



Enhancing Informatics Learning through Android-Based Interactive Media: A Development Study with the ADDIE Model

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Abstract

Initial observations in Grade X Informatics classes at SMA Negeri 1 Panji identified a significant pedagogical challenge: low student motivation and engagement, largely due to the perceived complexity of the subject matter. To address this issue, Android-based learning media was proposed as an innovative solution, leveraging its ability to present content dynamically through integrated multimedia elements such as images, videos, animations, and interactive quizzes. This research and development (R&D) study aimed to design and implement such media to increase student participation, improve conceptual understanding, and create a more interactive learning environment. The development process followed the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). Data were collected from 19 Grade X students, one subject teacher (serving as a material expert), and a media expert (holding a Master's degree in Computer Science). Results indicated that the developed Android-based interactive learning media, named "Bitnesia," is highly suitable for educational use. This conclusion is supported by outstanding validation outcomes, with media expert, material expert, and student effectiveness tests all scoring $\geq 90\%$. The study affirms that a well-designed learning media application can significantly contribute to a stimulating and effective Informatics learning experience.

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INTRODUCTION

In the contemporary digital era, the integration of technology into education has become imperative for enhancing learning quality and fostering independent learning. This is reinforced by the findings of Kaarakainen and Saikkonen (2021), who stated that digital technology has the potential to enhance traditional learning

experiences and is expected to address persistent issues, such as low student engagement or inequities in educational access. Consistent with this, Sakiinah et al. (2022) found that technologies such as online learning platforms, mobile applications, and innovative software present significant opportunities to improve the learning process. Further

supporting this, research by Carstens et al. (2021) demonstrates that technology can increase student interest and active participation.

Among the most rapidly developing and accessible technologies are Android-based devices, which offer considerable flexibility for educational use. Eliza et al. (2024) revealed that smartphones with the Android operating system can function effectively as multimedia learning tools. The use of such interactive, Android-based media is expected to provide a more engaging and stimulating learning experience, particularly in informatics subjects that benefit greatly from visual aids and active student participation.

However, despite this potential, observations in Grade X Informatics classes at SMA Negeri 1 Panji identified a persistent lack of conceptual understanding and low student involvement in the learning process. Consequently, many students lack motivation, perceiving the subject matter as difficult to comprehend. Although technology is utilized to some extent, it often lacks interactive elements like computer simulations, educational games, or visualizations that are crucial for facilitating conceptual understanding. As a result, students struggle to focus and participate actively, leading to suboptimal learning outcomes. In this context, Android-based learning media emerges as a promising solution due to its capacity to present material dynamically through images, videos, animations, and interactive quizzes. Consistent with Utami et al. (2023), the need for such media is supported by multimedia learning theory.

Furthermore, the use of interactive learning media provides opportunities for independent learning and skill development (Abidin et al., 2023).

The use of Android-based learning media is a strategic solution to address student disengagement. It allows for a more dynamic presentation of material, thereby increasing student motivation and understanding, and aligns with government initiatives to promote information technology in education. While qualified teachers are essential for effective classroom management, material delivery, and student motivation (Sibagariang et al., 2021), their success is optimized when supported by appropriate and innovative learning media. Android-based interactive media can help teachers facilitate an effective and efficient learning process that aligns with the characteristics of the digital generation (Huda & Marsono, 2021; Rahayuningsih & Muhtar, 2022). Thus, this media functions not only as a supplementary tool but also as a means to create a conducive learning environment that fosters active participation.

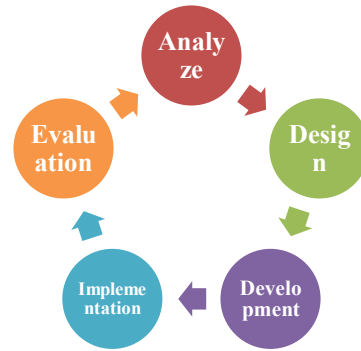
Therefore, this study aims to develop interactive Android-based learning media tailored for the Informatics subject for Grade X at SMA Negeri 1 Panji. This development seeks to facilitate students' conceptual understanding and increase their engagement in the learning process. Previous studies, such as those by Marlianto et al. (2024), focused solely on computer networks, while Romisa (2023) developed an application limited to computer hardware concepts. In contrast, the present research provides a

comprehensive solution aligned with the entire Grade X Informatics curriculum at the specified school. It integrates interactive features designed based on an analysis of student needs, particularly for topics identified as challenging. Consequently, this application is expected to not only improve learning outcomes but also complement existing materials that have yet to be optimally addressed. Based on this rationale, the research is conducted under the title: “Enhancing Informatics Learning Through Android-Based Interactive Media: A Development Study with the ADDIE Model”.

METHOD

This study employed a Research and Development (R&D) approach. The development process adhered to the ADDIE model, which provides a systematic framework comprising five iterative phases: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). As noted by Rachman et al. (2024), the ADDIE model is a systems approach that organizes the planning process into a logical sequence of steps. Each stage is interconnected, with the output from one phase serving as the input for the next, ensuring a structured and coherent workflow. This model is widely recognized for its effectiveness in developing learning media (Gustafson & Branch, 2007) and was selected for its adaptability to various developmental contexts. The stages of the ADDIE model are illustrated in Figure 1.

Figure 1. Stages of the ADDIE Development Model



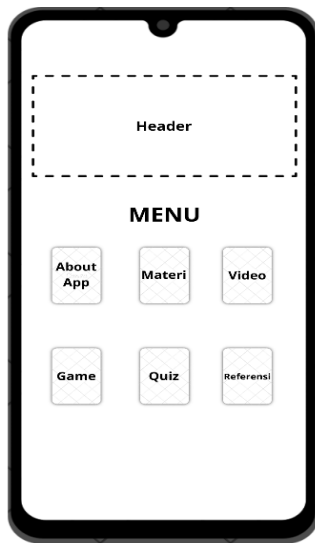
Analysis Phase

The initial phase involved a comprehensive analysis to identify the needs of both students and teachers. The objective was to diagnose the specific challenges and obstacles present in the informatics learning process for 10th-grade students. This was achieved through direct observation of classroom activities and the collection of data pertaining to the necessity for Android-based learning media, including the specific informatics topics to be addressed.

Design Phase

In this phase, the interactive Android-based learning media, named "Bitnesia" (a portmanteau implying broad and in-depth informatics learning), was designed using the Kodular platform. Kodular is a block-based visual programming tool that facilitates the creation of Android applications without the need for manual coding. The application interface was designed for a 1080 x 1920 pixel resolution to ensure optimal display on standard smartphones. The main menu was structured as a grid of sliders featuring the following sections: About App, Material, Video, Quiz, Game, and Reference. The design of the menu interface is presented in Figure 2.

Figure 2. Menu Interface Design



Development Phase

This phase focused on the construction of the application by populating each menu component:

1. About App: Contains a general description of the application, its objectives, and its benefits for 10th-grade informatics.
2. Material: Provides digital textbook content for the 10th-grade informatics curriculum.
3. Video: Hosts learning materials packaged in video and animation formats.
4. Quiz: Serves as an evaluation tool with quizzes designed to assess and hone student abilities.
5. Game: Incorporates an educational game specifically tailored to 10th-grade informatics topics.
6. Reference: Lists additional sources related to the curriculum materials to broaden student understanding.

Implementation Phase

The developed application was implemented and tested with a sample of

19 10th-grade students at SMA Negeri 1 Panji. A purposive sampling technique was employed to select participants based on the criterion that they were currently enrolled in the informatics course. The trial aimed to observe student engagement during learning sessions using the Bitnesia application and to gather initial data on its effectiveness in enhancing participation and understanding.

Evaluation Phase

A summative evaluation was conducted based on feedback from experts and users. The objective was to measure the media's validity and effectiveness. A validation instrument was developed in the form of a questionnaire comprising 15 items rated on a 4-point Likert scale. The questionnaire assessed constructs such as ease of understanding, readability, evaluation quality, and interface usability. The validation involved:

1. One media expert (a lecturer holding a Master's degree in Computer Science).
2. One material expert (an experienced high school informatics teacher).
3. Nineteen users (the student participants).

Feedback from this evaluation was analyzed to identify areas for improvement for future versions of the application.

Data Collection and Analysis

Data were collected through observation and questionnaires. Observations were conducted to monitor student learning behaviors during the implementation phase. Two questionnaires were administered: (1) a product validation test for experts to assess

the media's suitability, and (2) an effectiveness test for students to gauge their perception of the media's utility in the learning process.

The validation data from material experts, media experts, and the effectiveness data from students were analyzed using a quantitative descriptive approach. Scores were based on a 4-point Likert scale with the following criteria: 4 (Very Eligible), 3 (Eligible), 2 (Quite Eligible), and 1 (Less Eligible). The results were converted into percentages and interpreted using the following eligibility intervals (Table 1).

Table 1. Media Suitability Assessment Interval

Interval	Criteria
81-100	Very Eligible
66-80	Eligible
51-65	Fairly Eligible
<50	Less Eligible

The learning media is deemed suitable for use (valid) if it scores in the "Very Eligible," "Eligible," or "Fairly Eligible" categories. A score in the "Less Eligible" category indicates that further development is required before the media can be implemented.

RESULT AND DISCUSSION

Results of the Development of Android-Based Interactive Learning Media

User Interface

The user interface (UI) display serves as the primary point of interaction, connecting the application with the user through a graphical format. The following figure presents the display of the developed Android-based interactive learning media application.

Figure 3. User Interface



Main Menu

The main menu serves as the central navigation hub of the application, integrating its core functional components. The components of this Android-based interactive learning media application include: an 'About' section detailing the application, learning materials, instructional videos, quizzes, educational games, and a references section compiled from various sources pertinent to Informatics subject matter for tenth-grade senior high school students. The main menu interface is presented in Figure 4.

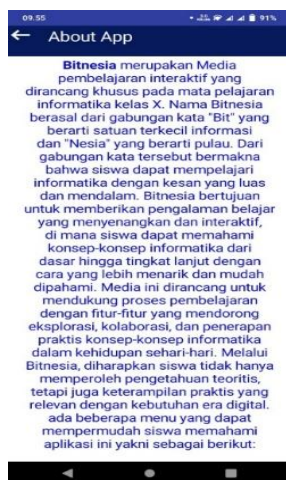
Figure 4. Main Menu



About View Apps

The "About" view within the application is a dedicated menu that presents information concerning the application itself. This application, named "Bitnesia," is further detailed in this section, which provides a comprehensive overview of its purpose, features, and contents. The "About App" interface is illustrated in Figure 5.

Figure 5. About App Display



Material View

The Materials display functions as a menu providing access to diverse learning materials. The content is sourced from the Class X Informatics textbook utilized at SMA Negeri 1 Panji. This interface is designed to facilitate ease of access, study, and comprehension for students, as illustrated in Figure 6.

Figure 6. Display of the Material Menu and Material Content Section

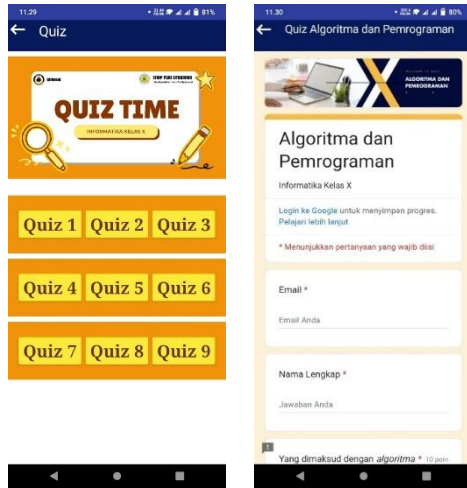


Video View

The Video menu provides a repository of various instructional videos covering Informatics subject matter for Grade 10. This feature is designed to enrich student knowledge by integrating learning materials from diverse external sources. Access to this unbounded information is intended to broaden their understanding, enabling students to consult multiple perspectives rather than relying on a single source. Consequently, students are encouraged to compare, analyze, and evaluate various viewpoints, thereby enhancing their digital literacy and

critical thinking skills. The design of this video interface is presented in Figure 4.

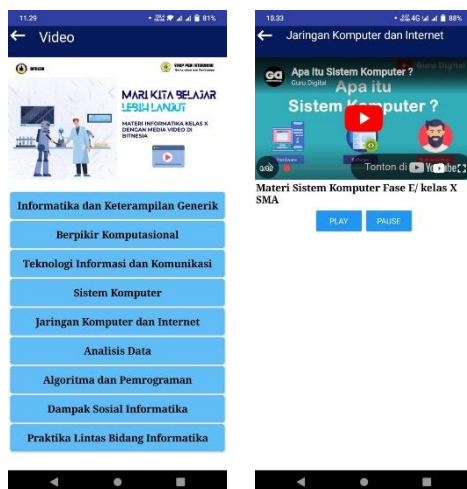
Figure 7. Video Menu Display and Video Content Section



Quiz View

The Quiz module functions as a menu providing various quizzes designed to hone students' knowledge and skills. This feature serves as a summative assessment tool, administered upon the completion of each chapter unit. Through this module, educators can evaluate the extent of student comprehension of the material covered. The interface for the quiz menu is presented in Figure 8.

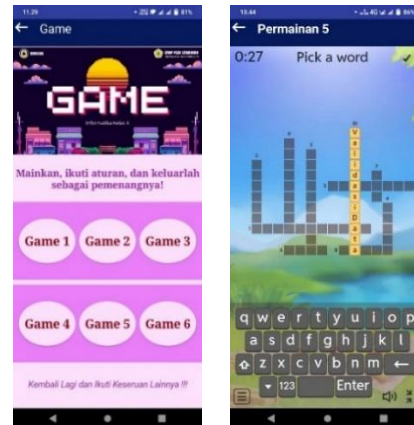
Figure 8. Quiz Content Section



Game View

The Game menu provides access to a variety of educational games designed to reinforce learning objectives. This module was developed utilizing the Wordwall software platform. The interface for this game menu is presented in Figure 9.

Figure 9. Game Menu Display and Game Content Section



Reference View

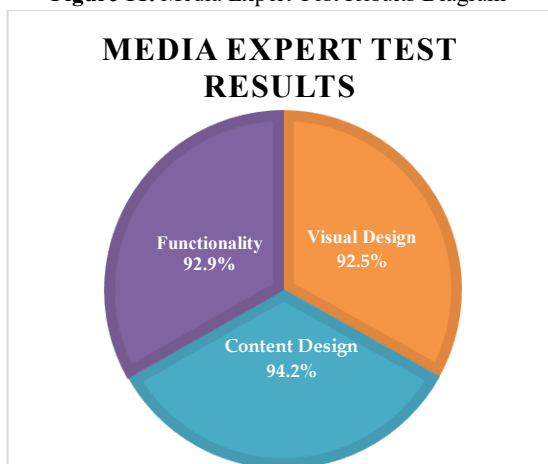
The References section provides a comprehensive list of sources utilized in the development of this instructional media application. The interface for this section is presented in Figure 10.

Figure 10. Reference View



Media Expert Test Results

Figure 11. Media Expert Test Results Diagram



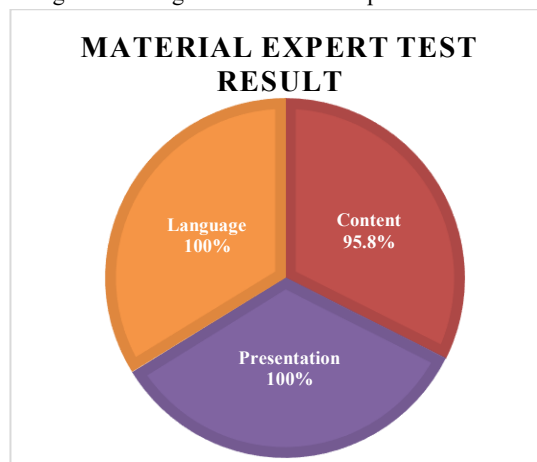
The results of the media expert assessment, as illustrated in Figure 11, indicate high scores across three key aspects. The visual design aspect received a score of 92.5%, the content design aspect achieved 94.2%, and the media functionality aspect obtained 92.9%. This evaluation was conducted using a structured assessment rubric encompassing three primary dimensions. The visual design aspect comprises three indicators: interface design, display appropriateness, and navigation ease. The content design aspect includes four indicators: text readability, color selection, element layout and placement, and application content typography. The media functionality aspect consists of three indicators: media stability and performance, interactive features, and customization capabilities.

Each indicator was evaluated by experts using a 1–4 Likert scale, with raw scores subsequently converted into percentage values. The final score for each aspect was derived by calculating the average of all indicator scores within that

aspect before conversion to a percentage. All three aspects yielded scores exceeding 80%, demonstrating that the developed learning media is rated as excellent. These results confirm that the Android-based interactive learning media is highly suitable for supporting the learning process, as it meets expected quality standards in visual design, content completeness and relevance, and functional performance. Consequently, this media offers significant potential to enhance student engagement, facilitate effective material comprehension, and provide an enjoyable and interactive learning experience tailored to the needs of students in the digital era.

Material Expert Test Results

Figure 12. Diagram of Material Expert Test Results



The results of the material expert evaluation, presented in Figure 12, demonstrate exceptional performance across key assessment aspects. The content feasibility aspect achieved a score of 95.8%, while both the presentation feasibility and language assessment aspects received perfect scores of 100%. These results indicate that the media meets the "very good" criteria across all dimensions, confirming its high suitability

for supporting the learning process. The media satisfies expected quality standards in terms of content validity, presentation quality, and linguistic appropriateness.

The evaluation reveals that the developed learning media is not only curriculum-aligned and relevant but also features an engaging presentation style and language accessible to students. Consequently, this media offers significant advantages for enhancing learning effectiveness, improving conceptual understanding, and motivating students to achieve optimal learning outcomes.

While the media demonstrates substantial strengths, material experts provided constructive recommendations for improvement. It was suggested that the quiz component should incorporate a vertical scroll feature within the application interface, enabling the Google Form content to display natively without redirecting users to an external webpage. Additionally, experts recommended publishing the application on the Google Play Store to facilitate seamless updates and ensure continuous accessibility for users.

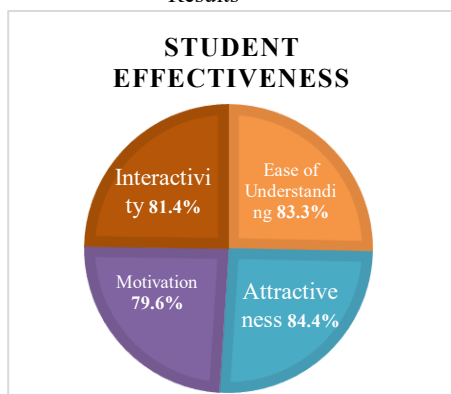
The results of the student effectiveness test, as illustrated in Figure 13, indicate strong performance across multiple evaluation dimensions. The aspect of material comprehensibility received a score of 83.3%, learning media attractiveness achieved 84.4%, assessment of media interactivity features obtained 81.4%, and student learning motivation evaluation scored 79.6%. According to the established assessment criteria, the aspects of material comprehensibility, media attractiveness, and interactivity features all fall within the "Highly Suitable" category. Meanwhile, the student learning motivation aspect is classified within the "Good" category.

Although the student learning motivation aspect did not reach the highest classification tier, these results demonstrate that the developed media successfully provides positive reinforcement for student learning engagement. The overall findings indicate that the learning materials effectively support student comprehension, capture learner attention, and provide interactive features that enhance the educational process. This aligns with research by Marlianto et al. (2024), which indicates that teaching materials incorporating interactive features can create a more effective and structured learning experience.

The media further facilitates deeper conceptual understanding through clear visual representations, systematic information organization, and opportunities for independent material exploration. Evidence of the media's effectiveness in enhancing student

Student Effectiveness Test

Figure 13. Diagram of Student Effectiveness Test Results



conceptual understanding is presented in Figure 14, which provides a detailed analysis of student comprehension outcomes.

Figure 14. Student Concept Understanding Analysis Diagram

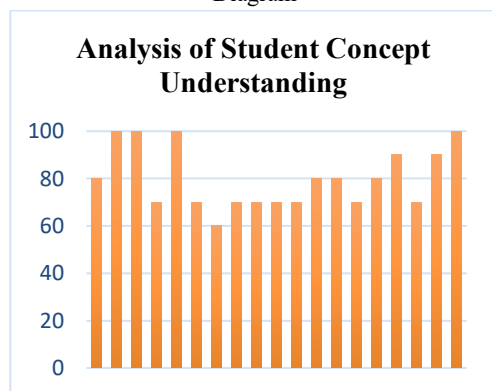


Figure 14 reveals considerable variation in student achievement scores, with an overall average score of 80. Among the 19 students assessed, 4 achieved a perfect score of 100, 2 scored 90, 4 scored 80, 8 scored 70, and 1 student scored 60. This distribution indicates diverse levels of material comprehension among students. Although one student obtained a score of 60, the media remains effective in enhancing overall conceptual understanding, while acknowledging the need for targeted guidance for certain individuals.

As emphasized by Yolanda (2020), success in the learning process can be evaluated through improvements in student understanding, content mastery, and academic achievement. The results suggest that the learning media contributes positively to these dimensions, particularly in facilitating conceptual understanding for the majority of students. The media demonstrates potential to support learning outcomes effectively, though supplementary strategies may be

necessary to address individual learning gaps and ensure inclusive progress.

Discussion

The findings of this study demonstrate that the Android-based learning media is highly suitable for implementation among tenth-grade students at SMA Negeri 1 Panji, particularly within the Informatics subject. The appropriateness of this media is substantiated through validation tests conducted by media experts, subject matter experts, and student effectiveness evaluations. Below is a detailed discussion of the validation outcomes for the Android-based learning media.

Validation Interpretation by Media Experts

The media expert evaluation employed several assessment criteria, encompassing visual design, content design, and functionality. Each aspect was further delineated into specific indicators:

1. Visual Design, comprising three indicators: interface design, visual display suitability, and ease of navigation.
2. Content Design, consisting of four indicators: text readability, color selection, layout and element placement, and application content typography.
3. Functionality, encompassing three indicators: media stability and performance, interactive features, and customizability.

The results from the media expert evaluation revealed scores exceeding 91% across all three aspects. According to the assessment interval, scores within the 81–

100% range are classified as "excellent," indicating that the media is highly appropriate for educational use. This aligns with the perspective of Sadiman, as cited in Kusum et al. (2023), who emphasizes that quality learning media should be engaging, relevant, user-friendly, and possess clear instructional value. Furthermore, Wibowo (2023b) contends that interactive, captivating, and relevant learning media can enhance student engagement, improve comprehension, and lead to better academic outcomes.

This interactive learning media offers several advantages, including increased student involvement, facilitated material comprehension, and an engaging, interactive learning experience. The application of appealing and interactive learning media can boost student interest and motivation (Fauzan, 2024). Research indicates that compelling media tends to capture student attention and promote active participation (Nurfadillah et al., 2021). According to Adam (2023), in addition to stimulating desire and interest, learning media can also exert psychological effects on students by not only conveying information but also shaping learning experiences that engage emotions, motivation, and perceptions. Thus, well-designed learning media can foster a positive learning environment and support deeper conceptual understanding.

Validation Interpretation by Subject Matter Experts

The material expert evaluation included criteria such as content feasibility, presentation suitability, and

language assessment, each broken down into specific indicators:

1. Content Feasibility, comprising three indicators: curriculum alignment, material accuracy, and content completeness.
2. Presentation Suitability, consisting of four indicators: ease of understanding and use, material interface appearance, diversity of material presentation, and student interaction and engagement within the application.
3. Language Assessment, encompassing six indicators: language clarity, terminology accuracy, user-appropriate language, language consistency, grammatical and spelling accuracy, and language style.

The results from the material expert evaluation showed scores of 95% or higher, with some aspects reaching 100%. Scores $\geq 80\%$ are categorized as "excellent," confirming the media's high suitability. The content feasibility aspect scored 95.8%, indicating that the media's content aligns with learning objectives, is accurate, and is both complete and up-to-date. The presentation feasibility aspect achieved 100%, reflecting the media's user-friendly navigation, supportive visualization, and ability to promote active student engagement through interactive features. The language assessment aspect also scored 100%, demonstrating that the media employs clear and comprehensible sentences, contextually appropriate terminology, and a communicative, friendly style that fosters a positive learning atmosphere.

This interactive learning media offers several strengths, including targeted

material, clear and understandable presentation methods, and communicative language suited to students' comprehension levels. This implies that the media not only facilitates material delivery but also aids students in understanding lessons more easily, enhances their sense of involvement, and motivates them to learn. This resonates with Raehang and Karim (2024), who argue that interactive media can transform classroom dynamics by creating a more participatory, collaborative, and engaging learning environment. According to Hutaauruk et al. (2022), media selection should not be based solely on educator preference but must consider the compatibility between the media and student characteristics.

The high scores across all assessment aspects confirm that the media meets established quality standards. This aligns with Suharsimi Arikunto's viewpoint, as cited in Alawiyah et al. (2021), which states that learning media can be deemed valid if the results align with predetermined criteria. This validity indicates that the media has undergone an objective and systematic evaluation process, fulfilling standards and quality indicators. Consequently, the media can be confidently integrated into the learning process, having satisfied content, presentation, and language feasibility requirements comprehensively. Thus, the media is not only conceptually sound but also empirically proven to support the achievement of learning objectives.

Effectiveness and Implications of Using Learning Media

The student effectiveness test yielded a score of 83.3% for material comprehensibility, indicating that the learning materials are well-designed and present content in a clear and accessible manner. The application incorporates diverse media formats, including text, animations, audio, and video, which facilitate conceptual understanding through interactive and dynamic explanations. The media's attractiveness scored 84.4%, reflecting the appeal of its graphic design, color scheme, layout, and visual animations, all of which enhance student engagement. This aligns with Nofita et al. (2025), who found that students exhibit greater focus and enthusiasm when learning with animated videos, as such media create a more interactive and enjoyable atmosphere.

The interactivity features aspect scored 81.4%, demonstrating that the media provides interactive elements such as navigation buttons, animations, videos, games, and quizzes that encourage active participation. As Susanti and Suripah (2021) noted, interactivity in learning media promotes student involvement in the learning process. Additionally, interactive media support individualized and adaptive learning experiences (Tabina et al., 2024).

The learning motivation aspect scored 79.6%, categorized as "Good." Although it did not reach the "Excellent" threshold, this score indicates that the media positively influences students' interest in learning. This finding aligns with Keller's ARCS model (Attention, Relevance, Confidence, Satisfaction), which highlights the importance of

attention and relevance in enhancing motivation (Li & Keller, 2018). Furthermore, Self-Determination Theory (Ryan & Deci, 2000) suggests that media fostering autonomy and competence can bolster intrinsic motivation. Thus, while the media has successfully increased student interest and excitement, there remains room for improvement to achieve optimal motivation levels. According to Putri et al. (2020), learning innovations can motivate students, and this media development represents one such innovation.

In summary, this interactive learning tool effectively delivers material in a clear and efficient manner while making learning enjoyable. It helps maintain student interest and encourages active participation. This corroborates Arsyad's view, as cited in Magdalena et al. (2021), that interactive and engaging learning media can enhance student attention, interest, and conceptual understanding.

The use of interactive learning tools also aids students in grasping key concepts, as evidenced by quiz performance within the application. The effectiveness test results show an average student score of 80, with most scores falling within the 70–100 range. This indicates that over half of the students have met or exceeded the Criteria for Achieving Learning Objectives (KKTP), confirming that the media supports clearer material comprehension. This aligns with Valensia and Purwati (2024), who assert that learning is considered complete when students achieve or surpass the learning objectives.

However, one student scored 60, suggesting suboptimal understanding and highlighting the need for more effective learning approaches and support to enhance motivation and competency achievement. As Yolanda (2020) emphasizes, success in the learning process can be measured through improvements in student understanding, material mastery, and learning outcomes. Therefore, educators, acting as facilitators, must innovate in creating interactive learning media to capture student attention, foster motivation, and encourage collaboration. This approach is essential for achieving desired learning outcomes.

Muzanni et al. (2024) state that innovative learning using interactive media can significantly improve students' conceptual understanding and motivation. The multimodal nature of interactive learning media—combining visual, audio, animated, and gamified elements—caters to diverse learning styles. Thus, Android-based interactive learning tools not only enhance educational effectiveness but also promote student independence and creativity in knowledge exploration.

CONCLUSION

This study demonstrates that the development of "Bitnesia," an Android-based interactive learning media application, successfully enhanced conceptual understanding and learning motivation among tenth-grade Informatics students at SMA Negeri 1 Panji. The media fulfilled both technical and pedagogical feasibility criteria, achieving expert validation scores exceeding 90% across all evaluated aspects. Student effectiveness tests further confirmed its

utility, with an average conceptual understanding score of 80.

The findings suggest that Android-based learning media can serve as an innovative and effective educational tool, supporting flexible, engaging, and efficient learning within digital education frameworks. Consequently, the integration of such media is recommended as part of broader efforts toward educational digitalization and technology-enhanced learning initiatives.

However, this study is limited to a specific school context and subject area. Future research should explore the generalizability of these results by testing Bitnesia in schools with diverse characteristics and across different academic subjects. From a development perspective, it is advisable to include institutional identifiers such as the STKIP PGRI Situbondo logo to enhance institutional visibility and strengthen the credibility and branding of the product.

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