Android-Based Instructional Multimedia for Food Ingredients Knowledge: A Development Study in Culinary Vocational Education

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ARTICLE INFO	ABSTRACT
	Background/Context:.The rapid development of digital technology has expanded learning opportunities through interactive multimedia. However, learning practices in vocational schools are still dominated by conventional methods with limited use of innovative media, resulting in low student motivation and engagement, particularly in the Food Materials Knowledge subject. **Objective/Purpose:** This study aimed to develop Android-based multimedia learning media and examine its validity, practicality, effectiveness, and impact on students' learning outcomes and motivation. **Method:** The research employed a Research and Development approach using the ADDIE model, which includes analysis, design, development, implementation, and evaluation stages. The product was validated by subject matter experts and media experts, followed by individual trials, small group trials, and field testing with Grade X Culinary Arts students. Data were collected through questionnaires, observations, and pre-test and post-test assessments. **Results:** Expert validation indicated that the developed multimedia was in the excellent category. Practicality testing showed very positive student responses, with a high feasibility score. Effectiveness testing revealed a significant improvement in learning outcomes, with the average post-test score increasing substantially compared to the pre-test and an N-gain value in the high category. **Conclusion:** The Android-based multimedia learning media is valid, practical, and effective in enhancing student engagement and learning outcomes in vocational food science education, and it can serve as an innovative learning tool to support interactive classroom instruction.

INTRODUCTION

Advances in information and communication technology through the use of computers and the internet have expanded access to information and provided multimedia facilities that improve the quality and appeal of learning. Digital technology enables flexible, interactive, and learner-centred learning, and has been proven to increase engagement and learning effectiveness when designed pedagogically and in line with learner characteristics(Baynit et al., 2025; Blumenstein, 2020). With the increasing use of digital technology, the development of learning media has become an important strategy because learning success is greatly influenced by educators' ability to choose the right methods and media, making teacher technological literacy a key requirement (Farisia & Syafi'i, 2024). Pedagogically designed digital technology-based learning media has also been proven to increase student engagement and learning outcomes (Drugova et al., 2021). However, the CoronaVirus Disease

(Covid-19) pandemic that has been raging since the end of 2019 has forced the sudden implementation of online learning, which has not been fully supported by the readiness of learning media, thus impacting the motivation and engagement of students (Mojumder et al., 2025). Although face-to-face learning has gradually resumed after the pandemic, teaching practices in many schools are still dominated by conventional lecture methods without the support of innovative learning media.

This condition was also found based on interviews at SMK Negeri 2 Gowa on 13 April 2022 with the teacher of the Food Materials Knowledge (PBM) subject, which showed that face-to-face learning was still dominated by lecture methods using blackboards and printed books, while online learning only utilised PowerPoint media. This learning pattern causes students to tend to be bored, passive, and unmotivated, which is in line with research findings that teacher-centred learning with static media reduces cognitive engagement, especially in vocational education that requires high visualisation and interactivity. PBM material is a basic competency of the Culinary Arts Department that forms the foundation for advanced practical learning, so that low motivation and activity among students has the potential to hinder the achievement of vocational competencies. This condition emphasises the need to develop more interactive learning media, so the researchers propose Android-based multimedia learning that utilises mobile devices that are familiar to students. The use of mobile-based multimedia has been proven to significantly increase students motivation, engagement, and conceptual understanding (Garzón et al., 2023). With unique products integrating text, images, audio, video, and interactive evaluations tailored to the characteristics of PBM materials.

Various studies indicate that Android-based learning multimedia are considered valid, practical, and effective in improving the quality of learning, while the use of interactive multimedia on mobile devices has a significantly positive impact on students learning outcomes and motivation compared to conventional learning (Aka, 2025; Bazhenova et al., 2022; Yudha et al., 2023). Furthermore, interactive multimedia are considered capable of accommodating differences in students learning abilities as they allow learning to take place individually and flexibly. The use of multimedia as a learning medium has also been proven to increase students activeness, creativity, and engagement, thereby reducing boredom in the learning process (Garzón et al., 2023; Yorganci, 2022).

Although research on mobile-based learning multimedia has been widely conducted, most studies remain concentrated on higher education and general subjects therefore, further research is required in more specific learning contexts(Bazhenova et al., 2022; Garzón et al., 2023). Research that specifically develops Android-based learning multimedia for the Food Materials Knowledge subject in vocational schools, particularly in the Culinary Arts Department, is still limited. In addition, the utilisation of learning multimedia in face-to-face learning contexts remains relatively limited compared to studies on online learning and blended learning (Kayi, 2024; Mojumder et al., 2025). Thus, there is a research gap that needs to be addressed through the development of contextual Android-based learning media that are aligned with the needs of vocational education.

Based on the above explanation, the researcher is interested in developing Android-based multimedia learning media that utilise devices already owned by students, with the aim of creating a more active and interactive learning environment and enhancing students learning motivation in the Food Materials Knowledge subject.

Based on the background of the study, the research questions are as follows:

RQ1: How is the development process of Android-based multimedia learning for the Food Science subject in the Culinary Arts Department at SMK Negeri 2 Gowa conducted?

RQ2: What are the levels of validity, practicality, and effectiveness of the developed Android-based multimedia learning?

RQ3: How does the use of Android-based multimedia learning affect students' learning motivation and engagement?

METHOD

The type of research employed was Research and Development (R&D), which is a research method aimed at producing a particular product and testing its effectiveness(Sugiyono, 2016). This research was conducted in the first semester of the 2023/2024 academic year at SMK Negeri 2 Gowa, located at

Jl. Masjid Raya No. 46, Bonto-bontoa, Sungguminasa, Somba Opu District, Gowa Regency, South Sulawesi.

The development model used in this study was the ADDIE model. According to Rayanto & Sugianti, 2020 the ADDIE model is an approach that emphasises the analysis of each component, which interacts with one another and is coordinated according to the existing phases. The advantages of the ADDIE model include: (1) it consists of five interrelated stages that are systematically structured and appear more comprehensive, namely Analysis, Design, Development, Implementation, and Evaluation; and (2) it involves collaboration with two subject matter experts and two media experts, thereby producing high-quality learning media.

The development process began with the Analysis stage, which consisted of validating performance gaps, confirming user characteristics, and identifying the required resources. The next stage was Design, which included the preparation of task lists and the testing of strategies. During the Development stage, the researcher realised the previously designed plan into a tangible product. This process involved generating content, selecting or developing supporting media, developing user guidelines, and conducting formative revisions.

The Implementation stage involved the use of the validated learning media, as well as the preparation of the subject teacher and students. Finally, the Evaluation stage aimed to assess the quality of the product and the process through steps such as determining evaluation criteria, selecting evaluation instruments, and conducting the evaluation.

RESULTS AND DISCUSSION

This research and development resulted in an Android-based learning application about Food Ingredients Knowledge. This application can be used on smartphones and contains knowledge about food ingredients, video tutorials on food ingredient processing, and practice questions. This application was developed through the stages of the ADDIE development model, which includes analysis, design, development, implementation, and evaluation. The stages of development are as follows:

1. Analysis

The results of the analysis formed the basis for considerations regarding the development of the learning application. The analysis was conducted with the involvement of teachers responsible for teaching Food Science. The following are the results of the interviews:

a) The teacher of the Food Materials Knowledge subject still frequently employed lecture-based methods, and during the pandemic period, learning was conducted online by sending documents through the WhatsApp application.

b) The media used consisted of the blackboard as an introduction to the material, supported by printed guidebooks.

c) The teacher perceived that students often lost focus during the learning process, as several students were observed occasionally checking their smartphones.

d) Students learning motivation was still considered low, as indicated by the limited interaction between the teacher and students; for example, when the teacher provided opportunities for students to ask questions, students sometimes remained silent and did not respond.

e) The teacher viewed the development of interactive multimedia-based learning media as important, with the expectation that it could help students avoid boredom, maintain focus during the learning process, and enhance students learning motivation.
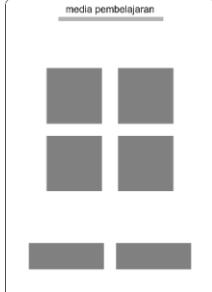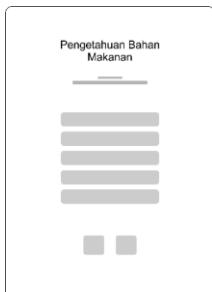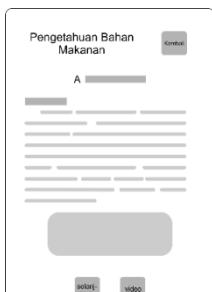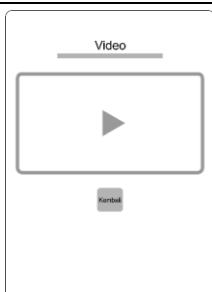
Based on the interviews conducted, it was identified that the causes of the problems included:

a) Students learning resources were limited to printed textbooks only

b) The utilisation of learning media was still insufficient

c) Students lacked focus and experienced difficulties in understanding the types and processing of food materials in the Food Materials Knowledge subject.

2. Design

Based on the results of the analysis, the next stage is design, which includes creating a storyboard and designing the material. The following is the storyboard and key points of the material that will be used as content:

Table 1 Storyboard

| No	Illustration	Description
1		Home Page On this page, there are buttons for Materials, Quizzes, Exercises, Profile, Instructions, and Music On/Off
2		Sub-Materials Page On this page, there are buttons for sub-topics 1 to 5, as well as a start button and a back to menu button
3		Materials Page On this page, there is a button to return to the Sub-Materials, as well as the contents of the materials when they are started or selected. There is also a button for the next material and a video about the material being opened.
4		Video Page There is a video that corresponds to the material being opened, and there is also a button to return to the Sub-Material.
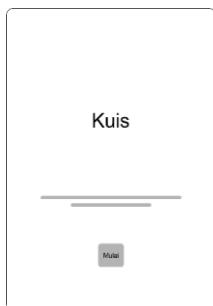
| 5		Quiz Information Page This page contains information about the time limit for completing the quiz, and a button to start the quiz.
6		Quiz Page On this page, you will find the time limit, questions and answers to choose from, as well as a 'next' button to move on to the next question and a 'back' button to exit the quiz.
7		Practice Page On this page, there are questions and answers to choose from, as well as a next button to move on to the next question and a back button to exit the exercise.
8		Score Page This page displays the calculated score based on the correctness of the answers selected on the quiz page or practice page. There is also a button to return to the previous page.
9		Profile Page On this page, there is information about the research title and the researcher. There is also a button to return to the menu page.
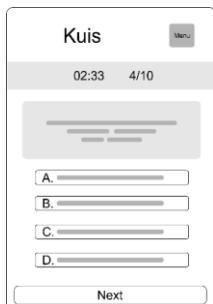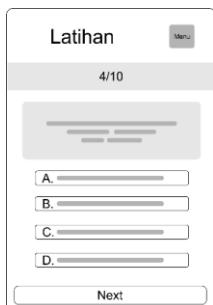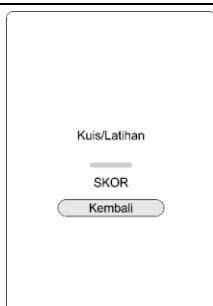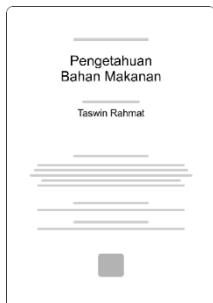
| 10		Instructions Page Contains information about the use of buttons in the learning application.
11		Pop Up Exit Displaying Yes and No options when you want to exit the learning application.

Furthermore, the material design to be used as content included:

a) Cereals

Explaining rice and various types of cereals such as rice, maize, oats, and wheat.

b) Legumes

Explaining legumes and their types, including legumes as seeds and legumes as fruits.

c) Vegetables

Explaining vegetables, including methods of storing vegetables, ways of processing vegetables, and examples of processed vegetable products.

d) Tubers

Explaining tubers and their types, such as cassava, sweet potatoes, taro, potatoes, and bulb vegetables.

e) Fruits

Explaining fruits, fruit classification, criteria for good-quality fruits, methods of storing fruits, and examples of processed fruit products.

3. Development

The Development stage involved the creation of learning content and continuous formative revisions aimed at improving the quality, functionality, and effectiveness of the multimedia learning media.

a) Producing content
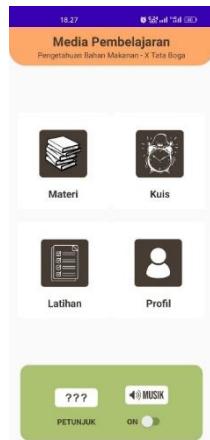

Figure 1. Main Menu Display

Figure 2. Sub-material display
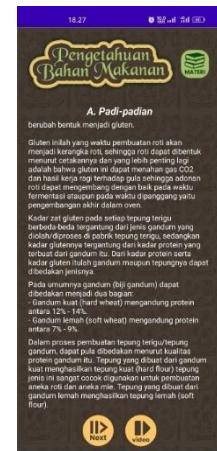

Figure 3. Display of Material Content

Figure 4. Video Display
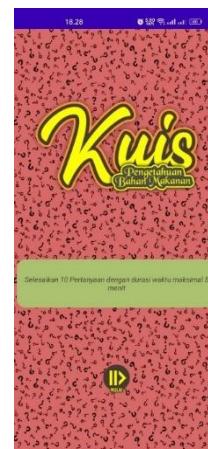
Figure 5. Initial Display of the Quiz

Figure 6. Quiz Display

Figure 7. Quiz Score Display

Figure 8. Exercise Display



Figure 9. Training Score Display
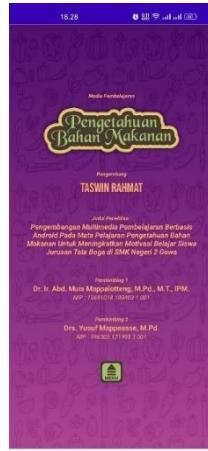
Figure 10. Profile Display


Figure 11. Display of Instructions
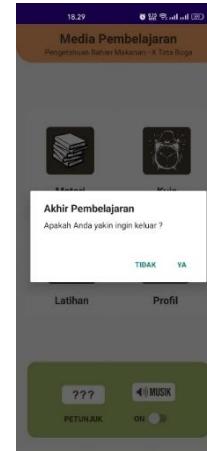
Figure 12. Output Display

Figures 1 to 12 illustrate the overall appearance and main features of the developed Android-based multimedia learning application, including the main menu, material content, video integration, interactive quizzes, exercises, score displays, user profile, instructions, and output interface.

b) Conducting formative revisions

The formative revision stage was carried out to evaluate the feasibility and quality of the multimedia learning product through subject matter expert validation, media expert validation, and an initial product trial, which served as the basis for product improvement.

1) Subject matter expert validation

The evaluation by subject matter experts was conducted to assess the content feasibility, presentation suitability, and language assesment of the developed learning media. The recapitulation of the validation results is presented in Table 2.

Table 2 Total recapitulation results by subject matter experts based on three aspects of validation

No	Validator Name	Aspect	Average aspect	Total average	Category
1	Husnawati, S.Pd	Eligibility of content	4,5	4,6	Very good
		Presentation suitability	4,7		
		Language assessment	4,7		
2	Fitriani, S.Pd	Eligibility of content	4,5	4,7	Very good
		Presentation suitability	5		
		Language assessment	4,8		
	Total			4,6	Very good

Source: Data processing results, 2023

Table 2 above shows that the average total assessment score by both validators based on the three validation aspects is 4.6, which falls into the Excellent category.

2) Media expert validation

Assessment by media experts aims to evaluate the quality of the display design and the level of interactivity of the learning media developed. The results of the validation recapitulation can be seen in Table 3.

Table 3 Total recapitulation results by media experts based on two aspects of validation

No	Validator Name	Aspect	Average aspect	Total average	Category
1	Dr. Ir. Abd. Muis Mappalotteng, S.Pd., M.Pd., M.T., Ipm	Display	4,9	4,9	Sangat Baik
		Interactivity	5		
2	Dewi Fatmarani Surianto, S.Kom., M.Kom	Display	4,0	4,1	Baik
		Interactivity	4,2		
	Avarage			4,5	Sangat baik

Source: Data processing results, 2023

Table 3 above shows that the average total assessment score by both validators based on the two validation aspects is 4.5, which falls into the excellent category.

3) Initial product testing

The initial product testing included individual tests and small group tests to assess students responses to the learning media. The results of the individual tests are shown in Table 4, while the results of the small group tests are presented in Table 5.

Table 4 Frequency distribution of responses from individual trial students

Interval	Category	Frequency	Relative percentage (%)	Cumulative percentage (%)
> 4,2	Very good	2	66	66
3,4 – 4,1	Good	1	33	100
2,6 – 3,3	Satisfactory			
1,9 – 2,5	Poor			
< 1,8	Very Poor			
Total		3	100	

Source: Data processing results, 2023

Based on the information in Table 4 above, it can be concluded that two students (approximately 66%) rated the learning media as excellent, while one student (approximately 33%) rated the learning media as good.

Table 5 Frequency distribution of responses from students in the small group trial

Interval	Category	Frequency	Relative percentage (%)	Cumulative percentage (%)
> 4,2	Very good	6	75	75
3,4 – 4,2	Good	2	25	100
2,6 – 3,3	Satisfactory			
1,9 – 2,5	Poor			
< 1,8	Very Poor			
Total		8	100	

Source: Data processing results, 2023

Based on the information in Table 5 above, it can be concluded that six students (approximately 75%) rated the learning media as excellent, while the other two students (approximately 25%) rated the learning media as good.

4. Implementation

The Implementation stage involved the application of the developed multimedia learning media in the classroom, including the preparation of the learning system and students to support effective use of the product.

a) Preparing the learning system

Preparing the learning system involves providing facilities, infrastructure, and ensuring the readiness of teachers. The facilities prepared to support the use of the media that has been developed include the use of smartphones to install the learning media application that has been developed. The infrastructure facilities include classrooms to make the teaching and learning process more comfortable and efficient. Teachers must also be well prepared to guide students in using the learning media that has been created. The preparation began with ensuring that the teachers had expertise in their fields. The researchers also obtained permission from the Food Science teachers to involve them in this study. On 3 October 2023, the teachers were informed that they would be involved in the study. The preparation begins with ensuring that the teachers have expertise in their field. The researchers also obtained permission from the Food Science subject teachers to involve them in this research. On 3 October 2023, the researchers met with the teachers to provide guidance on the use of the media that had been created, which would later be used as teaching materials for students.

b) Preparing students

The students were the focus of the development of the interactive learning media that was created. A total of 41 students from Class X of SMK Negeri 2 Gowa were selected as samples for implementation. Before the trial was conducted, the teacher in charge informed the students to bring their personal mobile phones, which would be used when using the interactive learning media that had been designed.

5. Evaluation

At this evaluation stage, calculations were made regarding the practicality and effectiveness of the food knowledge application. The development of Android-based multimedia learning received a positive response, so it can be said that the development was practical and effective. This was proven through field tests and questionnaires that were distributed to assess the practicality of the media, as well as pre-tests and post-tests to assess the effectiveness of the media. The following are the results of the practicality and effectiveness tests:

a) Practicality Test

Field tests were conducted with three assessment aspects, namely programming, content and appearance, using a sample of 30 students majoring in Culinary Arts at SMK Negeri 2 Gowa. The following are the results of the field test assessment:

Table 6 Summary of student responses on three assessment aspects

No	Aspect	Avarage
1	Programming	4,7
2	Content	4,6
3	Interface Design	4,7
	Overall Mean Score	4,7

Source: Data processing results, 2023

Table 7 Frequency distribution of student responses on three assessment aspects

Interval	Category	Frequency	Relative percentage (%)	Cumulative percentage (%)
> 4,2	Very good	29	96	96
2,7 – 4,1	Good	1	4	100
2,6 – 3,3	Satisfactory			
1,9 – 2,5	Poor			

< 1,8	Very Poor		
Total		30	100

Source: Data processing results, 2023

Table 7 shows that 29 students (approximately 96%) rated the learning media in all three aspects (programming, content, and interface design) as excellent, while 1 student (approximately 4%) rated the learning media in all three aspects as good. Overall, the cumulative assessment from all students was positive.

b) Effectiveness Test

To measure the effectiveness of the media that had been developed, the researchers conducted trials with pre-tests and post-tests, which were then calculated using the n-gain formula.

Table 8 Comparison of pre-test and post-test statistical values

Statistical Values	*pre-test*	*post-test*
Skor	2500	3640
Average	60,98	88,78
Minimum value	20,0	40,0
Maximum Value	93,3	100

Source: Data processing results, 2023

Table 9 Comparison of pre-test and post-test scores

Minimum Passing Grade	*Pre-test*	Percentage (%)	*Post-test*	Percentage (%)
<75	27	66	6	15
>75	14	34	35	85
Jumlah	41	100	41	100

Source: Data processing results, 2023

$$N - Gain\ (g) = \frac{Skor\ Posttest - Skor\ Pretest}{Skor\ Ideal - Skor\ Pretest}$$

$$= \frac{3640 - 2500}{4100 - 2500}$$

$$= \frac{1140}{1600}$$

$$= 0,71$$

From the n-gain classification data, it can be concluded that Android-based interactive learning media has a high level of effectiveness with a value of 0.71.

Discussion

1. Learning Media

An interactive Android-based learning media application for the Food Science subject, specifically Plant-Based Food Materials for Grade X Culinary Arts students at SMK Negeri 2 Gowa, has been successfully developed and is accessible via smartphone. The application was developed using Android Studio, supported by Photoshop CS6 and CorelDraw X7, with the aim of producing innovative and effective learning media to enhance students' understanding and learning motivation. This study examines the practicality, effectiveness, and user responses to the application, which was developed using the ADDIE model through the stages of Analyse, Design, Develop, Implement, and Evaluate. The resulting Food Knowledge application was built using the Kotlin programming language and integrated with the YouTube API Key to support learning videos. The application includes a main menu, material menu, instruction menu, developer profile menu, quiz menu, and exercise menu, and can be accessed offline for text and image content and online for video content, allowing flexible use in various learning conditions.

Validation results indicate that the application was rated very good by both subject matter and media experts. Subject matter experts assessed the content, presentation, and language aspects with average scores of 4.6 and 4.7, while media experts evaluated appearance and interactivity with average scores of 4.9 and 4.1, resulting in an overall average of 4.5. Individual and small group trials also yielded very good results, with average scores of 4.5 and 4.4, respectively. These findings demonstrate that the developed learning media meet valid and feasible criteria, consistent with previous studies stating that learning tools are considered valid when expert assessments confirm their feasibility for use, either with or without revisions as part of the development process (Yulia et al., 2023).

2. Effectiveness and Practicality

After being declared valid, the Android-based interactive multimedia learning application was tested for practicality through field trials involving 30 students. The results of the trials showed an average feasibility score of 4.7 in terms of programming, content, and appearance, which is in the excellent category. This shows that the application is easy to use and practical for implementation in learning.

The effectiveness of the application was tested through a pre-test and post-test design involving 41 students. The results of the analysis showed a significant increase in student learning outcomes after using the application, with the average score increasing from 60.98 in the pre-test to 88.78 in the post-test. The n-gain value of 0.71 was in the high category, indicating the effectiveness of the application in improving learning outcomes. These findings are consistent with research stating that interactive multimedia can improve the clarity of material presentation, learning engagement, and student learning outcomes (Hadi et al., 2022), and improve cognitive achievement and conceptual understanding more optimally than conventional learning (Azizah et al., 2024; Nirina et al., 2024). From a practical standpoint, the results of this study are in line with previous findings which state that Android-based interactive multimedia is flexible, easy to use, and supports independent learning (Kadarsih & Fitria, 2022). In addition, increased motivation and engagement among learners shows that integrating text, images, audio, video, and interactive assessments into a single application can create more engaging learning experiences and reduce learning fatigue (Watrianthos et al., 2022; Nurlaela et al., 2024).

In the context of vocational education, the use of Android-based interactive multimedia is highly relevant because it can visualise abstract and procedural concepts related to vocational competencies. These findings reinforce previous research showing that the use of Android-based multimedia in vocational schools can increase students interest in learning, independence, and readiness to understand practical material (Dirgatama et al., 2021; Gustina et al., 2024). The positive response of students, as demonstrated by the results of individual tests, small group tests, and field tests with a rating of "very good", further confirms that the application developed is suitable for use as a learning medium for Food Science.

CONCLUSIONS

Based on the results of research in Class X Culinary Arts at SMK Negeri 2 Gowa, the development of Android-based interactive learning media for the Food Science subject using the ADDIE model was deemed excellent. Validation by two media experts yielded an average score of 4.5 and two subject matter experts yielded a score of 4.6, while individual and small group trials each yielded a score of 4.4, which is classified as excellent. Field trial results showed a practicality score of 4.7, while the n-gain analysis result of 0.71 was in the high category. Therefore, it can be concluded that the developed learning media is valid, practical, and effective.

Based on these findings, follow-up is needed so that the learning media developed can be optimally utilised by teachers as an alternative learning aid to improve the quality of the learning process. For students, the use of this media is expected to encourage flexible independent learning, thereby improving learning outcomes. Furthermore, future researchers are advised to develop applications with more interactive features, such as quiz score storage, video content addition, and improvements in the quality and depth of learning materials.

AKNOWLEDGMENT

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