

Development of Android-Based Learning Media via "Smart Study" Application to Enhance IPAS Learning in Indonesian Primary Schools

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Received 15 March 2026, Revised 23 April 2026, Accepted 25 April 2026, Available online 28 April 2026

To link to this article: <https://doi.org/10.53797/ujssh.v5i2.17.2026>

Abstract: This study aims to develop and evaluate an Android-based learning media application, "Smart Study," designed for fourth-grade students studying Integrated Natural and Social Sciences (IPAS) in Indonesian primary schools. The study follows the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model to ensure a systematic product development process. The application integrates interactive learning elements such as texts, images, videos, and quizzes. Results showed that the media was rated "very interesting" in terms of content (mean score: 3.34), design (3.21), and language (3.36). Learning effectiveness was demonstrated through a significant difference in post-test scores between experimental (88.47) and control groups (79.82), with an N-gain score of 0.67 (medium category). These findings suggest that the Smart Study application is a feasible and effective tool for enhancing IPAS learning in elementary education.

Keywords: Android-based learning media, IPAS, Smart Study, primary education, ADDIE model

1. Introduction

The rapid advancement of digital technology has significantly transformed various sectors of society, including education. Digital technologies have created new opportunities for improving teaching and learning processes by providing more flexible, interactive, and student-centered learning environments. In primary education, there is an increasing demand for learning media that are not only accessible but also engaging, interactive, and capable of accommodating students' diverse learning needs. However, traditional instructional approaches, which often rely heavily on textbooks and teacher-centered explanations, frequently fail to encourage active student participation and meaningful learning experiences. As a result, students may experience reduced motivation and difficulties in understanding scientific concepts, ultimately affecting their learning outcomes (Hwang & Tsai, 2011; Sung et al., 2016).

In Indonesia, the Integrated Natural and Social Sciences (IPAS) subject was introduced through the Merdeka Curriculum to promote interdisciplinary learning that connects scientific knowledge, environmental awareness, and social understanding. The subject aims to help students develop critical thinking, problem-solving skills, and a deeper understanding of the relationship between humans and their environment. Despite its potential benefits, the implementation of IPAS continues to face several challenges. Preliminary observations and interviews conducted in elementary schools indicate that many teachers still depend primarily on printed textbooks and have limited access to innovative digital learning resources. Consequently, students often struggle to understand abstract scientific concepts and demonstrate limited enthusiasm toward learning activities, particularly in topics such as *Plants as a Source of Life on Earth*. Similar challenges have been reported in science education research, which highlights the need for instructional media capable of supporting conceptual understanding through meaningful and interactive learning experiences (OECD, 2019; Chiu et al., 2023).

One promising approach to addressing these challenges is the use of mobile learning (m-learning). Mobile learning refers to the utilization of mobile devices to facilitate learning anytime and anywhere, thereby extending learning opportunities beyond the traditional classroom setting. Among various mobile platforms, Android has become the most

widely used operating system globally and in Indonesia due to its accessibility, affordability, and open-source architecture. These characteristics provide substantial opportunities for educators and developers to create educational applications tailored to curriculum requirements and student characteristics. Previous studies have demonstrated that mobile learning applications can significantly improve students' academic achievement, motivation, engagement, and self-directed learning skills when educational content is presented through multimedia features such as animations, videos, interactive texts, and formative assessments (Sung et al., 2016; Crompton & Burke, 2018).

Furthermore, multimedia learning theory suggests that students learn more effectively when information is presented through multiple channels, including visual and verbal representations, rather than through text alone. The integration of images, audio, animations, and interactive activities can reduce cognitive load while enhancing learners' ability to construct meaningful knowledge structures (Mayer, 2021). Consequently, Android-based learning applications have considerable potential to improve science learning by providing students with engaging and interactive educational experiences that facilitate conceptual understanding and knowledge retention.

In response to these educational needs, this study developed an Android-based learning application entitled *Smart Study* to support fourth-grade students in learning IPAS content. The application was specifically designed to assist students in understanding the topic *Plants as a Source of Life on Earth* in accordance with the objectives of the Merdeka Curriculum. The development process employed the ADDIE instructional design model, which consists of five systematic stages: analysis, design, development, implementation, and evaluation. The ADDIE model has been widely recognized as an effective framework for developing educational products because it emphasizes iterative evaluation and continuous improvement throughout the design process (Branch, 2009).

In addition to developing the application, this study examined its effectiveness in improving students' learning outcomes and investigated teacher and student responses toward its implementation. Evaluating both effectiveness and user perceptions is essential for determining whether a digital learning medium is not only pedagogically effective but also practical and acceptable within real classroom contexts. Therefore, this study contributes to the growing body of research on mobile learning by providing empirical evidence regarding the use of Android-based applications to support elementary science education in Indonesia.

1.1 Conceptual framework

The conceptual framework for this study is grounded in the ADDIE instructional design model, which provides a systematic and iterative process for developing effective learning media. The model comprises five core stages: Analysis, Design, Development, Implementation, and Evaluation. This model is particularly suitable for educational technology development as it ensures that instructional products are learner-centered, goal-oriented, and continuously refined through feedback and assessment (Daryanto, 2020). In the context of this study, the ADDIE model guided the creation of the *Smart Study* application as follows:

1. Analysis identified student needs, curriculum requirements, and media constraints in the classroom.
2. Design involved structuring the content, user interface, learning flow, and integration of multimedia components (e.g., video, quizzes, images).
3. Development focused on coding the application, content production, and iterative validation with subject matter experts.
4. Implementation involved real-world testing in classroom settings.
5. Evaluation consisted of expert validation, user feedback, and learning outcome assessments through pre- and post-tests.

This framework is further supported by two key educational theories:

1. Constructivist Learning Theory

According to Piaget and Vygotsky, learning is most effective when students are actively involved in constructing knowledge through meaningful experiences. The *Smart Study* application aligns with this theory by allowing students to explore IPAS content interactively, promoting self-paced learning, discovery, and reflection.

2. Mobile Learning (m-Learning) Theory

M-learning emphasizes learning anytime and anywhere using mobile devices, making education more accessible and personalized. Android, being the most popular platform in Indonesia, provides a flexible and scalable solution for delivering rich educational content. The application supports ubiquitous learning by offering offline access, multimedia-rich lessons, and instant feedback through in-app quizzes.

Integrating ADDIE with constructivist and m-learning theories ensures that the *Smart Study* application not only delivers content effectively but also fosters critical thinking, autonomy, and motivation among primary school learners. This combination provides a strong theoretical and practical foundation for designing impactful digital learning tools in the Indonesian educational context.

ADDIE Model → Application Design → Constructivist Principles → Mobile Learning Features → Learning Outcomes.

1.2 Research Objectives

This study aims to design, develop, and evaluate an Android-based learning media application (*Smart Study*) to enhance IPAS (Integrated Natural and Social Sciences) learning among fourth-grade elementary students. The specific objectives are as follows:

1. **To analyze the feasibility** of the *Smart Study* application as a digital learning medium for IPAS, based on expert validation in terms of content, design, and language.
2. **To examine the effectiveness** of the application in improving student learning outcomes, as measured by pre-test and post-test scores and normalized gain (N-gain).
3. **To assess student and teacher responses** to the usability, attractiveness, and pedagogical relevance of the *Smart Study* application in classroom practice.

To implement the ADDIE model in the structured development of digital learning media, ensuring alignment with curriculum standards and constructivist learning principles.

2. Methodology

This research employed a Research and Development (R&D) approach using the ADDIE model, a well-established instructional design framework comprising five systematic stages: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model was selected for its comprehensive process in developing learning media that is both learner-centered and curriculum-aligned

2.1 Research design

The research followed the R&D method with a quantitative-qualitative mixed approach. The study was conducted over several phases, including expert validation, limited trials, field implementation, and student learning outcome assessment.

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The ADDIE model guided the development of the *Smart Study* application:

- **Analysis:** Conducted through interviews and observations in eight elementary schools in Grobogan Regency, Central Java. Teachers and students identified limited access to engaging IPAS media and reliance on textbooks.
- **Design:** Learning objectives were defined based on the national *Kurikulum Merdeka*. Content was structured to cover the IPAS topic “Plants as a Source of Life on Earth,” incorporating multimedia features including narration, interactive quizzes, video, and animations.
- **Development:** The prototype application was created using Android Studio and supported by multimedia design tools. It underwent validation by three experts: one content expert, one media expert, and one language expert. Revisions were made accordingly.
- **Implementation:** The final version of *Smart Study* was tested on two groups of fourth-grade students: an experimental group (using the app) and a control group (using conventional learning). The trials were conducted in real classroom settings.
- **Evaluation:** Involved expert validation scores, user response questionnaires, and analysis of students’ learning outcomes. A pre-test and post-test were administered to both groups. Learning gain was measured using the normalized gain (N-gain) formula.

2.2 Participant and Respondent

Participants consisted of 50 fourth-grade students from two elementary schools: 25 in the experimental class and 25 in the control class. Purposive sampling was used to select schools with similar academic levels and access to Android devices.

The respondents of this study consisted of two main groups:

1. Validation Experts

To ensure the quality and feasibility of the *Smart Study* application, three experts were selected through purposive sampling based on their academic background and expertise: **Content Expert:** A university lecturer specializing in IPAS (Integrated Natural and Social Sciences) education. **Media Expert:** A professional in educational technology with experience in mobile application design. **Language Expert:** A lecturer in Indonesian language education, focusing on readability and linguistic appropriateness for primary-level learners.

2. Elementary School Students and Teachers

The primary users of the application included: **50 fourth-grade students** from two public elementary schools in Grobogan Regency, Central Java, Indonesia. The students were divided into two groups:

Experimental Group (n = 25): Used the *Smart Study* application during IPAS lessons. **Control Group** (n = 25): Received instruction using conventional teaching methods (textbooks and lectures).

Two classroom teachers assisted in the implementation and provided feedback on the practicality of the application. The selection of student respondents employed **purposive sampling**, with consideration given to: Similar academic performance across groups, Availability of Android devices for the experimental class, Prior exposure to IPAS curriculum content. This distribution enabled a balanced comparison of learning outcomes and perceptions between groups using the developed application and those using traditional instruction. The research instruments used in the study was composed of two parts: multiple choice test items (Part I) and process skills checklist (Part II). The spiral curriculum of K12 program shows that science subjects specifically in the field of Physics, Chemistry, Biology and Environmental Science are taught within four quarters in each school year. For grade 8 science, Chemistry topics were offered during the third quarter.

2.3 Data Collection Instruments

- Expert Validation Sheets (Likert scale) for content, media design, and language.
- Student Questionnaires measuring ease of use, motivation, and content understanding.
- Pre-test and Post-test multiple-choice assessments based on the IPAS learning indicators.

2.4 Data Analysis

- Expert validation scores were analyzed descriptively using average score interpretation.
- Questionnaire responses were analyzed using percentage-based frequency distributions.
- Learning effectiveness was assessed using the N-gain score, categorized into low (<0.3), medium (0.3–0.7), and high (>0.7) gain levels.
- An independent sample t-test was used to compare the post-test results between experimental and control groups to determine statistical significance

3. Findings and Discussion

This study aimed to develop and evaluate the *Smart Study* Android application as a learning medium for Integrated Natural and Social Sciences (IPAS) in elementary education. The findings demonstrate that the application is pedagogically feasible, effective in improving student learning outcomes, and positively received by both students and teachers. These results contribute to the growing body of evidence supporting the use of mobile learning technologies to enhance science education in primary schools

3.1 Expert Validation Results

Prior to classroom implementation, the *Smart Study* application underwent a comprehensive validation process involving experts in content, media design, and language. The validation results indicate that the application meets high standards in terms of instructional quality, usability, and curriculum alignment. The language component received the highest evaluation score, suggesting that the vocabulary, sentence structure, and instructional guidance were appropriate for fourth-grade students. The content component also achieved a high rating, confirming that the materials accurately reflected the learning objectives of the *Plants as a Source of Life on Earth* topic within the Merdeka Curriculum. Although the visual design component obtained a slightly lower score, it remained within the “good” category, indicating that the interface was sufficiently engaging and user-friendly while still allowing room for future enhancement.

These findings highlight the importance of systematic instructional design and expert review during educational product development. According to Branch (2009), the design and development stages of the ADDIE model play a critical role in ensuring that instructional products are pedagogically sound and responsive to learner needs. Furthermore, multimedia learning research suggests that educational applications should balance content accuracy with attractive visual design to maximize learning effectiveness (Mayer, 2021). The high validation scores obtained in this study therefore indicate that the *Smart Study* application successfully integrates educational content with appropriate multimedia elements, making it suitable for elementary learners.

The positive evaluation from media experts is also consistent with previous studies on mobile learning applications. Hwang and Tsai (2011) reported that well-designed mobile learning environments enhance accessibility, engagement, and learning flexibility, particularly when educational content is presented through interactive and visually appealing interfaces. Consequently, the validation results provide strong evidence that the *Smart Study* application possesses the necessary pedagogical and technical qualities for classroom implementation.

Table 1. Expert Validation Results of the Smart Study Application

Aspect	Mean Score	Category	Interpretation
Content Quality	3.34	Very Good	Very Interesting
Visual Appearance	3.21	Good	Interesting
Language	3.36	Very Good	Very Interesting

3.2 Student Learning Outcomes

The effectiveness of the Smart Study application was evaluated through comparisons of pre-test and post-test scores between the experimental and control groups. The nearly identical pre-test scores observed in both groups indicate comparable baseline knowledge levels, thereby ensuring a fair comparison of learning outcomes. However, substantial differences emerged following the intervention. Students who used the Smart Study application achieved significantly higher post-test scores than those who participated in conventional instruction. Moreover, the experimental group demonstrated a considerably higher N-gain score, indicating greater improvement in conceptual understanding.

These findings suggest that the multimedia features embedded within the application, including interactive texts, instructional videos, visual illustrations, and formative quizzes, contributed positively to students' learning experiences. According to multimedia learning theory, students learn more effectively when information is presented through complementary verbal and visual channels rather than through text alone (Mayer, 2021). The integration of multiple forms of representation helps learners construct meaningful mental models while reducing unnecessary cognitive processing. Therefore, the superior performance of the experimental group can be attributed to the application's ability to facilitate deeper cognitive engagement with scientific concepts.

The findings also support constructivist perspectives on learning, which emphasize the importance of active learner participation in knowledge construction. Mobile learning environments provide opportunities for students to explore content independently, interact with learning materials at their own pace, and receive immediate feedback on their understanding. Such learning experiences promote meaningful learning and conceptual development (Crompton & Burke, 2018). Similarly, Sung et al. (2016), in a meta-analysis of mobile learning studies, concluded that integrating mobile devices into teaching and learning significantly improves student achievement across various educational contexts.

In addition, the topic addressed in this study involves scientific concepts that are often abstract for elementary students. Through the use of multimedia elements, the Smart Study application transformed these concepts into more concrete and understandable representations. Previous research has demonstrated that interactive digital media can improve science learning outcomes by visualizing complex phenomena and supporting inquiry-based learning processes (Chiu et al., 2023). Thus, the significant learning gains observed in this study reinforce the effectiveness of Android-based learning applications in elementary science education.

Table 2. Comparison of Pre-test and Post-test Scores

Group	Pre-test Mean	Post-test Mean	N-Gain	Category
Experimental Group	64.15	88.47	0.67	Medium
Control Group	63.88	79.82	0.43	Medium

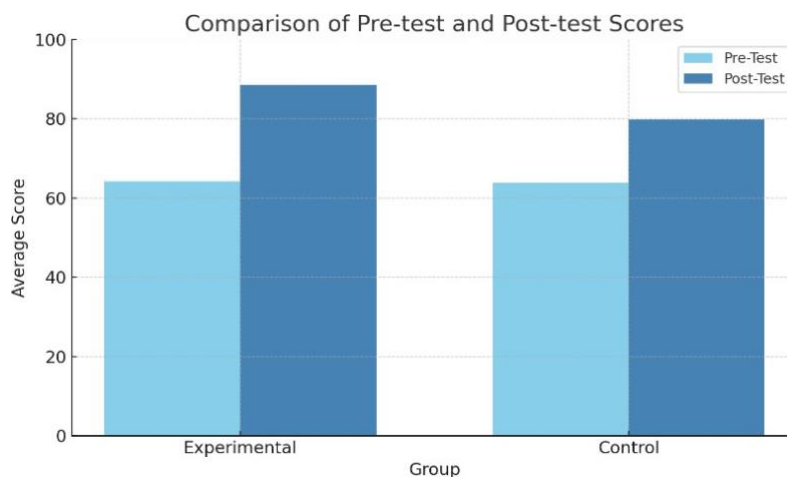


Figure 1. Comparison of pre-test and post-test scores

3.3 Student and Teacher Responses

Beyond academic achievement, the practical usability and acceptance of educational technology are essential factors influencing long-term implementation. The questionnaire results indicate that both students and teachers responded very positively to the Smart Study application. Most users reported that the application was easy to use, supported independent learning, and increased their interest in learning science.

The high level of perceived ease of use is particularly important because usability is a key determinant of technology acceptance in educational settings. If a digital learning tool is overly complex, students may become frustrated and disengaged. In contrast, intuitive interfaces enable learners to focus on content rather than technical difficulties. Previous studies have similarly found that user-friendly mobile learning applications contribute significantly to learner satisfaction and engagement (Crompton & Burke, 2018).

A particularly noteworthy finding is that most students believed the application supported independent learning. This result aligns with the core principles of mobile learning, which emphasize learner autonomy, flexibility, and self-regulated learning. Mobile learning technologies allow students to access educational resources at their own pace and according to their individual learning needs, thereby promoting greater responsibility for learning (Sung et al., 2016). The positive responses observed in this study therefore suggest that the Smart Study application successfully shifted the learning process toward a more student-centered approach.

The multimedia features embedded within the application also received highly favorable evaluations. Students reported that instructional videos improved their understanding of the subject matter, while quizzes increased motivation and enjoyment during learning activities. These findings support the argument that multimedia-rich learning environments can increase student engagement and reduce boredom by presenting information in dynamic and interactive ways (Mayer, 2021). Furthermore, immediate feedback provided through quizzes may strengthen learning by helping students identify misconceptions and monitor their progress.

Teachers likewise reported positive experiences with the application, particularly regarding its alignment with the objectives of the Merdeka Curriculum. The curriculum emphasizes student-centered learning, differentiated instruction, and the integration of technology into classroom practice. The Smart Study application supports these goals by providing flexible learning pathways, interactive content, and opportunities for independent exploration. Therefore, teacher feedback further confirms the practicality and pedagogical value of the application within contemporary elementary education.

Overall, the findings indicate that the Smart Study application is not only effective in improving student learning outcomes but also practical, engaging, and compatible with current educational reforms. The integration of mobile learning technology, multimedia content, and curriculum-aligned instructional design creates a meaningful learning environment capable of supporting both academic achievement and learner autonomy in elementary science education

Table 3. Student and Teacher Responses to Smart Study Application

Statement	Positive Response (%)
The application is easy to use	94%
The videos help in understanding the topic	91%
The quizzes are fun and motivating	87%
The design and images are attractive	89%
The application supports independent learning	92%

The user responses overwhelmingly reflect high satisfaction and strong pedagogical utility. A striking 94% of users found the application easy to use, which is a critical success factor for mobile learning (m-learning) in primary education. If a tool is too complex, it becomes a barrier rather than a facilitator. Moreover, 92% of respondents felt the application supported independent learning. This is a profound finding, as it indicates the app successfully shifts the instructional dynamic from teacher-centered to student-centered, empowering young learners to take charge of their own pacing. This strongly supports the findings of Arifin & Marzuki (2021), who highlighted mobile learning's unique capacity to foster learning independence.

Additionally, the integration of multimedia and gamified elements proved highly effective. With 91% agreeing that videos aided comprehension and 87% finding the quizzes fun and motivating, it is evident that the application effectively leverages intrinsic motivation. These responses validate the theoretical framework of m-learning and align with Wahyuni & Prasetyo (2022) and Mulyani (2019), who noted that interactive features like animated videos and immediate quiz feedback drastically reduce student boredom and increase active engagement in elementary science classes. Teachers also corroborated these data points in qualitative feedback, noting that the Smart Study app seamlessly

integrated with the Kurikulum Merdeka's demand for differentiated and context-rich instruction (Nursalim & Rachmawati, 2020; Setyawan, 2020).

4. Conclusions

This study successfully developed and evaluated an Android-based learning media application, Smart Study, for the Integrated Natural and Social Sciences (IPAS) subject in fourth-grade elementary education. The development followed the ADDIE model, which provided a structured process from needs analysis to final evaluation.

Key conclusions drawn from the findings include:

1. The Smart Study application received high validation scores from experts in terms of content quality (3.34), visual design (3.21), and language (3.36), indicating that it is pedagogically appropriate and user-friendly for primary students.
2. The application significantly improved student learning outcomes. The experimental group achieved a higher post-test average (88.47) compared to the control group (79.82), with an N-gain score of 0.67 (medium category), confirming the effectiveness of the media.
3. Student and teacher responses were overwhelmingly positive, with more than 90% of students stating that the application was easy to use, visually engaging, and helpful in understanding the IPAS material. Teachers highlighted its alignment with the curriculum and its potential to enhance classroom engagement.

These results validate the potential of mobile-based media as an effective instructional tool, especially in the context of Indonesia's evolving national curriculum and increasing access to mobile technology in schools.

5. Recommendations

1. **For Teachers:** Integrate mobile learning media such as *Smart Study* into IPAS lessons to enrich instructional delivery, foster student autonomy, and accommodate diverse learning styles.
2. **For Curriculum Developers:** Consider supporting the development of digital learning resources that align with the *Kurikulum Merdeka*, particularly for integrated subjects like IPAS, which require contextual and interdisciplinary approaches.
3. **For Future Researchers:** Conduct extended trials of the application across diverse geographic and socioeconomic school contexts to validate scalability and adaptability. Further enhancements such as gamification, augmented reality (AR), or voice narration may be explored to increase engagement.
4. **For Policymakers and Schools:** Provide support and infrastructure (e.g., device access, training, internet connectivity) to ensure equitable adoption of mobile learning media, particularly in rural and underserved areas.

Acknowledgement

The author would like to express sincere gratitude to the Muria Kudus University for support given.

Conflict of Interest

The authors declare there is no conflict of interest.

References

- Branch, R. M. (2009). *Instructional design: The ADDIE approach*. Springer. <https://doi.org/10.1007/978-0-387-09506-6>
- Chiu, T. K. F., Ismailov, M., Zhou, Q., & Au, O. T. S. (2023). Effects of mobile learning on students' learning performance: A meta-analysis. *Education and Information Technologies*, 28(7), 7933–7955. <https://doi.org/10.1007/s10639-022-11415-3>
- Crompton, H., & Burke, D. (2018). The use of mobile learning in higher education: A systematic review. *Computers & Education*, 123, 53–64. <https://doi.org/10.1016/j.compedu.2018.04.007>
- Hwang, G. J., & Tsai, C. C. (2011). Research trends in mobile and ubiquitous learning: A review of publications in selected journals from 2001 to 2010. *British Journal of Educational Technology*, 42(4), E65–E70. <https://doi.org/10.1111/j.1467-8535.2011.01183.x>
- Mayer, R. E. (2021). Evidence-based principles for how to design effective instructional videos. *Journal of Applied Research in Memory and Cognition*, 10(2), 229–240. <https://doi.org/10.1016/j.jarmac.2021.03.007>

- OECD. (2019). *PISA 2018 results (Volume I): What students know and can do*. OECD Publishing. <https://doi.org/10.1787/5f07c754-en>
- Sung, Y. T., Chang, K. E., & Liu, T. C. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. *Computers & Education, 94*, 252–275. <https://doi.org/10.1016/j.compedu.2015.11.008>