MIKAILALSYS
Journal of Multidisciplinary Sciences

e-ISSN : 2987-2286
p-ISSN : 2987-3924

Index : Dimensions, Scilit, Crossref, Garuda, Semantic, Lens,Google Scholar,Base, etc

https://doi.org/10.58578/mikailalsys.v4i2.10093

Design and Development of Android-Based Augmented Reality Educational Media on Computer Materials and Their Components at SMA Negeri 1 Rambatan

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Article Info:

Submitted:	Revised:	Accepted:	Published:
Mar 28, 2026	Apr 25, 2026	May 7, 2026	May 12, 2026

Abstract

Digital technology has become increasingly important in Informatics learning; however, the development of Android-based Augmented Reality media for computer component materials remains limited. This study aims to design and develop Android-based Augmented Reality educational media for learning computer materials and components at SMA Negeri 1 Rambatan. A research and development approach was employed using the Multimedia Development Life Cycle model, comprising the stages of concept, design, material collecting, assembly, testing, and distribution. The study involved 60 students selected through purposive sampling, two media experts, and two material experts. Data were collected through observation, documentation, expert validation questionnaires, and User Acceptance Testing, then analyzed using descriptive quantitative analysis and Aiken's V. The findings indicate that the ARCompt application successfully presents 14 three-dimensional computer component models grouped into input devices, output devices, storage devices, and processing units. The User Acceptance Testing result obtained a mean score of 3.10, categorized as very good. Media expert validation produced an Aiken's V score of 0.85, categorized as very valid, while material expert validation

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produced a score of 0.73, categorized as fairly valid. The study concludes that ARCompt is feasible as an interactive learning medium to support Informatics learning on computer components. These findings contribute to the development of technology-enhanced educational media and provide practical implications for integrating Android-based Augmented Reality into Informatics learning. Further research is recommended to examine the effectiveness of ARCompt through experimental research.

Keywords: Augmented Reality; Android-Based Learning Media; Informatics Learning; Computer Components; Multimedia Development Life Cycle

INTRODUCTION

The rapid development of digital technology has significantly influenced the transformation of education at various levels (Akour & Alenezi, 2022; Timotheou et al., 2023). In the global context, digital technology is no longer viewed merely as a supporting tool, but as an essential part of creating interactive, flexible, and meaningful learning experiences (Yadav, 2024)(Alam & Mohanty, 2023)(Mhlongo et al., 2023). The use of digital media in learning can increase students' engagement, provide broader access to information, and help teachers present abstract materials in a more concrete form. In line with this, technology-based learning media are considered capable of supporting active learning because they allow students to interact directly with learning objects and construct their understanding through visual and practical experiences (Sari & Munir, 2024; Susilowati et al., 2024).

In Indonesia, the integration of digital technology in education has become increasingly important along with the implementation of the Merdeka Curriculum. This curriculum encourages schools and teachers to design contextual, flexible, and student-centered learning according to the needs and characteristics of learners. In Informatics subjects at the senior high school level, students are expected to master various competencies, including computational thinking, information and communication technology, computer systems, computer networks, data analysis, algorithms, programming, the social impact of informatics, and cross-field practices. These competencies are closely related to the demands of the digital era, where students are required not only to understand concepts theoretically but also to develop technological

literacy and problem-solving skills (Falloon, 2020; Harnani et al., 2021; Kek & Huijser, 2011).

However, the implementation of Informatics learning in schools still faces several challenges, especially in materials that require visual and spatial understanding. One of the materials that often becomes difficult for students is computer components and their supporting parts. This material requires students to recognize the shape, structure, function, and working relationship of each computer component. When the material is delivered only through textbooks, two-dimensional images, or slide presentations, students tend to receive limited information and have difficulty imagining the real form of the components being studied. According to Mayer (2002), learning will be more effective when verbal explanations are supported by relevant visual representations because students can process information through both visual and verbal channels.

The same problem was found in Informatics learning at SMA Negeri 1 Rambatan. Based on the researcher's observation, the teacher generally delivered material on computer components using projector-assisted slide presentations. Although this method helped present the material systematically, students still had limited opportunities to observe the physical form and detailed structure of each computer component directly. The learning process mostly introduced the names and basic functions of computer components, while discussions about the types, structures, variations, and working mechanisms of the components were still limited. As a result, students' understanding tended to remain at a basic level and had not yet developed into a deeper and more comprehensive understanding.

Another issue is related to the limited use of Android devices as learning media. In daily learning activities, students generally use Android devices only when instructed by the teacher, not as independent learning tools to explore additional information or interact with digital learning materials. This condition indicates that the potential of Android technology has not been optimally utilized in Informatics learning. In fact, Android-based learning media can provide wider opportunities for students to learn independently, access interactive materials, and engage with learning content in a more flexible way. This opportunity is supported by the availability of adequate school facilities, such as computer laboratories, usable computers, local area network access, projectors, and Wi-Fi facilities that can support technology-based learning activities.

Previous studies have shown that the use of technology-based learning media can improve the quality of learning and increase students' motivation. Susilowati et al. (2024)found that digital technology can encourage students to be more actively involved in learning activities. Sari & Munir (2024) also reported that digital learning media can strengthen collaborative activities and support faster access to learning information. In the context of Informatics learning, Yulia et al. (2023) emphasized that the integration of computational thinking, basic programming, and computer network materials can increase students' creativity and learning motivation. Nevertheless, most previous studies have focused on the general use of digital media or Informatics learning strategies, while specific development of Android-based Augmented Reality media for computer components at the senior high school level remains limited.

Augmented Reality is one of the technologies that can be used to overcome these limitations. Augmented Reality refers to a technology that combines virtual objects with the real environment and presents them interactively in real time (Arena et al., 2022; Dargan et al., 2023; Syed et al., 2022). Through this technology, students can observe three-dimensional virtual objects using smartphone cameras, allowing them to see computer components in a more realistic and detailed form. Billinghurst et al. (2015) explain that Augmented Reality has strong potential in education because it can create learning experiences that are interactive, contextual, and visually rich. In addition, Augmented Reality can support students in understanding complex concepts by providing visual simulations that are difficult to present through conventional media (Akçayır & Akçayır, 2017).

The novelty of this study lies in the design and development of Android-based Augmented Reality educational media specifically for computer and component materials at SMA Negeri 1 Rambatan. This research does not only focus on the use of digital media in general, but also on how Augmented Reality can be designed as an interactive learning medium that allows students to observe, rotate, enlarge, and access information about computer components through three-dimensional visualization. The development of this media is expected to provide a more concrete learning experience, direct the use of Android devices toward educational purposes, and increase students' interest in Informatics subjects.

Based on these problems and opportunities, this study focuses on designing and developing Android-based Augmented Reality educational media for computer and component materials at SMA Negeri 1 Rambatan. The purpose of this study is to produce an interactive learning medium that can help students understand the form, function, and structure of computer components more clearly and meaningfully. Through the development of this media, Informatics learning is expected to become more visual, interactive, and relevant to students' needs in the digital era.

METHODS

This study employed a research and development approach because the main objective was to design, develop, and evaluate an Android-based Augmented Reality educational media for computer and component materials. Research and development is appropriate when a study aims to produce a specific educational product and examine its feasibility before implementation in learning activities. According to Sugiyono (2019), development research is used to create a product and test the quality or feasibility of the product through systematic stages. In this study, the product developed was an Android-based learning application that presents computer components through interactive three-dimensional visualization. The data obtained from expert validation and user testing were analyzed using a descriptive quantitative approach to determine the feasibility level of the media.

The research design used in this study was the Multimedia Development Life Cycle (MDLC) model. This model was selected because it is suitable for developing multimedia-based learning products that combine text, images, animation, three-dimensional objects, and interactive features. The MDLC model, adapted from Luther and developed by Sutopo, consists of six main stages: concept, design, material collecting, assembly, testing, and distribution (Sutopo, 2003). This design was considered relevant because the development of Augmented Reality media requires a structured process, starting from identifying learning problems, designing application flow, preparing learning materials and 3D objects, integrating all components into an Android application, conducting product testing, and distributing the final product to users.

The concept stage was carried out by analyzing the existing learning system, learning problems, proposed system, and system requirements. The analysis showed that

Informatics learning on computer and component materials at SMA Negeri 1 Rambatan still relied on textbooks, slide presentations, and two-dimensional images. These media were considered insufficient to help students understand the real shape, structure, function, and variation of computer components. Therefore, the proposed system was an Android-based Augmented Reality educational media that could display computer components, such as input devices, output devices, storage devices, and processing units, in the form of interactive 3D models. This system was designed to help students observe learning objects more clearly, rotate objects, zoom in or zoom out, and access additional information about each component.

The design stage included the preparation of system flow, application structure, user interface design, Unified Modeling Language diagrams, three-dimensional models, and Augmented Reality markers. The system flow was described through a flowchart that explained the application process from the splash screen, main menu, learning menu, material page, 3D scan feature, understanding test, CP and ATP menu, application guide, about page, and exit menu. The system was also modeled using several UML diagrams, including use case diagram, activity diagram, class diagram, sequence diagram, deployment diagram, component diagram, state machine diagram, package diagram, and communication diagram. These diagrams were used to clarify the relationship between users and system features, the application workflow, the internal structure of the application, and the interaction among system components.

The population of this study was students of SMA Negeri 1 Rambatan who studied Informatics, especially students who received material on computers and their components. The sample was selected purposively because the respondents had specific characteristics relevant to the developed media, namely students who studied Informatics and needed visual learning support for computer component materials. Purposive sampling is appropriate when researchers select participants based on certain considerations related to the research objectives (Sugiyono, 2019). In addition, the validation process involved two Informatics teachers as material experts and two lecturers from the Informatics Engineering Education study program as media experts. The involvement of these experts aimed to ensure that the developed media was appropriate in terms of learning content, curriculum relevance, media design, functionality, and technical feasibility.

The data collection techniques used in this study included observation, documentation, expert validation questionnaires, and user acceptance testing. Observation was conducted to identify the learning process, learning media used by teachers, students' difficulties, and the availability of school facilities. Documentation was used to collect supporting data, such as learning materials, CP and ATP, application design documents, 3D model designs, AR markers, and screenshots of application development. The expert validation questionnaire was used to assess the feasibility of the media from the aspects of material and media quality. The material expert questionnaire focused on the suitability of content, accuracy of concepts, relevance to the curriculum, clarity of explanation, and usefulness of the media for Informatics learning. The media expert questionnaire assessed interface design, navigation, readability, interactivity, AR functionality, and technical performance.

The product development process was conducted through the material collecting and assembly stages. In the material collecting stage, the researcher collected and prepared learning content, user interface components, 3D models, markers, and other supporting assets. The 3D models were designed using Blender and consisted of several computer components, such as mouse, keyboard, monitor, printer, projector, speaker, motherboard, CPU, GPU, PSU, hard disk, RAM, PC, and SSD. The user interface was designed using Figma, while the Augmented Reality markers were prepared to trigger the appearance of 3D objects. In the assembly stage, all assets were integrated using Unity. Vuforia SDK was used to support marker-based Augmented Reality features, while Visual Studio was used for coding and debugging using C#. The final application was then built into an Android Package Kit file so that it could be installed on Android devices.

The testing stage was conducted to ensure that the application worked properly and met user needs. Product testing was divided into internal functional testing, expert validation, and user acceptance testing. Functional testing was conducted to check whether each feature of the application worked according to its function, including the main menu, material menu, AR scan feature, evaluation menu, CP and ATP menu, guide page, and about page. Expert validation was carried out by material experts and media experts to assess the feasibility of the product before it was used by students. User acceptance testing was conducted to determine users' responses to the application, especially in terms of ease of use, clarity of display, usefulness of features, and attractiveness of the learning experience.

The validation questionnaire used a four-point rating scale. A score of 4 indicated "very feasible," a score of 3 indicated "feasible," a score of 2 indicated "less feasible," and a score of 1 indicated "not feasible." The validity of the media was analyzed using Aiken's V formula, which measures the level of agreement among experts regarding the validity of each item. Aiken's V is appropriate for analyzing content validity based on expert judgment (Aiken, 1985). The formula used in this study was:

$$V = \Sigma s / n(c - 1)$$

In this formula, **V** represents the validity index, **s** represents the score given by the validator minus the lowest score, **n** represents the number of validators, and **c** represents the number of rating categories. The validation criteria were classified into three categories: $0.8 < V \leq 1.0$ as very valid, $0.4 < V \leq 0.8$ as fairly valid, and $0 < V \leq 0.4$ as less valid. The developed media was considered feasible when the expert validation score reached the fairly valid or very valid category.

The data analysis technique used in this study was descriptive quantitative analysis. The scores from expert validation and user testing were calculated to determine the average score and feasibility category of the developed media. The user acceptance testing score was calculated using the average score formula:

$$\text{Average score} = \Sigma Si / n$$

In this formula, **ΣSi** represents the total score given by all respondents for each assessment item, while **n** represents the number of respondents. The results of the analysis were then interpreted descriptively to explain the quality, feasibility, and usability of the Android-based Augmented Reality educational media. After the application passed the testing and validation stages, the product was distributed in the form of an APK file and submitted to SMA Negeri 1 Rambatan as a learning medium for Informatics subjects.

RESULTS

The results of this study consist of three main findings: the development result of the Android-based Augmented Reality educational media, the results of User Acceptance Testing (UAT), and the results of expert validation. The developed product is an Android-based learning application named **ARCompt**, which was designed to support Informatics learning on computer and component materials at SMA Negeri 1 Rambatan. The

application provides learning materials, Augmented Reality-based 3D visualization, evaluation features, user guidance, and supporting information related to the application and school profile.

1. Development Result of Android-Based Augmented Reality Educational Media

The Android-based Augmented Reality educational media developed in this study contains several main displays that support the learning process. The first display is the **Splash Screen**, which appears when the application is opened. This page functions as an initial display during the application loading process before users are directed to the Home Screen. The splash screen also introduces the identity of the application and gives a professional first impression to users.



Figure 1. Splash Screen Display

The second display is the **Home Screen**, which functions as the main navigation page. This page contains eight menus, namely CP and ATP, Teaching Materials, Evaluation, Guide, Developer Profile, School Profile, About Application, and Exit. The home screen was designed with a modern technology-based visual theme so that students can easily understand the function of each menu.



Figure 2. Home Screen Display

The **CP and ATP** page presents the Learning Outcomes and Learning Objective Flow of Informatics subjects for one semester at SMA Negeri 1 Rambatan. This feature provides information about the competencies that students need to achieve. Therefore, the content presented in the application remains aligned with the curriculum used in the school.



Figure 3. CP and ATP Display

The **Teaching Materials** page contains four main topics, namely Input Devices, Output Devices, Processing Unit, and Storage. These topics were selected based on the material of computers and their components. This page also provides a floating robot icon that functions as a shortcut to scan a complete 3D computer model.



Figure 4. Teaching Materials Display

The material pages are divided into four sections. The Input Devices page presents materials about mouse and keyboard. The Output Devices page presents materials about monitor, printer, projector, and speaker. The Processing Unit page presents materials about motherboard, CPU, GPU, and PSU. Meanwhile, the Storage page presents materials about hard disk, RAM, and SSD. Each page contains a brief explanation and a "Pelajari Materi" button that directs users to more complete material.



Figure 5. Input Devices Material Display

The **Download Marker** page provides AR markers that can be downloaded and used to display 3D objects. The **Scan 3D Object** page activates the camera on the Android device. Users must scan the appropriate marker to display the 3D object. If the scanned marker does not match the selected material, the 3D object will not appear. This feature shows that the AR system was designed to connect each learning topic with the appropriate three-dimensional visualization.

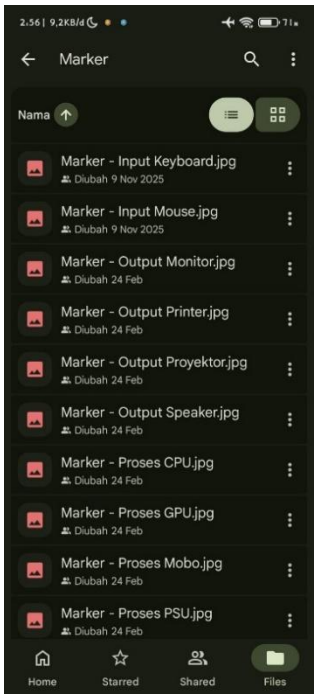


Figure 6. Download Marker Display

The application also provides an evaluation feature. This feature consists of the Evaluation Menu, Student Biodata Form, Quiz Question Page, Final Score Page, and Screenshot Notification Pop-up. Before starting the quiz, students fill in their full name and class. The quiz consists of objective questions with four answer choices. When students choose the correct answer, the system displays the notification "Tepat Sekali." If the answer is incorrect, the system displays the notification "Oops Belum Tepat." After all questions are answered, the system displays the student's name, class, final score, number of correct answers, and number of incorrect answers.



Figure 7. Evaluation Menu Display

The application also includes a screenshot reminder before students return to the Home Screen. This feature helps students save their evaluation results. In addition, the application provides a Guide page, Developer Profile page, School Profile page, and About Application page. The Guide page explains how to download markers, scan 3D objects, and use each button in the application. The Developer Profile and School Profile pages provide supporting information about the application developer and SMA Negeri 1 Rambatan.



Figure 8. About Application Display

Overall, the developed media has fulfilled the main functions of Android-based Augmented Reality educational media. The application can present learning materials, display 3D objects, provide interactive navigation, and evaluate students' understanding through quizzes. Therefore, the media can support students in learning computer components through visual and interactive learning experiences.

2. User Acceptance Testing Result

User Acceptance Testing was conducted to determine the level of user acceptance of the ARCompt application. This test involved 60 students of SMA Negeri 1 Rambatan as the final users. The test was conducted on February 6, 2026, in the computer laboratory of SMA Negeri 1 Rambatan. Students were asked to use all main features of the application, including opening the application, accessing the learning materials, scanning AR markers, and completing the quiz. After using the application, students filled in a questionnaire related to display, usability, functionality, and usefulness.

The UAT score was calculated using the following formula.

$$\textbf{Average Score} = \Sigma Si / n \qquad (1)$$

Description:

ΣSi = total score given by respondents for each assessment item

n = number of respondents

Table 1. Recapitulation of User Acceptance Testing Results

No.	Assessment Aspect	Mean Score	Category
1	The ARCompt application can be installed and opened on students' Android devices.	3.51	Very Good
2	The buttons on the main menu function and direct users to the correct pages.	3.43	Very Good
3	The application often crashes or lags during use.	1.66	Very Good
4	The learning page displays four main learning materials.	3.30	Very Good
5	The buttons in each material page direct users to the appropriate material.	3.55	Very Good
6	The "Pelajari Materi" button displays the material correctly.	3.35	Very Good
7	The camera function for scanning AR markers runs normally.	3.50	Very Good
8	The 3D AR object fails to appear even though the marker is scanned correctly.	1.63	Very Good

No.	Assessment Aspect	Mean Score	Category
9	The 3D object displayed matches the scanned marker.	3.36	Very Good
10	The 3D AR object can be rotated and zoomed smoothly.	3.48	Very Good
11	The "Ayoo Mulai" button in the evaluation menu works properly.	3.45	Very Good
12	The answer choices in the quiz cannot be selected or saved by the system.	2.05	Good
13	The final score is displayed correctly after the quiz is completed.	3.45	Very Good
14	The final score page displays student score data accurately.	3.41	Very Good
15	The final score pop-up provides a screenshot warning before returning to the main menu.	3.45	Very Good
16	The back button does not function and causes users to be stuck on one page.	1.75	Very Good
17	All information and instruction texts are readable.	3.36	Very Good
18	The guide page displays the application usage instructions correctly.	3.48	Very Good
19	The About Application, Developer Profile, and School Profile pages display clear information.	3.48	Very Good
20	The application responds quickly when users press a button.	3.35	Very Good
	Overall Mean	3.10	Very Good

Based on Table 1, the overall mean score of User Acceptance Testing was **3.10**, which was categorized as **Very Good**. This result indicates that the ARCompt application was positively accepted by students. The highest score was found in the aspect of button accuracy on each material page, with a mean score of **3.55**. The installation aspect also obtained a high score of **3.51**, indicating that the application could be accessed properly on students' Android devices.

Several negative statements were scored using reverse scoring so that the interpretation remained consistent. For example, the statement related to application crashes obtained a score of **1.66**, which was interpreted as **Very Good** because a lower score on negative items indicates fewer technical problems. The same interpretation was applied to the statement related to the failure of 3D objects to appear, which obtained a score of **1.63** and was categorized as **Very Good**. These results show that the application worked properly and could be used by students without significant technical obstacles.

3. Media Expert Validation Result

Media expert validation was conducted to assess the feasibility of the application from the aspects of functionality, interface design, navigation, interactivity, AR performance, and technical quality. This validation involved two media experts. The instrument consisted of 20 assessment items. The validation score was analyzed using Aiken's V formula.

$$V = \Sigma s / [n(c - 1)] \qquad (2)$$

Description:

V = validity index

Σs = total score after subtracting the lowest score

n = number of validators

c = number of rating categories

The criteria for interpreting Aiken's V are as follows.

$0.80 < V \leq 1.00$ = Very Valid

$0.40 < V \leq 0.80$ = Fairly Valid

$0.00 < V \leq 0.40$ = Less Valid

Table 2. Summary of Media Expert Validation Result

Assessment Aspect	Number of Items	Aiken's V Range	Mean Aiken's V	Category
Application functionality and performance	5	0.66–1.00	0.85	Very Valid
Interface design and navigation	6	0.66–1.00	0.83	Very Valid
AR feature and 3D visualization	4	0.66–0.83	0.78	Fairly Valid
Interactivity and user feedback	3	0.66–1.00	0.83	Very Valid
Portability and overall feasibility	2	1.00	1.00	Very Valid
Overall Result	20	0.66–1.00	0.85	Very Valid

Based on Table 2, the average Aiken's V score from media expert validation was **0.85**, which was categorized as **Very Valid**. This result indicates that the application is feasible in terms of media quality. The media experts considered that the application could be installed and run properly, had clear navigation, provided appropriate feedback, displayed relevant 3D objects, and could be accessed without an internet connection. Several items obtained a score of **0.66**, especially those related to loading time, navigation simplicity, icon clarity, interactivity, and layout structure. However, the overall validation

result shows that the ARCompt application is feasible to be used as a learning medium from the media aspect

4. Material Expert Validation Result

Material expert validation was conducted to assess the suitability, accuracy, clarity, and relevance of the learning content. This validation involved two Informatics teachers at SMA Negeri 1 Rambatan. The validation focused on the suitability of the material with CP and ATP, the accuracy of computer component information, the clarity of language, the relevance of quiz items, and the usefulness of the application as a learning medium.

Table 3. Summary of Material Expert Validation Result

Assessment Aspect	Number of Items	Aiken's V Range	Mean Aiken's V	Category
Suitability with CP and ATP	1	1.00	1.00	Very Valid
Accuracy and relevance of content	5	0.66–1.00	0.86	Very Valid
Language clarity and material organization	5	0.00–1.00	0.46	Fairly Valid
3D visualization and contextual presentation	4	0.83–1.00	0.96	Very Valid
Quiz relevance and learning evaluation	3	0.83–1.00	0.89	Very Valid
Usefulness as teacher and student learning media	2	1.00	1.00	Very Valid
Overall Result	20	0.00–1.00	0.73	Fairly Valid

Based on Table 3, the average Aiken's V score from material expert validation was **0.73**, which was categorized as **Fairly Valid**. This result indicates that the learning content in the application is feasible to use, although several aspects still require revision. The highest scores were found in the suitability of the material with CP and ATP, the contextual presentation of 3D objects, the relevance of quiz items, and the usefulness of the application as a learning medium. However, some items related to language clarity, consistency of technical terms, and material sequence obtained lower scores. Therefore, minor revisions are needed to improve the clarity and consistency of the material before broader implementation.

5. Final Feasibility Result

The final feasibility of the ARCompt application was determined based on the results of User Acceptance Testing, media expert validation, and material expert validation. The summary of the final feasibility results is presented in Table 4.

Table 4. Final Feasibility Result of the Developed Media

Assessment Type	Score	Category
User Acceptance Testing	3.10	Very Good
Media Expert Validation	0.85	Very Valid
Material Expert Validation	0.73	Fairly Valid

Based on Table 4, the Android-based Augmented Reality educational media is feasible to be used in Informatics learning. The User Acceptance Testing result showed that students accepted the application very well. The media expert validation showed that the application was very valid in terms of functionality, design, navigation, interactivity, and technical quality. The material expert validation showed that the content was fairly valid and could be used after minor revisions. Therefore, the ARCompt application can be used as an interactive learning medium to support students' understanding of computers and their components at SMA Negeri 1 Rambatan.

DISCUSSION

The findings of this study indicate that the Android-based Augmented Reality educational media developed for computer and component materials has met the criteria of feasibility from the aspects of product functionality, user acceptance, media quality, and material relevance. The development of the ARCompt application was based on the need for more visual and interactive learning media in Informatics subjects, especially because computer component materials require students to understand the shape, function, structure, and relationship among hardware components. The results show that the application can present learning materials, display three-dimensional objects, provide AR-based interaction, and support students' understanding through evaluation features.

The User Acceptance Testing result showed an overall mean score of **3.10**, which was categorized as **Very Good**. This result indicates that students were able to use the application properly and positively accepted its features. The highest score was found in the aspect of button accuracy on each material page, while other aspects such as application installation, AR camera function, object rotation and zooming, guide page clarity, and application response also received very good scores. These findings show that the developed media is not only technically functional but also accessible and understandable for students as end users. This result is important because the success of educational

technology does not only depend on the sophistication of its features, but also on the ease of use and acceptance by learners.

The UAT findings also confirm that the use of Augmented Reality can support a more concrete learning experience. Previously, students mostly learned computer components through textbooks, slide presentations, and two-dimensional images, which limited their ability to observe the real form of each component. Through ARCompt, students can access 3D visualizations of input devices, output devices, processing units, and storage devices. This condition supports the argument that Augmented Reality can help transform abstract or difficult-to-observe objects into visual and interactive learning experiences. In line with Arena et al. (2022) Augmented Reality combines virtual objects with real environments, allowing users to interact with digital content in real time. Therefore, the ARCompt application provides a relevant solution to the problem of limited visualization in Informatics learning.

The results of media expert validation also strengthen the feasibility of the developed application. The average Aiken's V score from media experts was **0.85**, which was categorized as **Very Valid**. This result indicates that the application has good quality in terms of functionality, interface design, navigation, interactivity, AR performance, and technical operation. The experts considered that the application could be installed and operated properly, had consistent design, provided clear feedback, and could be used without an internet connection. However, several aspects still received lower scores, such as loading time, navigation simplicity, icon clarity, interactivity, and layout structure. These findings show that although the application is feasible, technical refinement is still needed to improve user comfort and application efficiency.

The material expert validation obtained an average Aiken's V score of **0.73**, which was categorized as **Fairly Valid**. This result shows that the learning content is appropriate and feasible to use, but still requires minor revision. The strongest aspects were the suitability of the media with CP and ATP, the accuracy of component labeling, the relevance of the quiz, and the usefulness of the application as a learning medium. However, several aspects related to language clarity, consistency of technical terms, and sequence of material presentation still need improvement. This means that the media is pedagogically relevant, but the presentation of learning content must be refined so that students can understand the material more easily and systematically.

The findings of this study are consistent with previous studies which state that digital learning media can increase students' engagement and make the learning process more interesting. Susilowati et al. (2024) found that digital technology can encourage students to become more actively involved in learning activities, while Sari and Munir (2024) emphasized that digital learning media can support access to information and collaborative learning. The findings also support Harnani et al. (2021) , who stated that technology integration in Informatics learning can improve students' motivation and creativity. In this study, the use of AR is more specific because it provides 3D visualization of computer components, allowing students to interact with learning objects rather than only reading explanations or viewing static images.

The results also support the theory of multimedia learning proposed by Mayer (2021), which explains that students learn better when information is presented through verbal and visual channels. The ARCompt application combines text explanation, visual display, 3D objects, and interactive navigation, so students receive learning information through multiple representations (Mills et al., 2025; NUGRAHA et al., 2025). This strengthens students' opportunity to understand the material more meaningfully. The use of 3D models also helps students recognize the shape and function of computer components, which are difficult to explain only through conventional methods. Therefore, the media developed in this study contributes to the implementation of visual, contextual, and technology-based learning in Informatics subjects.

Practically, the findings of this study imply that ARCompt can be used as an alternative learning medium for teachers in teaching computer and component materials. Teachers can use this application to make explanations more efficient, especially when physical computer components are not available in sufficient numbers. Students can also use the application independently because it provides material, AR visualization, guide, and evaluation features in one platform. The use of Android devices also makes the media more flexible, because students can access it through devices they commonly use. This supports the effort to direct Android use toward educational purposes rather than only entertainment or communication activities.

Theoretically, this study contributes to the development of technology-based learning media, especially in the context of Augmented Reality for Informatics learning at the senior high school level. The novelty of this study lies in the development of Android-

based AR educational media that specifically presents computer components through marker-based 3D visualization. Unlike previous studies that generally focused on digital media or Informatics learning strategies, this study produces a specific product that integrates curriculum content, AR visualization, learning materials, and evaluation features. Thus, this research expands the application of Augmented Reality in computer system learning and provides a reference for similar media development in other technical or vocational materials.

However, this study has several limitations. First, the implementation was limited to SMA Negeri 1 Rambatan, so the findings may not fully represent students from other schools with different facilities, digital literacy levels, or learning environments. Second, the study focused on product feasibility and user acceptance, while the effectiveness of the application in improving learning outcomes was not tested through an experimental design using pre-test and post-test. Third, the application used marker-based Augmented Reality, so the quality of object detection may still depend on camera quality, lighting conditions, and marker clarity. Fourth, the material validation results show that several aspects of language clarity, technical term consistency, and material sequence still need revision before wider use.

Based on the discussion above, the Android-based Augmented Reality educational media developed in this study can be considered feasible for use as a learning medium in Informatics subjects. The application was accepted very well by students, validated as very valid by media experts, and considered fairly valid by material experts. Although minor revisions are still needed, especially in the clarity and organization of learning content, the ARCompt application has the potential to support more interactive, visual, and meaningful learning of computer and component materials at SMA Negeri 1 Rambatan.

CONCLUSION

This study concludes that the design and development of Android-based Augmented Reality educational media on computer and component materials at SMA Negeri 1 Rambatan were successfully completed using the Multimedia Development Life Cycle (MDLC) method. The development process involved the stages of concept, design, material collecting, assembly, testing, and distribution. The application, named **ARCompt**, was developed using Unity with marker-based Augmented Reality technology and can run

on Android devices. The learning content was implemented through 14 main 3D models grouped into four learning materials, namely Input Devices, Output Devices, Storage, and Processing Unit. Each 3D model was equipped with descriptions, functions, and supporting explanations to help students understand computer components more visually and interactively.

The results of User Acceptance Testing showed that the application functioned properly, including menu navigation, 3D object display, object interaction, learning material access, and evaluation features. The validation results from media and material experts also indicated that the application was feasible to be used as a learning medium. These findings show that ARCompt can support Informatics learning by providing a more interactive, visual, and engaging learning experience for students. Future research is recommended to test the effectiveness of this application through experimental studies involving pre-test and post-test designs, as well as to expand the application content to other Informatics topics and different school contexts.

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