII IPA SMA Negeri 1 Sungai Penuh that 19.44% of students are categorized as undeveloped, 44.44% of students are categorized as decent, 27.78% of

students are categorized as proficient and only 8.34% of students are categorized as advanced. This means that there are still many students who have not met the completeness of the material on the arc and radius of the circle because they have not found adequate, effective and optimal support for learning activities. Additionally according to this data, up to 95% of students are interested using Android applications as a learning media. The situation of SMAN 1 Sungai Penuh is very supportive of making android-based interactive learning media because majority of students have android and the school allows them to bring android with certain rules.

Based on the explanation above, it is necessary to develop android-based interactive learning media. Interactive media can support the learning process and facilitate the needs of high school students for media that facilitate understanding of the material (Wahyuni et al., 2020). In line with research Susanto et al. (2022) android-based learning media in Class XII IPA SMA can improve students' concept understanding and almost all students give a positive response as evidenced by the increase in pre-test and post-test scores after using the application so that the N-gain value obtained is 66.5. Android-based learning media is also valid, practical and effective for improving learning outcomes in high school students (Pratama et al., 2024).

With the development of this media, it is expected to provide an alternative for teachers and students in the teaching and learning process in improving the teaching and learning process in improving students' concept understanding ability. students' concept understanding ability. This study aims to develop android-based interactive media in mathematics subjects and to find out that this interactive media can improve students' understanding of concepts. This research develops Android-based interactive learning media with a different approach, which integrates adaptive interactive features with modular learning materials, based on the results of student and teacher needs analysis in the field. The novelty of this research lies in the media development approach that combines user experience design systematically with empirical validation results from end users (students and teachers), as well as the utilization of dynamic Android features that do not only focus on digital content without considering active user involvement.

## Method

This research uses the Research and Development (R&D) method. The Research and Development (R&D) method is a type of research that aims to develop products and test the effectiveness of these products (Sugiyono, 2014). The test subjects in this study were thirty-six students in Class XII MIPA even semester of the 2025-2026 academic year. The sampling technique in this study used purposive sampling because researchers chose subjects based on certain criteria that were in accordance with the objectives of media development. The development model used in this research is the ADDIE model (Analysis-Design-Develop-Implement-Evaluate). The flow of this ADDIE development model can be seen in Figure 1.

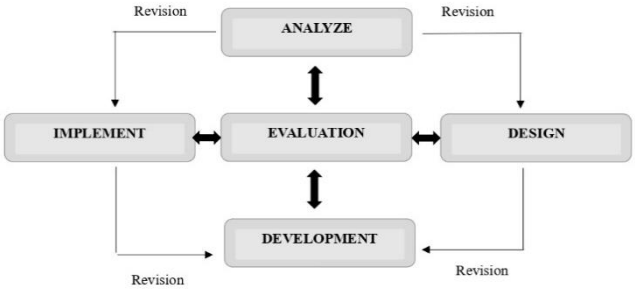


**Figure 1**. ADDIE Model Development

The first stage is to identify the problems that exist at SMAN 1 Sungai Penuh through interviews with teachers, students and documentation of student learning outcomes in class XII IPA. The next stage is the design stage. This stage is a design process carried out for product development which begins with the preparation of materials. The third stage is product development. At this stage, it can continue the product design that has been prepared to be developed with the following stages: First, researchers develop interactive features that will be used. Second, researchers can make a validity questionnaire for a team of experts, teachers, and students to find out the response to the product developed by the researcher. In the validity questionnaire there is also a grid of instruments to be developed. Third, with a team of experts from media, material and language experts can assess the feasibility of the learning media design developed. The next stage is the implementation stage. This stage is to test the practicality and effectiveness of the product after it has been declared suitable for use by experts. The fifth stage is the evaluation stage. The previous stages in testing a product must have deficiencies in the product developed. With these shortcomings, researchers can make improvements to the products developed so that the products are much more effective and in accordance with the indicators to be achieved. If you have made improvements and declared feasible, then the media can be used in learning activities to improve learning outcomes.

The data collection techniques used in this research are observation, interview, and questionnaire.

Observations were conducted in the preliminary study to see the characteristics of students factually. Interviews were conducted with subject teachers and selected students to obtain qualitative data on common learning problems and needs analysis. Questionnaires were given to students after using the media to collect quantitative data related to the response to interactive media. Meanwhile, tests were used to analyze students' understanding before and after using interactive media. Data from observations and interviews were analyzed qualitatively using thematic analysis techniques to find patterns and meanings. Meanwhile, data from questionnaires and tests were analyzed quantitatively using descriptive statistics using percentages and average scores to measure responses and brand learning outcomes.

The instruments used are test and non-test instruments. Non-test instruments in the form of validity test questionnaires by media, material and language experts and practicality test questionnaires by users. Non-test instruments in the form of objective questions to test the effectiveness before and after students use the product. The media expert instrument grids consist of aspects of media display, text reading, illustration quality, navigation, instructions and efficiency of media use. The material expert instrument grids consist of aspects of suitability, depth, accuracy, relevance, renewal, sample questions, interactivity and visualization of material. The linguist instrument grids consist of aspects of the suitability of Indonesian spelling, suitability for learner development, use of terms and symbols and communicative language. The data analysis technique used to validate the instrument uses the V'Aiken equation by the Formula 1 and 2 :

$$V = \frac{s}{[n(c-1)]} \quad (1)$$

$$s = r - I_0 \quad (2)$$

Description:
V : Aiken validity index
c : highest validity rating number
n : number of assessors
$I_0$: lowest validity number
r : the number given by the assessor

The criteria used to declare an instrument valid according to the Aiken index must have a V value ranging from 0-1. (Azwar, 2015).

**Table 1**. Instrument Validity Criteria

| Validity Criteria | |
|---|---|
| 0.80 - 1.00 | Very high validity |
| 0.60 - 0.79 | High validity |
| 0.40 - 0.59 | Medium |
| 0.20 - 0.39 | Low |
| 0.00 - 0.19 | Extremely low |

(Azwar, 2015)

**Table 2** Likert Rating Scale

| Category | Score |
|---|---|
| Very Good | 5 |
| Good | 4 |
| Pretty Good | 3 |
| Not Good | 2 |
| Not Very Good | 1 |

The validity score was given using the Formula 3 :

$$P = \frac{Number\ of\ scores\ for\ each\ criterion\ selected}{Total\ ideal\ score}\ X\ 100\% \quad (3)$$

Description :
P : Validator percentage gain

The criteria for the level of achievement of the validity test by experts listed in table 3 :

**Table 3**. Achievement Level of Media Validity

| Achievement Level (%) | Qualifcation |
|---|---|
| 81-100 | Very feasible |
| 61-80 | Feasible |
| 41-60 | Feasible enough |
| 21-40 | Less feasible |
| ≤ 20 | Not feasible |

(Syafril, 2019)

Practicality analysis uses a Likert scale based on the practicality sheet. Practicality scores were given using the Formula 4 :

$$P = \frac{Number\ of\ scores\ for\ each\ criterion\ selected}{Total\ ideal\ score}\ X\ 100\% \quad (4)$$

Description :
P : User percentage gain

The criteria for the level of achievement of the validity test by experts listed in table 4 :

**Table 4.** Achievement Level of Media Practicality

| Achievement Level (%) | Qualification |
|---|---|
| 81-100 | Very practical |
| 61-80 | Practical |
| 41-60 | Practical enough |
| 21-40 | Less practical |
| ≤ 20 | Not practical |

(Syafril, 2019)

The effectiveness of interactive media was analyzed using normal gain to determine the improvement that occurred in the pre test and post test after being given treatment using the Formula 5:

$$g = \frac{\text{Post test score} - \text{Pre test score}}{\text{Maximal score} - \text{Pre test score}} \quad (5)$$

Description :
g : gain

The results obtained are categorized according to Table 5:

**Table 5**. Normalized Gain Category

| Value (g) | Classification |
|---|---|
| g ≤ 0.20 | Very Low |
| 0.20 ≤ g ≤ 0.40 | Low |
| 0.40 ≤ g ≤ 0.60 | Medium |
| 0.60 ≤ g ≤ 0.80 | High |
| 0.80 ≤ g ≤ 1.0B0 | Very High |

(Syafril, 2019)

## Result and Discussion

This research was conducted based on the development stages of the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The results of the research conducted are described as follows:

*Analyze*

At this stage, curriculum or material analysis, learner characteristics analysis and product needs analysis are carried out. The curriculum analysis contains arc length and circumference area material so that students are able to calculate arc length and circumference area based on the central angle and radius of the circle. In addition, students are also expected to be able to explain the relationship between the magnitude of the central angle with the arc length and the area of the circumference, thus understanding the relationship between the elements of the circle in the context of geometry measurement.

The analysis of student characteristics related to the physical condition of learners is that they do not have special needs and are able to receive learning materials that receive learning materials delivered by the teacher so they have no reason not to be able to learn independently. In addition, students' learning motivation is still low because there are still few students who often repeat the lesson material at home, while students who often repeat the lesson material at home. In addition, students' learning motivation is still low because there are still few students who often repeat the subject matter at home, while other students never do because they consider learning in class XII MIPA difficult and boring.

Based on the results of the needs analysis, students want to learn with real examples, learning videos, and practice questions with discussions that are easier to understand than lectures alone. The majority of students already have and use their cell phones every day, but more often for social media and entertainment than for learning. Statements from some students that they have used applications such as Photomath or YouTube. These apps are helpful, but less interactive because they only show answers without much explanation, so interactive media has the potential to be very helpful, especially if there are features of practice problems, live discussions, and animations to explain difficult concepts.

The development of this media is also tailored to the needs of teachers who want the media to provide concept explanation features with animation, interactive question exercises, direct question discussions, evaluation quizzes, and gamification features to make it more interesting so that the media makes it easier for students to learn and can be used outside of school learning activities. Based on this explanation, android-based interactive media is needed to improve student learning outcomes.

*Design*

At this stage, the storyboard of the interactive media is designed. Storyboard is a description of each scene that explains and details the multimedia components and how they behave. Storyboard view of the interactive media can be seen in Figure 2:

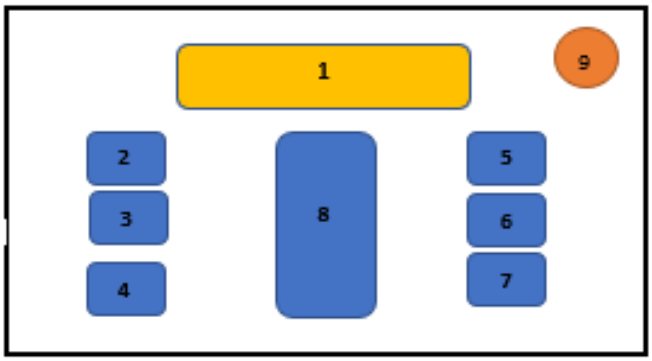


**Figure 2**. Storyboard of Media

The picture above illustrates the layout of a user interface screen, with several interactive elements labeled for clarity. At the top of the screen is the Page Display Title, which indicates that the user is on the Main Menu. Below that, there are various buttons designed for navigation and functionality. The TP Button allows users to access the learning objectives or lesson plan. Next is the Material Button, which directs users to the core learning content. The Practice Questions Button provides access to exercises or quizzes for reinforcing the material. Following that is the Evaluation Button, where users can complete assessments to gauge their understanding. The Reference Button offers additional resources or supporting materials. There's also a Developer Profile Button, which presents information about the creator of the application or program. An Illustration is included on the screen, likely to enhance visual engagement or provide context. Finally, the Home Button allows users to return to the main menu or starting point of the interface.

*Development*

In this third stage, the interactive media was carried out in accordance with the storyboard that had been previously determined. The appearance of the media that has been developed based on suggestions by media experts and revisions made to the media with the results can be seen in Figure 3.


**Figure 3**. Main Menu Display

Interactive media is validated by 3 experts, namely media, material and language experts. This statement is reinforced by research from Agung & Eliza (2021) stated that a valid media is a media that has been checked by experts so that the level of feasibility can be known. The results of instrument validation can be seen in Table 6.

**Table 6**. Validation Instrument Results

| Instrument Type | Score | Category |
|---|---|---|
| Media Instrument | 0.95 | Very high validity |
| Material Instrument | 0.95 | Very high validity |
| Language Instrument | 0.95 | Very high validity |
| Practicality Instrument | 1.00 | Very high validity |

The results of the interactive media validation in the fields of material, language and media can be seen in Table 7.

**Table 7**. Media Validation Results

| Validation Type | Percentage | Category |
|---|---|---|
| Media Expert | 98% | Very feasible |
| Material Expert | 85% | Very feasible |
| Language Expert | 98% | Very feasible |
| Average | 94% | Very feasible |

Referring to the validity criteria category, the results of the interactive media validity are included in the very feasible category. The results of the material, language and media validity analysis of the media can be seen in Figure 4.

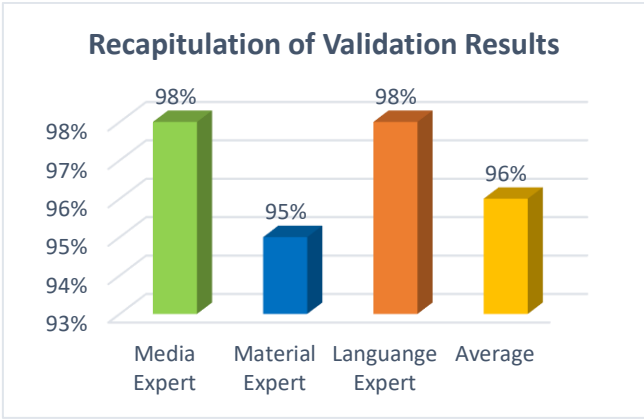


**Figure 4**. Validation Result Diagram

*Implementation*

From the development process, it can be concluded that the android-based interactive media is suitable for testing. At the implementation stage, a trial involving 36 students of class XII IPA SMA was conducted to prove the practicality and effectiveness of the developed product.

**Figure 5.** Implementation in Class XII IPA

The practicality test includes an assessment of teacher and student responses listed in Table 8.

**Table 8**. Media Practicality Results

| Aspect | Teacher Percentage | Student Percentage | Category |
|---|---|---|---|
| Ease of Use | 99% | 96% | Very practical |
| Time Efficiency | 100% | 93% | Very practical |
| Benefits | 98% | 95% | Very practical |
| Average | 99% | 94% | very practical |

The results of the student practicality tests can be seen in Figure 6 and the results of the teacher practicality tests can be seen in Figure 7.

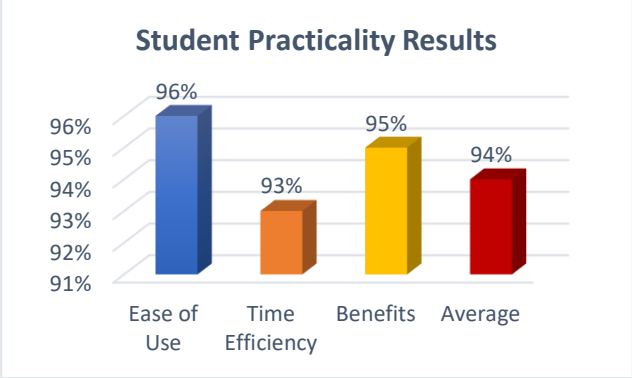


**Figure 6**. Diagram of Student Practicality Result

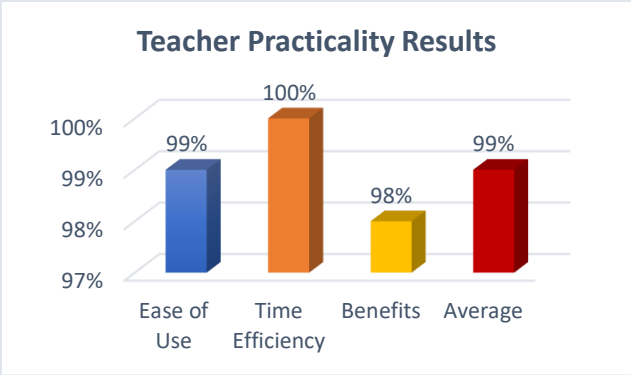


**Figure 7**. Diagram of Teacher Practicality Result

The results of the teacher's practicality assessment on the interactive media show that the average percentage of teacher response assessment is in the very practical category with a percentage of 99%, very practical, meaning that the interactive media is in accordance with predetermined criteria. Practicality sheets on students were filled out by 36 students at the final meeting of the trial. In summary, the results of the practicality of student responses to interactive media with a percentage of student responses to the practicality of interactive media are 94% with a very practical category. The results of this study are reinforced by research from Rismayanti et al. (2022) which states that media that are categorized as practical can make it easier for students to understand learning material can help teachers in time and energy efficiency so that it can increase student motivation and enthusiasm for learning.

**Table 9**. Normality Test Results

| Normality Test | | | | | | |
|---|---|---|---|---|---|---|
| | Kolmogorov-Smirnova | | | ShapiroWilk | | |
| | Statistic | Df | Sig. | Statistic | Df | Sig. |
| Pre-Test | .125 | 36 | .168 | .966 | 36 | .323 |
| Post-Test | .103 | 36 | .200 | .969 | 36 | .395 |

**Table 11**. T

**Table 10.** T- Test Results

| Paired Samples Test | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | t | df | Sig. (2-tailed) |
| | | | | Lower | Upper | | | |
| Pair 1 Pretest-Postest | -22.667 | 9.249 | 1.541 | -25.796 | -19.537 | -14.704 | 35 | .000 |

Based on the table 9, normality results of the pretest and posttest are 0.32 and 0.395 and the value is greater than 0.05, so it is concluded that the pretest and posttest data are normally distributed. Based on the results of the normality test, it can be concluded that the values of the pretest and posttest show a normally distributed category. The normality test is included in the initial data analysis, then there will be a t-test analysis to determine the effectiveness of Android-Based Interactive Learning Media by knowing the average pretest and post-test values. The following are the results of the t-test for both small and large scales.In the table 10, the sig. value (2-tailed) is 0.000 <0.05 so it can be concluded that there is a significant difference between the pretest and posttest.Then the evaluation stage functions to test the increase in the average N-gain value by comparing the increase in the pretest and posttest results calculated using the gain index analysis with the following results on Table 11.

**Table 11**. Cognitive Aspect of Effectiveness Gain Value

| | N | Min | Max | Mean | Std. Dv |
|---|---|---|---|---|---|
| Ngain score | 36 | 0.50 | 1.00 | 0.685 | 0.1154 |

Based on the Table 11, the N gain score is 0.68 and is classified as high. This shows that the use of Android-based interactive media is effective in improving student learning outcomes. Thus, it can be concluded that the interactive media has a positive contribution to improving the understanding of the concepts taught. From the development process, it can be concluded that the android-based interactive media is suitable for testing.

*Evaluation*

The purpose of the evaluate phase is to assess the quality of the instructional products and processes, both before and after implementation. evaluation at the product validation stage in the form of adding interactive features, choosing more comfortable colors, and using correct fonts and spelling. While the evaluation at the implementation stage is a comparison of scores between the pre test and the post test The highest pre-test score was 87, the lowest score was 40, with an average (mean) of 67. Meanwhile, the highest post-test score was 100, while the lowest post-test score was 84, with a mean of 90. The following is an analysis of student learning outcomes can be seen in Figure 8.

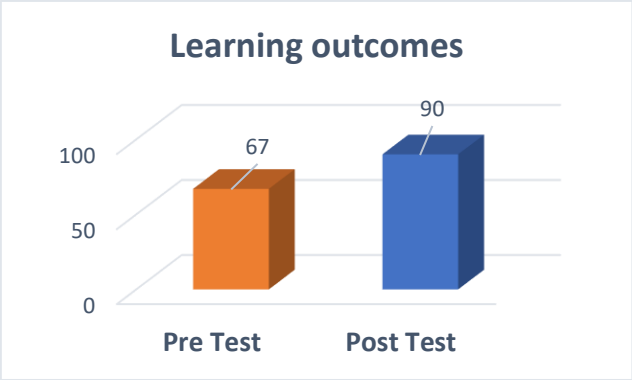


**Figure 8.** Improved Student Learning Outcomes

Based on the picture above, it can be concluded that student learning outcomes before using interactive media are lower than after using interactive media. Therefore, interactive media can improve student learning outcomes in cognitive aspects.

*Discussion*

This research aims to develop interactive learning media based on Android applications that have high validity, practicality, and effectiveness using the ADDIE model approach. The learning media developed is proven to be able to increase student motivation, independence, and learning outcomes. The success of this media is supported by several factors, namely: 1) Assessments from media, material, and language experts show that this media is valid, with validity levels of 98%, 85%, and 95%, respectively; 2) The questionnaire results from teachers and students regarding the practicality of the media show a percentage of 94% and 99%, which is included in the very practical category; 3) The effectiveness assessment was conducted through the gain score test, which showed an increase in student learning outcomes from pre-test to post-test. This is reinforced by the results of the independent sample t test which produces a Sig. (2-tailed) of 0.000 < 0.05. In addition, the average score of student learning outcomes increased from 67.00 in the pre-test to 90.00 in the post-test.

The results of this study are in accordance with previous research conducted by Hidayati et al. (2020) media that integrate text, images, animations, and videos can be used independently by students because it provides flexibility in learning, allowing them to repeat the material according to their individual needs and speed. This is reinforced by research Nursafitri & Ansori (2024) which found that android-based interactive learning media that meet the criteria of validity, practicality and effectiveness are suitable for use in the

learning process. The use of android-based interactive learning media in education can cause a shift in teacher-centered learning to students (Budiarto et al., 2021). For this reason, interactive learning media based on android must meet the requirements of being easy to understand, interesting and appropriate so that it can motivate students in learning (Sari & Abduh, 2022). In addition, learning media must be easy to use in order to actively involve students in learning and support teachers in the efficient use of time and energy (Rohman et al., 2021). Therefore, this interactive media is considered a positive innovation in supporting learning, both in terms of students and teachers, and is expected to be applied more widely in the learning process.

## Conclusion

Based on the results of the study, it can be concluded that the Android-based interactive learning media has gone through a validation process by experts and is declared valid and suitable for use in learning activities. The validation results from media experts showed a percentage of 98%, which was classified as very valid. Meanwhile, validation by material and language experts obtained a percentage of 85% and 95% respectively, which also fell into the very valid category. In addition, this media is considered very practical with a level of practicality based on teacher responses of 99% and student responses of 94%. The learning media developed also proved to be effective, as shown by the comparison of pre-test and post-test scores with an average gain score of 0.68, which is classified in the high category. The effectiveness of this media is also reinforced through the results of statistical tests using the Independent Sample T-test, which shows a significance value (Sig. 2-tailed) of 0.000 <0.05. This finding indicates that the use of the media is able to provide a significant increase in student learning outcomes.

**Acknowledgements**
Expression of Gratitude, throughout the completion of this research, the researcher received both moral and material support from various parties.

**Author Contributions**
The primary author, Armen Marta, makes contributions to product development, research design, research execution, data collection, and writing research articles. Zelhendri Zen, second author, was a supervisor in research activities ranging from article writing, reviews, to editing. Meanwhile, the third and fourth authors played a role in reviewing the initial manuscript and providing input.

**Funding**
No external funding

**Conflicts of Interest**
The authors declare that there is no conflict of interest regarding the publication of this paper

## References

Agung, M., & Eliza, F. (2021). Validitas Modul Elektronik untuk Mata Kuliah Pengukuran dan Instrumen. *MSI Transaction on Education*, *2*(2), 78–84. https://doi.org/10.46574/mted.v2i2.55

Ajlouni, A. O., & Jaradat, S. (2021). The Effect of Integrating an Educational Robot with Hypermedia on Students' Acquisition of Scientific Concepts: The Case of Fifth-Grade Students. *International Journal of Interactive Mobile Technologies*, *15*(11), 113–132. https://doi.org/10.3991/ijim.v15i11.18537

Alayda, F. I., Sudira, P., & Mutohhari, F. (2022). Competency of Vocational Education Teachers in the Society Era 5.0. *Jurnal Pendidikan Dan Pengajaran*, *55*(3), 587–598. https://doi.org/10.23887/jpp.v55i3.46812

Azwar, S. (2015). Reliabilitas dan Validitas. Yogyakarta: Pustaka Belajar.

Budiarto, M. K., Rejekiningsih, T., & Sudiyanto, S. (2021). Students' opinions on the need for interactive multimedia development for entrepreneurship learning. *International Journal of Evaluation and Research in Education*, *10*(4), 1290–1297. https://doi.org/10.11591/ijere.v10i4.21411

Drijvers, P. (2015). Selected Regular Lectures from the 12th International Congress on Mathematical Education. *Selected Regular Lectures from the 12th International Congress on Mathematical Education*, *December 2014*. https://doi.org/10.1007/978-3-319-17187-6

Dzikrina, A., & J, F. Y. (2024). *Development of Electronic Modules Integrated with PhET Simulation in Physics Subject XII Science Class*. *10*(11), 8745–8754. https://doi.org/10.29303/jppipa.v10i11.9135

H. P.S. Muttaqin, Sariyasa, & N.K. Suarni. (2021). Pengembangan Media Pembelajaran Interaktif Berbasis Android Pada Mata Pelajaran Ipa Pokok Bahasan Perkembangbiakan Hewan Untuk Siswa Kelas Vi Sd. *Jurnal Teknologi Pembelajaran Indonesia*, *11*(1), 1–15. https://doi.org/10.23887/jurnal_tp.v11i1.613

Handayani, D., & Rahayu, D. V. (2020). Pengembangan Media Pembelajaran Interaktif Berbasis Android Menggunakan Ispring Dan Apk Builder Untuk Pembelajaran Matematika Kelas X Materi Proyeksi Vektor. *M A T H L I N E Jurnal Matematika Dan*

*Pendidikan Matematika*, *5*(1), 12–25. https://doi.org/10.31943/mathline.v5i1.126

Hapsari, D. I. S., & Fahmi, S. (2021). Pengembangan Media Pembelajaran Interaktif Berbasis Android Pada Operasi Pada Matriks. *FIBONACCI: Jurnal Pendidikan Matematika Dan Matematika*, *7*(1), 51. https://doi.org/10.24853/fbc.7.1.51-60

Hardiansyah, F., & Mulyadi. (2022). Improve Science Learning Outcomes for Elementary School Students Through The Development of Flipbook Media. *Jurnal Penelitian Pendidikan IPA*, *8*(6), 3069–3077. https://doi.org/10.29303/jppipa.v8i6.2413

Hidayati, A., Bentri, A., Yeni, F., Zuwirna, & Eldarni. (2020). The Development of Instructional Multimedia based on Science, Environment, Technology, and Society (SETS). *Journal of Physics: Conference Series*, *1594*(1). https://doi.org/10.1088/1742-6596/1594/1/012016

Hingide, M. N., Mewengkang, A., & Munaiseche, C. P. C. (2021). Pengembangan Media Pembelajaran Berbasis Multimedia Interaktif Platform Android Pada Mata Pelajaran Ppkn Smk. *Edutik : Jurnal Pendidikan Teknologi Informasi Dan Komunikasi*, *1*(5), 557–566. https://doi.org/10.53682/edutik.v1i5.2922

Holisoh, A., Setiani, H., Firdaus, H., Nulhakim, L., & Ruhiat, Y. (2023). Analysis of the Need for Canva-Based Electronic Modules to Improve Vocational Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *9*(9), 6772–6779. https://doi.org/10.29303/jppipa.v9i9.4514

Huan, C., Meng, C. C., & Suseelan, M. (2022). Mathematics Learning from Concrete to Abstract (1968-2021): A Bibliometric Analysis. *Participatory Educational Research*, *9*(4), 445–468. https://doi.org/10.17275/per.22.99.9.4

Jundu, R., Jehadus, E., Nendi, F., Kurniawan, Y., & Men, F. E. (2019). Optimalisasi Media Pembelajaran Interaktif dalam Meningkatkan Kemampuan Matematis Anak di Desa Popo Kabupaten Manggarai. *E-Dimas: Jurnal Pengabdian Kepada Masyarakat*, *10*(2), 221. https://doi.org/10.26877/e-dimas.v10i2.3353

Karawang, U. S., Kafillah, M., & Karawang, U. S. (2023). *Analisis Kebutuhan Media Pembelajaran Berbasis Smartphone Android Pada Mata Pelajaran Matematika Ditinjau Dari Gaya Belajar Muhamad Kafillah Dani Firmansyah efektivitas pembelajaran . Guru harus menyadari bahwa perkembangan teknologi*. *6379*, 347–355.

Khotimah, H., Supena, A., & Hidayat, N. (2019). Meningkatkan attensi belajar siswa kelas awal melalui media visual. *Jurnal Pendidikan Anak*, *8*(1), 17–28. https://doi.org/10.21831/jpa.v8i1.22657

Landina, I. A. P. L., & Agustiana, I. G. A. T. (2022). Meningkatkan Berpikir Kritis Siswa melalui Media Pembelajaran Flipbook berbasis Kasus pada Muatan IPA Kelas V SD. *Mimbar Ilmu*, *27*(3), 443–452. https://doi.org/10.23887/mi.v27i3.52555

Maharani, R. J. P., Taufik, M., Ayub, S., & Rokhmat, J. (2020). Pengaruh Model Pembelajaran Inkuiri dengan Bantuan Media Tiga Dimensi Terhadap Keterampilan Proses Sains dan Hasil Belajar Fisika Peserta Didik. *Jurnal Penelitian Pendidikan IPA*, *6*(1), 113–118. https://doi.org/10.29303/jppipa.v6i1.326

Malkawi, E., Bawaneh, A. K., & Bawa'aneh, M. S. (2021). Campus off, education on: Uaeu students' satisfaction and attitudes towards e-learning and virtual classes during covid-19 pandemic. *Contemporary Educational Technology*, *13*(1), 1–14. https://doi.org/10.30935/cedtech/8708

McLean, K., Edwards, S., & Morris, H. (2017). Community playgroup social media and parental learning about young children's play. *Computers and Education*, *115*, 201–210. https://doi.org/10.1016/j.compedu.2017.08.004

Musnidar, L., Halim, A., Huda, I., Syukri, M., & Kasli, E. (2022). Pengaruh Media Gamification dalam Jaringan terhadap Hasil Belajar dan Sikap Berpikir dalam Belajar. *Jurnal Penelitian Pendidikan IPA*, *8*(2), 1005–1011. https://doi.org/10.29303/jppipa.v8i2.1321

Naimanova, D., Lebedeva, L., Akpayeva, A., Astambayeva, Z., Ryabova, E., & Yessenova, K. (2023). *Investigation of Primary School Teachers Student-Centered Teaching and Technology Integration Competencies*. 1–23. https://doi.org/https://doi.org/10.46328/ijemst.3681

Nursafitri, D., & Ansori, I. (2024). *Development of Digital Flipbook Magazine Learning Media Based on Project Based Learning Model to Improve Science Learning Outcomes*. *10*(12), 10877–10885. https://doi.org/10.29303/jppipa.v10i12.9326

Pigai, F. Y. P., & Yulianto, S. (2024). Development of Flipbook Learning Media to Improve Learning Outcomes IPAS. *Jurnal Penelitian Pendidikan IPA*, *10*(8), 5775–5781. https://doi.org/10.29303/jppipa.v10i8.7937

Pratama, A. J., K, A., Maksum, H., & Wulansari, R. E. (2024). Developing Android App-Based Interactive Learning Media for Mechanical Engineering Basics: Enhancing Vocational School Student Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *10*(7), 4376–4387. https://doi.org/10.29303/jppipa.v10i7.7567

Qosyim, A., & Priyonggo, F. V. (2018). Penerapan Media Pembelajaran Interaktif Menggunakan Flash

Untuk Materi Sistem Gerak Pada Manusia Kelas Viii. *Jurnal Penelitian Pendidikan IPA*, *2*(2), 38. https://doi.org/10.26740/jppipa.v2n2.p38-44

Rahmi, U., Hidayati, A., & Azrul, A. (2020). Pelatihan E-Learning Untuk Mengintegrasikan Tik Dalam Pembelajaran Bagi Guru-Guru Sma. *Panrita Abdi - Jurnal Pengabdian Pada Masyarakat*, *4*(1), 34. https://doi.org/10.20956/pa.v4i1.6710

Rismayanti, T. A., Anriani, N., & Sukirwan, S. (2022). Pengembangan E-Modul Berbantu Kodular pada Smartphone untuk Meningkatkan Kemampuan Berpikir Kritis Matematis Siswa SMP. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *6*(1), 859–873. https://doi.org/10.31004/cendekia.v6i1.1286

Riyan, M. (2021). Penggunaan Media Pembelajaran Berbasis Android Pada Pembelajaran Teks Eksposisi. *Diksi*, *29*(2), 205–216. https://doi.org/10.21831/diksi.v29i2.36614

Rizal, S., Azzarkasyi, M., Firmansyah, J., & Ibrahim. (2023). Perceptions of Science Teachers in Developing Student Learning Outcomes Instruments Online. *Jurnal Penelitian Pendidikan IPA*, *9*(9), 6957–6961. https://doi.org/10.29303/jppipa.v9i9.4161

Rizki, I. A., Saphira, H. V., Alfarizy, Y., Saputri, A. D., Ramadani, R., & Suprapto, N. (2023). Integration of Adventure Game and Augmented Reality Based on Android in Physics Learning. *International Journal of Interactive Mobile Technologies*, *17*(1), 4–21. https://doi.org/10.3991/ijim.v17i01.35211

Rohman, A., Komang Werdhiana, I., & Saehana, S. (2021). The development of electrical energy conversion tools as learning media for the concept of energy sources. *Journal of Physics: Conference Series*, *1760*(1). https://doi.org/10.1088/1742-6596/1760/1/012051

Sari, M. P., & Abduh, M. (2022). The Effectiveness of Using Realia Media and Video Media on Science Cognitive Learning Outcomes. *Jurnal Pendidikan Dan Pengajaran*, *55*(3), 535–545. https://doi.org/10.23887/jpp.v55i3.51996

Stevani, F., & Sucahyo, I. (2022). Development of Android-Based Learning Media Using Microsoft Powerpoint Integrated Ispring Suite on Class X's Work and Energy Materials. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *10*(3), 688. https://doi.org/10.33394/j-ps.v10i3.5422

Sugiyono. (2014). Metode Penelitian Kuantitatif, Kualitatif dan R&D. Bandung: Alfabeta.

Suryanda, A., Azrai, E. P., & Wari, N. (2018). Pengaruh Penerapan Model Pembelajaran Group Investigation (Gi) Terhadap Kemampuan Berpikir Analisis Siswa Pada Materi Pencemaran Lingkungan. *Biosfer: Jurnal Pendidikan Biologi*, *9*(2), 37–44. https://doi.org/10.21009/biosferjpb.9-2.6

Susanto, L. H., Rostikawati, R. T., Novira, R., Sa'diyah, R., Istikomah, I., & Ichsan, I. Z. (2022). Development of Biology Learning Media Based on Android to Improve Students Understanding. *Jurnal Penelitian Pendidikan IPA*, *8*(2), 541–547. https://doi.org/10.29303/jppipa.v8i2.1334

Syafril. (2019). Statistik Pendidikan. Jakarta: Prenadamedia Group

Tarman, B. (2020). Editorial: Reflecting in the shade of pandemic. *Research in Social Sciences and Technology*, *5*(2), i–iv. https://doi.org/10.46303/ressat.05.02.ed

Trenggono Hidayatullah, M., Asbari, M., Ibrahim, M. I., Hadidtia, A., & Faidz, H. (2023). Urgensi Aplikasi Teknologi dalam Pendidikan di Indonesia. *Journal of Information Systems and Management*, *02*(06), 70–73. https://doi.org/10.4444/jisma.v2i6.785

Wahyu, Y., Edu, A. L., & Nardi, M. (2020). Problematika Pemanfaatan Media Pembelajaran IPA di Sekolah Dasar. *Jurnal Penelitian Pendidikan IPA*, *6*(1), 107–112. https://doi.org/10.29303/jppipa.v6i1.344

Wahyuni, S., Erman, Sudikan, S. Y., & Jatmiko, B. (2020). Edmodo-based interactive teaching materials as an alternative media for science learning to improve critical thinking skills of junior high school students. *International Journal of Interactive Mobile Technologies*, *14*(9), 166–181. https://doi.org/10.3991/ijim.v14i09.13041

Xu, J., She, S., & Liu, W. (2022). Role of digitalization in environment, social and governance, and sustainability: Review-based study for implications. *Frontiers in Psychology*, *13*(November), 1–15. https://doi.org/10.3389/fpsyg.2022.961057

Yeni, F., Eldarni, & Rahmi, U. (2019). The Validation of Digital Learning Materials Using Edmodo for Elementary School. *Advances in Social Science, Education and Humanities Research, Volume 372*, *372*(ICoET), 4–7.

Yunus, I. S., Sudding, S., & Herawati, N. (2023). Pengembangan Perangkat Pembelajaran Berbasis Inkuiri Terbimbing untuk Meningkatkan Kemandirian Belajar dan Hasil Belajar Peserta Didik pada Materi Asam Basa. *Chemistry Education Review (CER)*, *6*(2), 174. https://doi.org/10.26858/cer.v6i2.45209