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Development of Android-Based Digital Books on the Diversity of Indonesian Society Integrating Science Concepts: A Bhinneka Tunggal Ika Framework

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Abstract: This study aimed to develop Android-based digital books on the diversity of Indonesian society, integrating science concepts within the Bhinneka Tunggal Ika framework. Using the Four-D R&D model—Define, Design, Develop, and Disseminate—the research produced a digital teaching material for Pancasila and Citizenship Education tailored to ninth-grade students. The content was validated by experts and tested in limited trials, showing that it meets educational standards and effectively supports student understanding of cultural diversity. The digital book integrates text, images, videos, and animations to create an engaging and interactive learning experience. It is designed to be accessible both in class and at home, promoting self-directed learning while fostering appreciation for Indonesia's multicultural identity. The findings show that this media enhances students' enthusiasm, motivation, and comprehension of diversity in the context of national unity. By combining technology with civic education, the digital book serves as an innovative tool to strengthen character values and promote harmony among diverse communities. This development contributes to modernizing teaching methods and making more relevant and impactful for today's digital-native generation.

Keywords: Android-based learning; Bhinneka Tunggal Ika; Digital books; Societal diversity

Introduction

Pancasila and Citizenship Education is a core subject in the Indonesian education system, mandated by the 2003 National Education System Law to instill national identity, democratic values, and civic responsibility. In line with the 2013 curriculum, aims to shape students' character based on Pancasila, laws, and societal norms. However, the current implementation of learning still largely relies on conventional methods such as lectures and question-and-answer sessions, which often result in passive student participation and limited engagement (Bavishi et al., 2022; Thwin & Lwin, 2018).

The lack of integration with technology and supporting media further hinders effective teaching and learning. One of the key topics in "The Diversity of Indonesian Society within the Framework of Bhinneka Tunggal Ika", which explores Indonesia's rich cultural, ethnic, linguistic, and religious diversity. This topic can be enriched through an interdisciplinary approach by integrating science (IPA) concepts such as environmental science, geography, biology, and technological literacy (Trefil & Hazen, 2016). For instance, understanding regional biodiversity, ecological balance, or scientific advancements in different parts of Indonesia can deepen students'

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appreciation for both natural and socio-cultural diversity.

Integrating science into learning not only enhances content knowledge but also fosters critical thinking and a more holistic perspective on unity in diversity. Technology-based learning materials, particularly Android-based digital books, offer flexible and interactive ways to engage students, making abstract concepts more tangible and relevant (Arifah et al., 2025; Basyiroh et al., 2024). These digital tools can present educational content in multimedia formats, allowing students to learn at their own pace and improving overall learning outcomes.

A preliminary study conducted at SMP Negeri 3 Tualang involving 29 Class IX students during the Odd Semester Mid-Year Assessment of the 2022–2023 academic year revealed that only 17.2% of students achieved scores above the minimum passing criteria (KKM), indicating significant learning difficulties. Further investigation through a questionnaire showed that 79.3% of students found the material difficult to understand, 65.5% considered printed textbooks too complex, and 72.4% reported that teachers relied heavily on lecture-based instruction due to limited technology use. Additionally, 93.2% of students had access to smartphones, suggesting readiness for digital learning solutions.

These findings highlight the urgent need for innovative, technology-driven teaching materials that integrate science concepts into learning instruction. Therefore, this research aims to develop an Android-based digital book that combines civic education with science learning, focusing on the theme of Indonesia's diversity under the principle of Bhinneka Tunggal Ika. By leveraging digital platforms and interdisciplinary content, this digital book seeks to enhance student engagement, improve comprehension, and strengthen the relevance of learning in the modern educational context.

Method

This research employed a Research and Development (R&D) approach to design and produce an Android-based digital book that integrates science concepts into the learning topic "The Diversity of Indonesian Society within the Framework of Bhinneka Tunggal Ika." The development process followed the Four-D model , which consists of four stages: Define, Design, Develop , and Disseminate (Ahmad et al., 2023; Jazuli et al., 2017; Rahman, 2020; Suganda et al., 2023).

This model ensures a systematic and comprehensive development process by aligning theoretical with practical application. In addition, the foundations Instructional Development Institute (IDI) model was also referenced to guide the development, which emphasizes a system-based approach through three key phases: define, develop, and evaluate (Damayanti et al., 2018; Saputri et al., 2020; Sulistyanto et al., 2022).

In the Define stage, a needs analysis was conducted to identify gaps in current teaching materials and learning methods, particularly regarding students' understanding of Indonesia's diversity and its scientific dimensions. This stage also included curriculum analysis, material mapping, and identification of science concepts that could be integrated—such as environmental diversity, regional biodiversity, and sustainable development principles.

The Design stage involved the creation of the initial prototype of the Android-based digital book. This included designing the interface, content structure, multimedia elements, and integration of science topics relevant to each sub-theme of Indonesia's diversity. The design was guided by both pedagogical principles and user experience standards for digital learning tools.

During the Develop stage, the digital book was built using appropriate software and platforms, incorporating interactive features such as animations, quizzes, videos, and simulations that link civic education with scientific knowledge. At this point, due to time constraints and other limitations, the research concluded at the development stage, without proceeding to full-scale dissemination or field testing (Japar et al., 2019; Wijaya & Vidianti, 2019). However, internal validation and expert review were carried out to assess the relevance, accuracy, and usability of the product before finalization.

By combining these two models—Four-D and IDI—the study ensured a structured and theoretically grounded approach to developing an innovative, interdisciplinary learning medium that enhances students' understanding of Indonesia's diversity from both civic and scientific perspectives, framed within the principle of Bhinneka Tunggal Ika.

Result and Discussion

The process of creating teaching material media for Pancasila and Citizenship Education is carried out by the development stages of Android-based teaching materials. The stages are as follows:

Stage Define (Determination)

Research and information gathering are the initial stages in developing android-based teaching materials (Dibaba, 2017; Mawati, 2022). At this stage of analyzing the needs for teaching materials, several analyses are

carried out, including curriculum analysis, student characteristics analysis, and concept analysis.

Curriculum Analysis

Curriculum analysis refers to the syllabus and lesson plans for Pancasila and Citizenship Education. The main materials developed in Android-based teaching materials are topics in the syllabus for Pancasila and Citizenship Education subjects. The indicators for competency achievement developed are work tools and teaching materials.

Analysis of Student Characteristics

Analysis of student characteristics is carried out before conducting classroom learning to see and understand the characteristics and environment of students. This analysis was carried out as a consideration for creating Android-based teaching material media in several aspects, namely: Determining User Requirements and Designing Android-based teaching material media for class IX students of SMP Negeri 3 Tualang.

The test subjects in this research were students in class IX of SMP Negeri 3 Tualang who were studying Pancasila and Citizenship Education subjects, generally, students had reached the age of 11 to 14 years (Hikmah et al., 2023; Larasati, 2022; Sulistyanto et al., 2022). At that age, students can analyze and make their hypotheses on a problem. Therefore, achieving this stage gives students the possibility to learn independently and in using learning technology students will be better off seeing and experiencing for themselves how the technology works through independent exploration rather than just being told by the teacher.

Defining Concepts

The concept analysis aims to determine the content and subject matter of Pancasila and Citizenship Education needed in developing this Android-based teaching material. The main concept in Android devices is that students can understand digital media, and visual interaction and understand the concept of Android-based teaching material media.

Stage Develop (Development)

At this stage the researcher designed an Android-based teaching material media through several stages, including:

Learning Media Design

Product Sketching

This stage is carried out by determining the concept of the learning media that will be built. Making product sketches is carried out based on the definition stage that has been carried out, then determining the media objects that will be used in developing Android-based teaching material media.

Media Design Creation

The design (design) stage of learning media is to create product appearance, style, and supporting object requirements for the product (Baring & Berame, 2022). Product specifications are made in the form of a general structure consisting of the following:

The Splash Screen page is the initial display of learning media when opened which contains an introduction to the Android-based teaching material media application on Android devices.

The Menu page consists of 5 sub-menus, namely: material menu, KI/KD menu, quiz menu, guide menu, and profile menu. Each submenu page will contain a display according to the submenu content.

Product Display

The following is the display form of the developed Android-based teaching material media product.

Splas Page

Figure 1. Initial display page of Android-based teaching material media

Figure 1 shows the initial appearance or cover of an Android-based digital book which provides information about the discussion in the Android-based digital book.

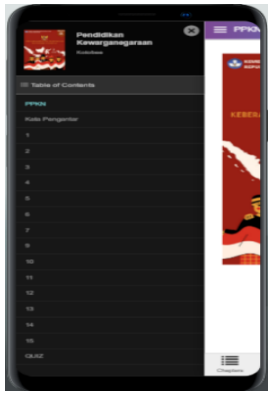

Figure 2. Menu display

Figure 2 Displays the Android-based digital book menu display which functions to show and direct students to be able to access the next page in the Android-based digital book.

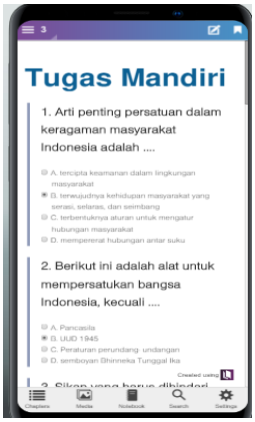

Figure 3. Display Quiz on Digital Books

Figure 3 shows the quiz display in the Android-based digital book, where students can then take the quiz directly and display the score according to the right and wrong answers directly in the digital book application. Video display on digital books which functions to display animated videos directly on digital books, which makes it easier for students to view and study videos related to the material discussed (Baring & Berame, 2022; Undari et al., 2022; Wardoyo et al., 2025).

Collecting data on the validity of learning media as a learning resource is done by using a questionnaire. In this case, the researcher gave questionnaires to 4 validators who would validate the learning media being developed, before carrying out validation tests on material experts and media as well as practicality tests on teachers and students, the questionnaire instruments used in the validation tests and practicality tests were tested for validity by experts. who understands questionnaire instruments, in this case, the validity test of the questionnaire instrument is adjusted to modify the grid (Kartini et al., 2020; Sudewa et al., 2021).

The questionnaire instrument that will be used in the validity test and practicality test is deemed fit to be used for research by the validator and can then be continued for material validation tests, as well as practicality tests. The first and second validators validate and evaluate the content (material) of the learning media, while the third and fourth validators provide an assessment of the design aspects of the learning media that are being developed.

The results of the assessment of each aspect of the indicators given to the validator are summed up and the percentage of the assessment according to the aspects that have been made is calculated. Material validation is summarized based on the validation categories assessed as shown in Table 3.

Table 3. Validator Assessment of Learning Media Materials

Indicator	Validity Results	category
Learning	0.87	Valid
Material	0.88	Valid
Average	0.87	valid

Based on Table 3, it can be seen from the results of validator 1 and validator 2 on learning material with learning and material indicators with values of 0.87 and 0.88 respectively with an average value obtained of 0.87, therefore the validator results are categorized (Kartini et al., 2020; Sudewa et al., 2021; Sukmawarti, 2021).

The validation of learning media is a validation of the results of the resulting product design (Nurhayati et al., 2019; Rahmaibu et al., 2016; Subiyantoro & Listyaningsih, 2020). The results of the design validation are summarized based on the validation categories assessed as shown in Table 4.

Table 4. Validator Assessment of Learning Media Design

Indicator	Evaluation	Category
Didactic Aspect	0.84	Valid
Construction Aspects	0.86	Valid
Technical Aspects	0.85	Valid
Average	0.85	Valid

From Table 4, the results of validator 1 and validator 2 regarding the learning media design obtained an average of 0.85 in the valid category. Based on Tables 3 and 4, it can be seen that the validation of the learning media is Valid, so it can be concluded that the learning media is in the category "Valid".

This study successfully developed an Android-based digital book as a teaching medium for Pancasila and Citizenship Education, integrating the theme of Indonesia's societal diversity with science concepts under the framework of Bhinneka Tunggal Ika. The development followed a systematic process consisting of three main stages: Define, Design, and Develop. In the Define stage, curriculum analysis, student characteristic analysis, and concept definition were conducted to ensure that the content aligned with educational standards and met students' learning needs. It was found that ninth-grade students, aged between 11–14 years, possess sufficient analytical skills to benefit from interactive and self-directed learning tools such as Android-based media. The design phase included creating product sketches, developing media interfaces, and structuring the application into key sections such as splash screen, menu page, quiz page, video display, and

guide/profile sections. These features were intended to enhance user experience and support diverse learning styles through multimedia integration.

The validation results showed high validity across both content and design aspects. Material validation by two experts yielded average scores of 0.87 and 0.88 for learning and material indicators respectively, while design validation achieved an average score of 0.85 across didactic, construction, and technical aspects. These outcomes indicate that the developed media is valid and suitable for use in classroom settings. These findings align with previous studies that have emphasized the effectiveness of mobile-based learning tools in enhancing student engagement and comprehension (Dibaba, 2017; Mawati, 2022). However, this research offers a novel approach by embedding cultural values and scientific concepts within a single digital platform, thereby promoting national identity alongside critical thinking.

The practical implications of this research are significant. Teachers can utilize the digital book as an alternative teaching resource that supports independent learning and increases student motivation. Moreover, the theoretical contribution lies in demonstrating how interdisciplinary approaches—combining social studies, science, and technology—can be effectively implemented in character education. Despite these strengths, the study has several limitations. The testing was limited to one school and a small number of validators, which may affect the generalizability of the results. Additionally, full implementation in real classroom settings has not yet been conducted, leaving some questions about its practical effectiveness. There is also a dependency on technological access, which might limit usability in areas with poor internet connectivity or limited device availability.

Alternative interpretations suggest that while the integration of science and cultural themes is innovative, further refinement could strengthen the depth of scientific concepts presented. Some validators noted that certain topics appeared superficial and could benefit from more detailed explanation. Therefore, future research should expand the scope of testing across different regions, conduct full-scale classroom implementations, and explore ways to deepen the scientific content. Enhancing interactivity through gamification, collaborative features, and adaptive feedback systems could also improve the learning experience. Overall, this research provides a promising foundation for the development of culturally relevant, technology-enhanced educational materials that promote unity in diversity through a modern pedagogical lens.

Conclusion

This study successfully developed an Android-based digital book focused on the diversity of Indonesian society, integrating science concepts within the framework of Bhinneka Tunggal Ika . The research concludes that the integration of technology in education is essential in the current era, particularly through interactive and accessible learning media such as Android-based digital books. The developed product serves as an innovative teaching tool for Pancasila and Citizenship Education tailored to ninth-grade junior high school students. It has been designed to align with curriculum requirements and student characteristics, offering an engaging, user-friendly platform that supports both classroom instruction and independent learning. The findings indicate that this digital learning medium is appropriate and effective for educational use, as it enhances student engagement, motivation, concentration, and interest during the learning process. By presenting content in a visually appealing and interactive format, the digital book enables teachers to deliver material more effectively while fostering a deeper understanding of Indonesia's cultural diversity through a scientific lens. This approach not only facilitates knowledge acquisition but also strengthens students' appreciation of unity in diversity, in line with the Bhinneka Tunggal Ika philosophy. The development of such media represents a valuable contribution to modernizing civic education and making it more relevant and impactful for today's tech-savvy generation.

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