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Development of Android Based Interactive Learning Media Using Articulate Storyline 3 to Improve Motivation and Conceptual Understanding in Informatics Lessons

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Abstract

This study aimed to develop Android-based interactive learning media using the Articulate Storyline 3 application for teaching computer hardware in Grade VII Informatics classes. The development model used was ADDIE, involving expert validation and effectiveness testing in both experimental and control classes. Validation results indicated the media was highly feasible, with average Likert-scale scores above 4.4. Effectiveness testing showed a significant improvement in students' conceptual understanding and learning motivation in the experimental class, with an N-Gain score of 0.77 (high category) and motivation levels increasing from "High" to "Very High." These findings support the integration of Android-based technology in education as an effective strategy to improve learning outcomes, especially in abstract and technical subjects.

Keywords: Interactive Learning Media, Android, Articulate Storyline 3, Motivation, Conceptual Understanding

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INTRODUCTION

The rapid advancement of Information and Communication Technology (ICT) in the 21st century has revolutionized educational practices across the globe. ICT plays a pivotal role in enhancing learning experiences, enabling more interactive, student-centered approaches that foster engagement and deeper understanding. UNESCO (2020) emphasizes the need for educational systems to integrate technology effectively to boost learning outcomes. Interactive learning media, in particular, serve as a powerful tool to transform conventional pedagogies, supporting active participation and improving conceptual understanding (Mayer, 2021; Kalyani, 2024).

Despite global progress, the integration of ICT in Indonesian schools, particularly in rural areas, remains limited. This disparity is marked by infrastructural deficiencies, including inadequate access to electricity and internet connectivity, minimal availability of computers, and a lack of modern classroom facilities (Subroto et al., 2023; Fitri, 2023; Oki et al., 2023). Financial constraints exacerbate these issues, as many rural schools operate with limited budgets that restrict investments in ICT tools and teacher training (Mapisa & Makena, 2024; Soekamto et al., 2022). Additionally, a significant human factor challenge exists: educators often lack the necessary training and confidence to incorporate technology into their teaching, further impeding ICT adoption (Isabella et al., 2024; Rana et al., 2021).

Socio-cultural barriers also hinder ICT integration. Traditional educational values and skepticism toward technology, especially in conservative or under-resourced communities, contribute to resistance against digital innovation (Xie et al., 2022; Ryn & Sandaran, 2020). These challenges collectively restrict the potential of Indonesian students, particularly in rural regions, to benefit from technological advancements in education. National-scale assessments reinforce this concern, revealing disparities in motivation and digital literacy between urban and rural students (Haikal et al., 2023; Mahendra et al., 2022).

Given these systemic challenges, leveraging widely accessible technologies, such as Android-based smartphones, presents a pragmatic solution. A majority of Indonesian students own or have access to Android devices, offering an opportunity to bridge educational gaps through mobile learning platforms (We Are Social, 2023; Zhao et al., 2022). Research highlights the effectiveness of Android-based learning tools in promoting active learning, enhancing engagement, and supporting independent study (Ikhsanty et al., 2021). Compared to traditional methods like PowerPoint presentations, Android media has demonstrated superior results in sustaining student attention, increasing motivation, and improving learning outcomes (Fitriyana et al., 2020; S et al., 2022).

The educational benefits of Android-based learning extend beyond student engagement. Studies have shown that mobile applications designed with interactive features can significantly enhance students' cognitive development and conceptual understanding (Hanny & Fajar, 2022; Kumalasari & Anggraito, 2023). For instance, in scientific subjects like genetics or human anatomy, Android learning environments have been shown to foster critical thinking and deeper comprehension by providing multimedia simulations and real-time feedback (S et al., 2022; Lebedeva et al., 2022).

Furthermore, the Discovery Learning model aligns well with mobile learning platforms. This pedagogical approach emphasizes student autonomy, exploration, and inquiry, allowing learners to construct knowledge actively rather than passively receiving information (Bruner, 1961; Mayer, 2021). The integration of Android-based applications within Discovery Learning environments has been found to enhance experiential learning, stimulate curiosity, and encourage problem-solving (Winarni et al., 2018; Machkour et al., 2023).

The Informatics subject in Indonesia's Independent Curriculum mandates the development of digital literacy, computational thinking, and technological proficiency among students (Bers et al., 2021). However, the abstract nature of informatics topics, such as computer hardware, often presents cognitive challenges for learners. Traditional teaching methods may fail to convey these complex concepts effectively, leading to low student motivation and limited understanding (Smith et al., 2022; Al-Adwan et al., 2021). Innovative, technology-driven instructional strategies are therefore essential to improve learning outcomes in this domain.

In this context, Articulate Storyline 3 emerges as a valuable tool for creating dynamic and interactive learning media. Known for its multimedia integration capabilities and user-friendly design, Articulate Storyline allows educators to develop customized content that is visually appealing and pedagogically sound (Johnson, 2022; Wibowo et al., 2023; Brown et al., 2022). When deployed via Android platforms, these learning modules become accessible to a broad student population, including those in resource-limited environments.

Although previous studies have explored the use of interactive media in education, few have combined the Discovery Learning model with Android-based applications developed through Articulate Storyline 3. For example, Nugroho and Arrosyad (2020) examined multimedia tools for learning, while Wulandari and Ramadhan (2020) focused on conventional interactive modules. However, these studies did not integrate a robust pedagogical model like Discovery Learning nor leverage mobile platforms to the extent presented in this research.

Moreover, the current literature lacks empirical data on how such integrated approaches impact student motivation and conceptual understanding in informatics education, particularly

in rural Indonesian schools. By combining the strengths of Android-based accessibility, Articulate Storyline's multimedia capabilities, and the Discovery Learning framework, this study aims to fill that gap and provide evidence-based recommendations for curriculum developers and educators.

This research, therefore, seeks to develop and evaluate Android-based interactive learning media using Articulate Storyline 3, integrated with the Discovery Learning model. The study focuses on computer hardware content in the Informatics subject for Class VII students in a rural Indonesian school setting. By addressing the shortcomings of conventional teaching methods and leveraging accessible technology, this intervention aspires to enhance both learning motivation and conceptual understanding among students. The findings will contribute to the growing body of knowledge on ICT integration in education, with specific relevance to under-resourced and digitally underserved contexts.

The broader goal is to inform policy, curriculum design, and teaching practice by demonstrating how interactive, mobile-based media can transform the educational landscape. With thoughtful implementation, such innovations hold the potential to democratize access to quality education and support the development of critical 21st-century skills among Indonesian learners.

METHOD

Research Design

This study employed a Research and Development (R&D) methodology to design, validate, and evaluate Android-based interactive learning media for Grade VII Informatics, specifically on the topic of Computer Hardware. The development followed the ADDIE model consisting of Analysis, Design, Development, Implementation, and Evaluation phases as recommended by Sugiyono (2019). This systematic model was chosen for its structured approach in instructional design and its suitability for educational product development.

The development process began with a needs analysis through interviews with Informatics teachers and student questionnaires. The findings revealed specific challenges in teaching and understanding computer hardware topics, such as the abstract nature of components, lack of visualization, and limited student engagement. These findings informed the design of the media content.

Using Articulate Storyline 3, the media was developed as an Android application comprising an introduction that outlines learning objectives, core material presented with multimedia content, interactive simulations and quizzes, and immediate feedback features. The learning media was designed to support Discovery Learning by encouraging student exploration, autonomy, and interactive engagement. The application could be accessed both online and offline, allowing self-paced learning and extended engagement beyond class time.

Sampling and Procedures

To assess the media's effectiveness, a quasi-experimental method was used, specifically the Nonequivalent Control Group Design. This design involved two pre-existing (intact) classes at SMPN 04 Banua Lawas, South Kalimantan. The experimental group (n = 31) used the Android-based interactive media, while the control group (n = 33) received traditional instruction. Sampling was conducted using a purposive sampling technique, based on criteria such as: (1) similar average academic performance based on previous semester grades, and (2) willingness of teachers and students to participate fully in the research.

Although randomization was not applied, internal validity threats were minimized by ensuring baseline similarity across groups, using validated instruments, and keeping instruction topics and schedules consistent. Both groups had balanced gender ratios (approximately 50% male and female), came from similar socio-economic backgrounds, and had comparable prior

knowledge, as they had all received introductory lessons on computer hardware before the study began.

This research adopted a quasi-experimental approach with a Nonequivalent Control Group Design to evaluate the effectiveness of Android-based interactive learning media, developed using Articulate Storyline 3, in improving students' motivation and conceptual understanding of Computer Hardware. Two groups of seventh-grade students at SMPN 04 Banua Lawas participated in the study: the experimental group (n = 31), which used the interactive media, and the control group (n = 33), which received conventional instruction.

The study employed the Research and Development (R&D) methodology, aimed at designing, validating, implementing, and evaluating educational media. The ADDIE development model consisting of Analysis, Design, Development, Implementation, and Evaluation guided the media creation process (Sugiyono, 2019). Each stage was aligned with both pedagogical goals and technical feasibility based on field needs.

Instruments and Data Collection

Instruments and data were collected through a pre-test and post-test to measure conceptual understanding; motivational questionnaires administered before and after the intervention; student response questionnaires to assess user experience with the media; and interview guides to gather teacher and student feedback during the needs-analysis and post-implementation stages. All questionnaires used a Likert scale from 1 (Very Poor) to 5 (Very Good), and average scores were interpreted using Sugiyono's (2016) classification for feasibility and motivation.

Data Analysis Techniques

Data were analyzed in SPSS (version 25) using a set of standard procedures: descriptive statistics (means and standard deviations), the Kolmogorov–Smirnov test for normality, Levene's test for homogeneity, paired-samples t-tests to evaluate within-group changes, independent-samples t-tests to compare between groups, effect size (Cohen's d) to estimate the magnitude of the treatment, and Normalized Gain (N-Gain) to assess learning improvement.

N-Gain measures the relative improvement in student learning between pretest and posttest, calculated using the formula and interprete using Table 1.

$$N\text{ - }Gain <\text{g}) \frac{SPostest - SPrestest}{Smax - SPretest}$$

g = Normalized Gain
$S_{Pretest}$ = Pretest Score
$S_{Postest}$ = Postet Score
S_{maks} = Maksimum Score

Table 1. N-Gain Interpretation Categories

N-Gain Value (g)	Category
g > 0.70	High
0.30 ≤ g ≤ 0.70	Medium
g < 0.30	Low

RESULTS AND DISCUSSION

An initial investigation conducted through interviews with teachers and students at SMPN 04 Banua Lawas highlighted notable difficulties in teaching and learning the topic of Computer Hardware. Educators pointed out that the material tends to be abstract, highly technical, and often fails to capture student interest mainly due to the reliance on traditional, lecture-based teaching methods that offer minimal student interaction. From the students' perspective, there was a strong preference for learning through more dynamic and user-friendly

media. Many expressed enthusiasm for using Android-based educational applications, suggesting a growing openness to technology-driven learning approaches.

To validate these qualitative insights, a baseline survey was administered. The results reinforced the earlier findings: 42% of the students admitted to experiencing low levels of motivation in learning the subject, and only 36% managed to score above the established Minimum Competency Standard (KKM). These findings clearly point to a significant gap in both engagement and academic performance, underlining the urgency of adopting more innovative and interactive instructional strategies.

The data suggest that the conventional teaching model heavily reliant on passive delivery does not effectively meet the diverse learning needs of students. As Computer Hardware is inherently complex and demands a certain level of conceptual understanding, presenting it through static explanations fails to facilitate meaningful learning. Moreover, the lack of visual and hands-on components in the current method further contributes to students' difficulties in grasping the material.

On the other hand, the interest in mobile-based learning tools offers a promising alternative. Android applications, for example, can incorporate multimedia elements such as animations, simulations, quizzes, and interactive modules that make abstract concepts more tangible and engaging. These tools not only accommodate different learning styles but also foster a sense of autonomy and active participation among students. Given that most students already have access to smartphones, the integration of such tools into classroom instruction becomes even more practical and relevant.

The observed challenges are not solely academic in nature; they also reflect deeper motivational and psychological barriers. When students feel disconnected from the material or perceive it as difficult and irrelevant, their willingness to engage declines. Therefore, creating a more stimulating and learner-centered environment is crucial to rebuilding their interest and confidence in the subject. This can be achieved through a technology-enhanced approach that makes learning more contextual, interactive, and student-friendly.

The preliminary analysis underscores the pressing need to transform the teaching of Computer Hardware at SMPN 04 Banua Lawas. The current traditional approach has proven insufficient in promoting student engagement and academic success. With over 40% of students lacking motivation and fewer than 40% meeting competency standards, it is evident that a pedagogical shift is necessary. The strong student interest in Android-based applications presents a valuable opportunity to revamp the learning experience. By incorporating mobile technology into instructional design, educators can create a more engaging, effective, and inclusive learning environment that addresses both the cognitive and emotional needs of learners.

Media Design: Articulate Storyline 3 as a Creative Learning Solution

To address the previously identified challenges in understanding computer hardware concepts among junior high school students, an educational media application was developed using *Articulate Storyline 3*, specifically adapted for Android platforms. This learning media features a structured sequence of modules that include an introduction, clearly defined learning objectives, core instructional content, interactive simulations, and evaluation quizzes with real-time feedback. The development of this application was grounded in the principles of *Discovery Learning*, which encourages students to explore and construct knowledge through active engagement, particularly through simulations and game-based elements.

The interface was designed with attention to the developmental and cognitive characteristics of junior high school students. High-quality illustrations and animations of computer hardware components such as motherboards, CPUs, RAM, and input-output devices were integrated to support visual learning. Visual representations are essential in technical subjects like computer hardware, where abstract and complex ideas often require concrete visualization to be properly understood. As emphasized by Gil-Flores et al. (2017), interactive

and visually rich ICT tools can significantly enhance accessibility to information, thus fostering better student engagement and comprehension.

The application was packaged as an APK file for Android devices, ensuring that it can be accessed both online and offline. This flexibility extends the learning experience beyond the classroom, allowing students to learn at their own pace and in their own time. By providing autonomy and accessibility, this media empowers students to take ownership of their learning, which is a key factor in promoting deeper and more sustained understanding.

Research supports the positive impact of interactive learning media in technical education. A study by Agustini et al. (2020) found that the integration of visual aids and simulations into the teaching of hardware concepts resulted in better student retention and a clearer understanding of how components function and relate to each other. By allowing learners to manipulate and observe digital representations of physical systems, the application provides a hands-on, experiential learning experience that deepens conceptual understanding.

Beyond cognitive benefits, such media also play a crucial role in enhancing students' motivation and engagement. As noted by Leftheriotis et al. (2017), incorporating gamification elements into educational activities such as point scoring, instant feedback, and levels has been shown to significantly increase student interest and active participation. This aligns with the motivation-centered design of the application, where students are encouraged to progress through content in an engaging, game-like environment. Motivation, as a driving factor in learning, contributes directly to performance outcomes, as students who enjoy the process are more likely to persist and succeed.

Figure 1. Interactive Learning Media Display

Furthermore, multimedia-rich learning environments cater to diverse learning preferences, creating inclusive spaces where all students can thrive. Dewi et al. (2019) emphasize that combining text, images, audio, and animation helps accommodate different learning styles whether visual, auditory, or kinesthetic thereby making content more accessible to a broader range of learners. Ayuni et al. (2022) further highlight that such multisensory learning experiences not only boost motivation but also improve memory retention and understanding. The collaborative aspect of interactive media should not be overlooked. According to Zaitseva et al. (2021), technology-enhanced learning fosters collaborative interactions among students, enabling peer instruction and shared problem-solving. This is

particularly beneficial for mastering complex topics like computer hardware, where group discussions and collaborative exploration can reinforce individual learning.

Importantly, the effectiveness of technology-based media is heavily influenced by teacher competencies. Farisa et al. (2023) assert that educators must possess both technological skills and pedagogical insight to design and implement interactive media successfully. Teachers should understand how to align media features with instructional goals and how to facilitate learning experiences that maximize student engagement and comprehension. Yulianti and Handican (2023) echo this, noting that professional development for teachers in educational technology is essential to ensure optimal use of digital learning tools in the classroom.

Figure 1 showcases the interface of the interactive learning media developed using *Articulate Storyline 3* for Android devices. The display includes user-friendly navigation, high-resolution illustrations of computer hardware components such as the motherboard, CPU, and RAM, as well as interactive elements like simulations, animations, and evaluation quizzes. The design is tailored for junior high school students, featuring an engaging and accessible layout. These features support the *Discovery Learning* approach and allow students to actively learn both online and offline**.**

Media Development and Expert Validation

The development process of the media involved a series of expert validations aimed at ensuring both content quality and technical functionality. Experts reviewed the media using structured validation instruments that evaluated key dimensions such as content relevance, pedagogical alignment, motivational impact, user accessibility, and overall usability. These steps were essential in refining the media product before broader implementation.

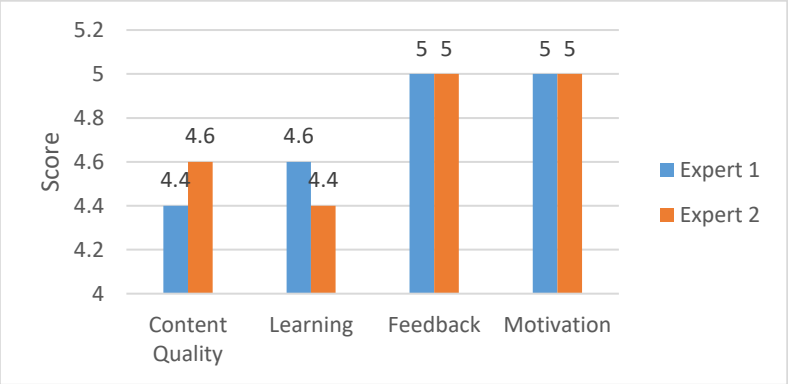

Figure 2. Material Expert Validation Results

Based on the data in Figure 2, the material experts provided consistently high ratings across the four evaluated dimensions. The scores for Content Quality, Learning Design, Feedback, and Motivation were all between 4.5 and 5.0 on a 5-point scale. The overall mean score across these indicators was 4.6. This outcome signifies that the media was judged to be in the "Very Feasible" category, indicating strong suitability for educational use without substantial revisions.

Such high scores suggest that the material was both relevant and well-structured according to pedagogical standards. The validation confirms that the media supports the intended learning outcomes and includes features that can effectively motivate students and provide constructive feedback mechanisms. These findings are consistent with the study by Sari and Herlina (2021), which emphasizes that well-validated learning content plays a critical role in strengthening students' conceptual understanding.

In terms of instructional value, the experts' ratings indicate that the media is likely to enhance learners' engagement with the subject matter and support deeper cognitive processing

through well-integrated feedback and motivational prompts. This adds weight to the decision to proceed with implementation in educational settings with minimal revisions.

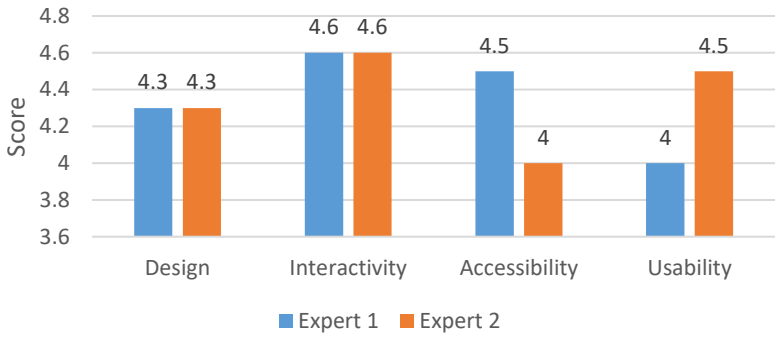

Figure 3. Media Expert Validation Results

Meanwhile, Figure 3 presents the evaluation results from two media experts who assessed the design from the standpoint of functionality and learner interaction. The aspects assessed included Design, Interaction, Accessibility, and Usability. On average, the two experts gave ratings that ranged between 4.0 and 4.6, resulting in a composite mean score of 4.4. This score places the media within the "Good" to "Very Good" category, suggesting that it meets essential quality standards in terms of digital learning environments.

Among the assessed aspects, Interaction received the highest average score of 4.6 from both experts. This finding highlights the effectiveness of the user interface and the extent to which the media promotes active user participation. A high level of interactivity is often associated with better engagement and retention of learning, as it encourages learners to manipulate, explore, and engage with the content in meaningful ways.

Differences in scores between the two experts were modest and appeared in areas like Design and Accessibility, with one expert rating slightly higher than the other. However, both agreed on the usability and the potential of the media to be accessible to its target users. These evaluations align with findings from Mulyadi et al. (2021) and Ardiansyah et al. (2021), who have previously underscored the importance of intuitive design and accessibility in increasing the effectiveness of educational media.

The results from this stage of validation provide a strong indication that the media is ready for implementation or pilot testing in a real educational setting. Its strengths in interactivity and usability make it particularly suited for digital environments where student engagement and interface functionality are crucial.

Implementation: Measuring Effectiveness

The implementation phase was carried out after the completion of the development of the Android-based interactive learning media. The primary goal of this stage was to assess the effectiveness of the developed media in enhancing students' conceptual understanding and learning motivation, particularly in the topic of *Computer Hardware* in the Informatics subject. Two groups were involved: the experimental class, which used the Android-based media, and the control class, which received conventional instruction.

Table 2 presents a comparison between the control and experimental classes based on pretest and posttest scores. The N-Gain (Normalized Gain) score, which indicates the level of improvement in conceptual understanding, was calculated for each group.

Table 2. Results of N gain test analysis

Number of Students	Pretest Score	Posttest Score	N-Gain	Category
Control Class (n=33)	47.7	83.3	0.68	Medium
Experimental Class (n=31)	47.9	85.8	0.77	High

The data from this study describe the outcomes of an intervention using Android-based interactive media compared to traditional teaching methods in the context of learning computer hardware. Students in the control class, who were taught using conventional instructional strategies, showed a measurable improvement in conceptual understanding. Their average pretest score was 47.7, which rose to 83.3 in the posttest. This yielded an N-Gain score of 0.68, which falls within the medium category. These results indicate that while traditional methods do support learning, the extent of conceptual gain is moderate. The control class benefited from structured instruction, but the approach may have been limited in fostering deeper engagement or independent exploration of abstract content.

In contrast, students in the experimental class, who learned using Android-based interactive media, demonstrated a higher level of improvement. Their average pretest score was 47.9 and increased to 85.8 in the posttest. The N-Gain score for this group was 0.77, categorized as high. A notable 58.1% of students in the experimental class achieved a high level of conceptual gain, suggesting that the interactive media had a significant impact on learning outcomes. Features embedded in the media such as quizzes, animations, and feedback likely contributed to this result by encouraging active participation and allowing students to learn at their own pace. The structured yet flexible nature of the media supported a more meaningful interaction with the content.

These findings are consistent with existing literature on mobile-based learning. Aini and Rusdiana (2024) reported that mobile applications enhance student involvement and ease the learning of abstract topics. Hamdani et al. (2022) emphasized the role of mobile tools in supporting independent study, particularly through repeated access to instructional materials. Similarly, Pramudibyanto et al. (2021) found that mobile learning platforms can improve comprehension and student engagement. The current study aligns with these conclusions, particularly in demonstrating how interactive design elements and user-friendly interfaces contribute to better retention and understanding.

In the context of contemporary education, the integration of Android-based media is especially relevant. The media not only supported the development of conceptual understanding but also provided opportunities for students to engage with digital learning tools aligned with 21st-century educational demands. The evidence from this study underscores the need for educators to consider adopting such tools to enhance instructional quality, particularly in areas where visual and interactive support can aid the learning of complex material.

The use of Android-based interactive media in this study proved more effective than traditional methods in improving students' conceptual understanding of computer hardware. The higher N-Gain scores and the percentage of students achieving high conceptual gains in the experimental class highlight the value of interactive technology in education. These results offer strong support for the integration of mobile learning tools into classroom practice, particularly as a means of strengthening student engagement and learning outcomes.

Learning Motivation

The analysis of student motivation data reveals a clear difference in the effectiveness of Android-based interactive media compared to traditional classroom instruction. Motivation scores were gathered through a questionnaire administered before and after the learning intervention in both the experimental and control classes. These scores reflect students' perceived motivation in various aspects of the learning experience, such as the desire to succeed, enjoyment of learning activities, and responsiveness to the learning environment**.**

In the experimental group, the average motivation score increased significantly from 3.4 before the intervention to 4.2 afterward. This change represents a shift from the "High" category to the "Very High" category. The greatest increase was recorded in the aspect of "Interesting Activities in Learning," which received a posttest score of 4.1. This suggests that

the engaging, responsive nature of the Android-based media effectively stimulated students' interest and sustained their attention throughout the learning process.

Table 3. Summary of Student Learning Motivation Scores in Control and Experimental Classes

Class	Pretest Total Score	Posttest Total Score	Mean Score (Pretest)	Mean Score (Posttest)	Motivation Category (Pre)	Motivation Category (Post)
Control Class	3379	3779	3.4	3.8	High	High
Experimental Class	3158	3919	3.4	4.2	High	Very High

These results support the theoretical framework proposed by Ryan and Deci (2020), who argue that intrinsic motivation in learning is driven by three core psychological needs: autonomy, competence, and relatedness. The interactive features embedded in the Android-based media such as guided feedback, activity-based content, and self-paced learning—are aligned with these motivational needs. They empower students to explore independently, receive immediate reinforcement, and engage with content in a personalized way. As a result, students were not only more involved but also more confident and persistent in their learning.

The effectiveness of this approach is further validated by previous studies. Shehata et al. (2024) emphasized that well-designed digital media significantly improves student motivation and engagement. Ikhsanty et al. (2021) and Fitriyana et al. (2020) also noted that the visual and interactive elements in mobile learning applications can boost student enthusiasm, particularly when applied to content that is otherwise abstract or complex. These findings resonate with the current study's outcomes, confirming the motivational value of interactive digital tools in education.

In comparison, students in the control class also demonstrated an increase in motivation, but the improvement was less pronounced. Their average score rose from 3.4 to 3.8, remaining within the "High" category. While this suggests a degree of motivational impact from conventional teaching, the absence of interactive or digital support may have limited the depth of engagement. Nonetheless, students still responded positively to other motivating factors present in a traditional setting, such as teacher interaction, class atmosphere, and collaborative peer learning. In particular, "Interesting Activities in Learning" also received a relatively high score in the control group, indicating that even in non-digital environments, thoughtful teaching practices can foster motivation.

Despite the improvements seen in both groups, the experimental class clearly experienced a greater motivational boost. The larger increase in mean score and the transition to the "Very High" category indicate that Android-based interactive learning has a stronger influence on students' affective engagement. This aligns with Liu et al. (2020) and Kumalasari & Anggraito (2023), who found a positive correlation between motivational factors and academic performance in mobile learning contexts. They emphasized that the ability to revisit materials, receive instant feedback, and actively participate in tasks leads to deeper cognitive processing and sustained motivation.

The role of digital technology in learning, therefore, extends beyond cognitive development. It also contributes significantly to affective outcomes like motivation. As highlighted by Huang et al. (2020), integrating technology into learning environments promotes student involvement, curiosity, and a positive emotional response to the learning process.

The data clearly demonstrate that Android-based interactive media not only enhances students' conceptual understanding but also significantly improves their motivation to learn. The media's capacity to provide engaging, relevant, and autonomy-supportive learning experiences plays a key role in achieving these outcomes. To ensure learners remain motivated

and actively involved, it is essential to continue developing innovative instructional models that integrate digital tools in meaningful ways.

Statistical Analysis and Educational Impact

This study utilized both quantitative and qualitative data to measure the effectiveness of Android-based interactive media in improving student learning outcomes. The statistical tests applied included paired t-tests, independent t-tests, and effect size calculations. These were supplemented by feedback from students and teachers to better understand perceptions of learning and engagement.

Table 4. Summary of Paired and Independent t-Test Results

Test Type	Group	Mean Difference	t-value	p-value	Significance
Paired t-test	Experimental	38.16	-12.53	< 0.01	Significant
	Control	35.62	-11.52	< 0.01	Significant
Independent t-test	Pretest	-	-	0.94	Not Significant
	Posttest	-	-	0.27	Not Significant
Effect Size (Cohen's d)	Posttest	-	-	-	0.35 (Small to Moderate)

The findings from this study demonstrate a statistically and pedagogically meaningful impact of Android-based interactive learning media on student outcomes. Quantitative data from the paired t-tests revealed significant improvements in both the control and experimental groups. Students in the experimental class showed a mean gain of 38.16 points ($t = -12.53$, $p < 0.01$), while those in the control class improved by 35.62 points ($t = -11.52$, $p < 0.01$). These results confirm that both instructional methods were effective in improving student learning. However, the higher t-value and lower p-value in the experimental group suggest a stronger and more reliable improvement, likely due to the engaging and adaptable nature of the interactive media used. To ensure that the two groups were comparable before the intervention, an independent t-test was conducted on pretest scores. The result ($p = 0.94$) confirmed no significant difference, indicating equivalent starting points for both groups. Although posttest comparisons also showed no statistically significant difference ($p = 0.27$), further analysis using Cohen's d produced an effect size of 0.35. This small to moderate effect size reflects a practical, if not statistically dramatic, advantage of the interactive media approach. According to Mikolajewicz and Komarova (2019), even such modest effect sizes can yield meaningful educational results, especially when applied to broader or diverse student populations.

These quantitative outcomes were reinforced by qualitative insights collected through teacher and student interviews. Students reported that the visual elements and simulations in the media helped them grasp abstract concepts more clearly. They also noted that the interactive tasks maintained their attention and encouraged active involvement during the learning process. Teachers shared similar observations, pointing out that students using the media showed increased independence, asking fewer procedural questions and engaging more proactively with the content. These accounts align with prior findings by Susanti et al. (2022) and Rodríguez et al. (2022), who highlight the value of interactive digital tools in promoting deeper, student-centered learning experiences. However, several teachers also cautioned that the successful use of such technology depends on sufficient support. As emphasized by Hussaini et al. (2023), professional development and continued assistance are essential to help teachers integrate new media into classroom routines effectively. Without this, even the most thoughtfully designed tools may fall short of their potential.

The study's findings also contribute to ongoing discussions about the implementation of Discovery Learning strategies. Although this approach is praised for its ability to enhance motivation and foster exploratory learning, it carries the risk of overwhelming students if not supported properly. In settings with limited digital literacy or educational resources, the absence of structured guidance may hinder rather than help student progress. This caution is

supported by the work of De' and Kaugi (2023) and Wuryaningsih et al. (2019), who advocate for balanced implementation that includes both digital resources and strong instructional scaffolding. In line with these considerations, the current study acknowledges certain limitations. The research was conducted in a single school, which restricts the ability to generalize the findings to other contexts. Assumptions about uniform access to devices and internet connectivity may not hold true in every learning environment, and variations in teacher delivery styles could have influenced the outcomes. To better understand student perceptions of the Android-based learning media, a post-intervention evaluation was conducted. The results of this evaluation are presented in Table 5.

Table 5. Average Student Ratings of the Android-Based Interactive Learning Media

Evaluation Aspect	Mean Score
Learning Aspects	4.3
Clarity of Material	4.2
Visual Appearance of Media	4.6
Ease of Use	4.3
Overall Average	4.4

Students responded positively to all aspects of the media, with the highest rating given to the visual design, which included animations, simulations, and gamified elements. These features made the learning experience more enjoyable and effective, a result consistent with findings from Darma Putra and Sujana (2020) and Astuti and Nugroho (2022), who concluded that well-developed digital media improves both motivation and conceptual understanding. Students also reported that the platform's intuitive interface and interactive content made it easier to stay focused and retain information.

Taken together, the statistical evidence and user feedback strongly suggest that Android-based interactive media has the potential to enhance both cognitive and affective learning outcomes. While the results cannot be broadly generalized without further research, they make a compelling case for continued innovation in digital learning tools. When paired with thoughtful instructional support and equitable infrastructure, such media can serve as a powerful tool for improving the quality and inclusivity of education.

CONCLUSION

The findings of this research indicate that Android-based interactive learning media developed using Articulate Storyline 3 is effective in enhancing both conceptual understanding and learning motivation among junior high school students studying Computer Hardware. The experimental group, which utilized the developed media, showed a higher normalized gain score (0.77) compared to the control group (0.68), suggesting a stronger improvement in learning outcomes. Additionally, the experimental group experienced a notable increase in motivation, advancing from a "High" to a "Very High" category, while the control group remained in the "High" range. Expert validation further confirmed the media's quality, with high scores in both pedagogical and technical dimensions. Students responded positively to the media, particularly appreciating its visual design and ease of use. These outcomes demonstrate that integrating mobile technology into instruction, especially with interactive and visually rich features, can support meaningful learning experiences in complex and abstract subjects like Informatics.

RECOMMENDATION

Given the positive outcomes of this study, it is recommended that educators and curriculum developers consider adopting Android-based interactive learning media as part of instructional strategies, particularly in technical subjects that require strong conceptual understanding. The development of such media should be aligned with well-established pedagogical models, such as Discovery Learning, to maximize student engagement and

autonomy. Schools should also invest in teacher training focused on the design and use of digital learning tools to ensure effective classroom integration. Future research is encouraged to expand implementation across diverse educational settings to assess generalizability and address potential challenges related to infrastructure, digital literacy, and instructional consistency. Policymakers should support initiatives that promote mobile-based learning solutions, especially in underserved or rural areas, as a way to bridge gaps in educational equity and improve learning outcomes across student populations.

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