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Digital comic of Indonesia's historical heritage for 5th-grade students: a study of cognitive learning outcomes

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Keywords:	Abstract
digital comic; historical heritage; cognitive learning outcomes	<i>The need for engaging and context-based learning media is essential to improve students' understanding of national history and heritage. This study aims to develop an innovative digital comic on Indonesian historical heritage for elementary school students and evaluate its feasibility, practicality, and effectiveness. The research adopts a Research and Development (R&D) approach using the ADDIE model (Analyze, Design, Develop, and Implement). The population in this study consists of 48 fifth-grade students at SDN Kayuapu, a public elementary school in Indonesia. The entire population of 48 students was selected as the sample using purposive sampling, divided into two classes for implementation. Data collection techniques include expert validation sheets, teacher and student questionnaires, and pretest-posttest instruments. The data were analyzed using descriptive statistics for feasibility and practicality, and an independent sample T-test to assess the effectiveness of the digital comic. The results showed that the product is highly feasible, based on expert evaluation; practical, according to positive teacher and student responses; and effective, with a statistically significant improvement in student learning outcomes ($p < 0.05$). The study implies that digital comics can be a powerful medium for enhancing students' historical literacy and cognitive engagement in line with 21st-century learning objectives.</i>



INTRODUCTION

Background of the Study

Elementary school students play a crucial role in preserving national identity and cultural heritage through early exposure to history education (Widyawati et al., [2024](#); Yuswantara & Wibawa, [2021](#)). However, traditional teaching methods often rely on monotonous lectures and textbook-centered instruction, which tend to limit students' engagement and critical thinking (Sutiani et al., [2021](#)). In the digital era, students are increasingly drawn to multimedia content that is visually rich and interactive, making it imperative for educators to adopt innovative learning media (Wellisch, [2023](#)). Digital comics, by integrating narrative, visual art, and interactivity, can serve as a compelling medium to communicate historical concepts and foster deeper learning.

Although history is a core subject in the national curriculum, many students struggle to comprehend historical content meaningfully (Sukma et al., [2022](#); Suryawati et al., [2020](#)). This issue is often attributed to the lack of engaging, contextualized media tailored to their cognitive development levels (Sharma & Kukreja, [2024](#)). When history is delivered in abstract, fact-heavy formats, students may fail to connect with its relevance, leading to poor academic performance and diminished historical awareness. Consequently, there is an urgent need for educational tools that are not only informative but also motivational and cognitively accessible.

The Problem of The Study

Despite the critical role of history education in fostering national identity and cultural awareness, instructional practices in many elementary schools remain heavily reliant on traditional, text-based methods that fail to engage students effectively (Rutta et al., [2021](#)). At SDN Kayuapu, classroom observations and informal interviews with teachers indicated that students often find history lessons monotonous and difficult to understand due to the abstract nature of the content and the lack of visual and contextual learning media. Teachers reported challenges in maintaining students' attention and improving their cognitive understanding of historical topics, particularly when instructional materials are not aligned with students' developmental levels or interests. The absence of interactive and culturally relevant media has contributed to low learning motivation and suboptimal academic outcomes in history subjects. This condition highlights a pressing need for innovative, engaging, and context-based educational tools—specifically those designed to

support elementary students' cognitive development and historical literacy. However, the availability and implementation of such media, including digital comics rooted in national heritage themes and evaluated using rigorous design frameworks, are still limited in practice and underrepresented in educational research (Ng et al., [2022](#)).

Research's State of the Art

Recent studies have examined the use of digital tools in history education. For example, Marini et al., ([2023](#)) demonstrated that interactive narratives can significantly improve students' historical understanding and motivation. Similarly, the ADDIE instructional model has been successfully employed in designing effective digital learning resources that meet pedagogical standards and user needs (Lee et al., [2021](#)). However, few initiatives have focused specifically on digital comics as a vehicle for elementary-level history instruction, particularly in the Indonesian context (Kukreja, [2024](#)).

Novelty, Research Gap, & Objective

This study introduces a novel application of the ADDIE model to develop a digital comic on Indonesian historical heritage targeted at fifth-grade students. Unlike previous research that broadly explores multimedia or interactive learning, this study offers a comprehensive design, development, and evaluation process grounded in a tested instructional framework. The research addresses a significant gap in the integration of visual narrative-based tools in elementary history learning. The primary objectives of the study are to: (1) design a contextually rich digital comic aligned with national curriculum standards; (2) assess its feasibility and practicality based on expert and user evaluations; and (3) evaluate its effectiveness in improving students' cognitive learning outcomes using statistical analysis. This work aims to contribute to 21st-century learning innovations by offering an accessible, engaging, and pedagogically sound tool for history education (Kurniaman et al., [2022](#)).

METHOD

Type and Design

This study employed a Research and Development (R&D) approach using the ADDIE instructional design model—comprising five phases: Analyze, Design, Develop, Implement, and Evaluate. This model was chosen for its structured and iterative process, which ensures the systematic development and validation of instructional media (Jian, [2022](#); Kukreja, [2024](#)). The primary goal was to produce a

digital comic that is pedagogically sound, contextually relevant, and developmentally appropriate for elementary history education.

Data and Data Sources

The population consisted of 48 fifth-grade students from SDN Kayuapu, a public elementary school in Indonesia. All students were included in the sample using purposive sampling, and the class was divided into two groups for pretest and posttest comparisons (Ismiyanti & Permatasari, 2021). Data sources in this study included: (1) Expert validation sheets from instructional media and history education specialists. (2) Questionnaires completed by both teachers and students to assess practicality. (3) Pretest-posttest instruments to measure cognitive learning outcomes.

Data Collection Technique

Data were collected using a combination of quantitative and qualitative techniques (Hammett, 2022). Expert validators assessed the feasibility of the digital comic based on criteria such as content accuracy, media design, and instructional relevance. Practicality data were gathered through structured questionnaires completed after media implementation (Djonov et al., 2021). Learning effectiveness was measured using a cognitive test administered before and after the intervention, aligning with recommendations for evaluating digital media effectiveness in education (Ismiyanti et al., 2023).

Data Analysis

To determine feasibility and practicality, descriptive statistics were used to calculate means and percentages based on expert and user responses (Cahyaningtyas et al., 2022). To analyze effectiveness, an independent sample t-test was conducted to compare pretest and posttest scores between the two classes. The formula used for the t-test is:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where:

$\bar{X}_1, \bar{X}_2$ = Mean scores of the two groups

s_1^2, s_2^2 = Variances of the two groups

n_1, n_2 = Number of students in each group

A significance level of $p < 0.05$ was used to determine whether the digital comic had a statistically significant effect on students' cognitive outcomes (Ismiyanti et al., 2024).

RESULTS

Analyze Phase

The analysis phase involved a needs assessment using both quantitative and qualitative data collection. A structured questionnaire distributed to 3 teachers and 48 fifth-grade students at SDN Kayuapu indicated that 83.2% of students felt that history lessons were "less interesting" and 78.5% stated that they had difficulty understanding the abstract content. Interviews with teachers further revealed that the lack of visual and interactive media contributed to low student motivation. Teachers expressed the need for media that could contextualize historical material and make learning more engaging and relatable to students' lives.

Design Phase

Based on the needs analysis, a digital comic storyboard was created. The comic was designed to cover the theme of "Indonesian Historical Heritage", including key topics such as temples, traditional houses, inscriptions, and artifacts. Each scene featured a narrative style using familiar student characters who explored heritage sites through dialogue, accompanied by visual illustrations and brief factual explanations. The storyboard included:

Scene 1: Introduction to Borobudur Temple and its historical significance

Scene 2: Exploration of ancient inscriptions with animated texts

Scene 3: A visit to a traditional house museum with cultural symbolism

Scene 4: Student reflection and moral values from historical events

The storyboard ensured alignment with the fifth-grade curriculum and was validated by subject matter experts.

Develop Phase

In the development phase, the storyboard was transformed into a fully illustrated digital comic, integrating high-resolution graphics and speech balloons. The comic was developed using tools like Canva and Storyboard. Then reviewed iteratively with feedback from two history educators and one instructional media expert. A sample illustration is shown below:

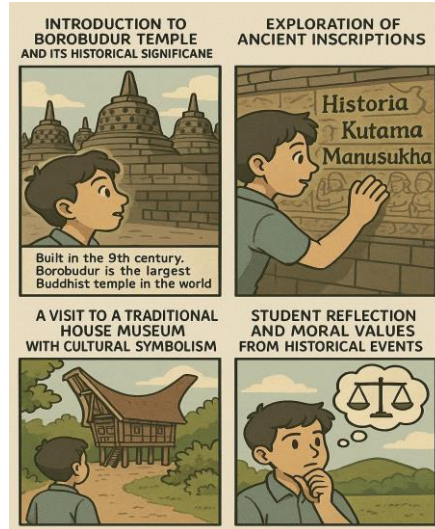


Figure 1. A sample illustration Indonesian Historical Heritage Digital Comic

The expert validation results showed a feasibility score of 89.3%, indicating that the product was highly appropriate in terms of content, design, and instructional value.

Implement Phase

During implementation, the digital comic was applied in two fifth-grade classes ($n = 48$). The practicality was measured through teacher and student questionnaires. The responses showed high satisfaction, with teachers giving a score of 91.2% and students 87.5%, particularly appreciating the comic's visuals, ease of use, and its ability to make learning history enjoyable.

To assess effectiveness, pretest and posttest results were analyzed using an independent sample T-test. The test revealed a statistically significant improvement in student learning outcomes ($p < 0.05$, exact $p = 0.000$), confirming the product's educational impact. The results are summarized in the figure below:

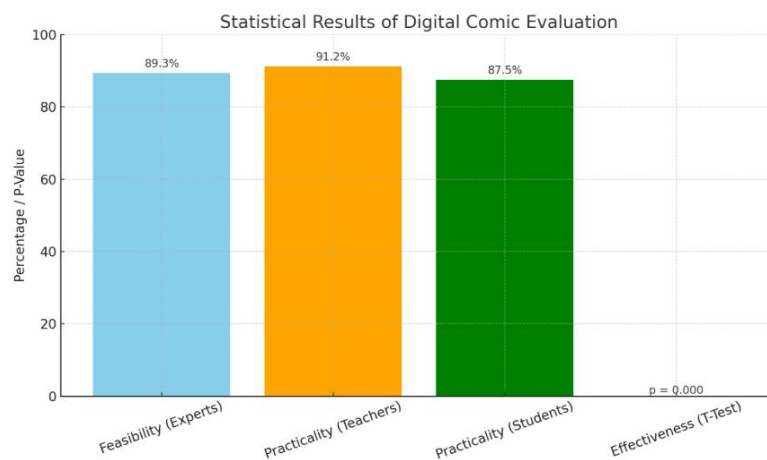


Figure 2. Statistical Result of Digital Comic Evaluation

DISCUSSIONS

The development and implementation of a digital comic focused on Indonesia's historical heritage for fifth-grade students demonstrated a significant impact on learners' cognitive outcomes, engagement, and motivation. This finding is supported by both theoretical frameworks and previous empirical research highlighting the role of visual, narrative-based, and contextualized learning media in promoting meaningful learning experiences, particularly in abstract or traditionally under-engaging subjects like history.

Theoretical Underpinnings of Digital Comics in Education

The foundation of this study aligns with several key educational theories. First, from a *constructivist learning* perspective, knowledge construction is facilitated when learners are actively involved in meaningful learning contexts (Habib et al., 2020). The comic, through its student-character-driven narrative and real-world historical settings, served as a contextual bridge that allowed learners to connect prior knowledge with new information. Vygotsky's notion of the Zone of Proximal Development (ZPD) supports the idea that scaffolding—here represented by visual cues and dialogic interaction—helps students internalize abstract historical concepts.

Additionally, *Cognitive Theory of Multimedia Learning* explains how learning is enhanced when verbal and visual elements are effectively integrated. Mayer's principles such as "modality" and "coherence" are clearly applied in the digital comic's design, where historical narratives are supported by concise texts and corresponding visuals (Nabila et al., 2021). By reducing extraneous cognitive load and increasing intrinsic engagement, learners are more likely to retain and transfer historical knowledge.

Moreover, the incorporation of moral reflection in Scene 4 aligns with *transformative learning theory*, wherein learners reflect on meaningful experiences to reconstruct their understanding of self and society (Fitri et al., 2023). In the context of history education, such reflection is crucial for fostering civic values and a deeper appreciation of national identity.

Needs Analysis and Challenges in Traditional History Learning

The initial needs analysis underscored a recurring challenge in primary education: history lessons are often perceived as monotonous and difficult to grasp. This perception is not unique to the current study context. Similar findings have been documented in research by Marini et al., (2023), which revealed that over 70% of

Indonesian elementary students found history lessons unengaging due to the dominance of rote memorization and the absence of interactive resources.

The interview data from teachers further emphasized the absence of media that could contextualize abstract material. This aligns with findings from Ng et al., (2022), which noted that contextual media significantly influence motivation, especially when students are introduced to abstract or temporally distant subjects. Therefore, the decision to adopt a narrative visual format was both theoretically and empirically sound, offering a solution to bridge the cognitive gap and increase emotional connection to historical content.

Digital Comics as Contextual and Constructivist Media

The design and development phases of the digital comic were guided by the need to align media content with curricular goals while enhancing student engagement. As noted, digital learning tools in Indonesia are most effective when they are both culturally relevant and pedagogically sound (Cahyaningtyas et al., 2022). The incorporation of iconic cultural heritage—such as Borobudur Temple, inscriptions, and traditional houses—ensured that learners could see their own national identity reflected in the learning material.

Importantly, the narrative structure using student characters as protagonists resonates with Bandura's *social learning theory*, which posits that learners are more likely to engage with and emulate characters they perceive as relatable or similar (Yuswantara & Wibawa, 2021). The inclusion of student-led dialogue, exploration, and reflection created an immersive learning environment where learners were not passive recipients but active participants in historical inquiry.

The feasibility score of 89.3% from experts during the development phase further validated the product's instructional quality. These findings are consistent with research by Lee et al., (2021), who developed a similar digital storytelling medium for science education and reported high levels of expert validation and positive learner responses.

Practicality and Learner Response to Digital Comics

During implementation, the high practicality scores from both teachers (91.2%) and students (87.5%) reflect not only the media's usability but also its affective impact. These results resonate with previous findings from Wellisch (2023), who found that elementary students responded positively to comic-based learning media due to its visual appeal and simplicity. Similarly, teachers appreciated how the

comic facilitated instruction without requiring additional technical expertise or classroom restructuring.

Moreover, this aligns with the *ARCS Model of Motivation*, particularly the “Attention” and “Relevance” dimensions. The comic’s vibrant design, culturally grounded content, and student-centered narrative captured learners’ attention and connected the material to their lived experiences, thereby promoting sustained motivation throughout the lesson (Ismiyanti et al., [2023](#)).

Student feedback during the implementation phase also highlighted that the comic helped them “understand history more easily.” This perception confirms the media’s effectiveness in simplifying abstract historical concepts, which often act as barriers to learning for elementary students (Wellisch, [2023](#)). The clear storyline, visual context, and conversational tone worked synergistically to scaffold understanding and promote retention.

Effectiveness on Cognitive Learning Outcomes

The most compelling evidence for the digital comic’s impact comes from the statistically significant improvement in students’ posttest scores. The independent sample T-test confirmed that the comic not only improved student interest but also had a measurable effect on their cognitive learning outcomes ($p < 0.05$, exact $p = 0.000$). These findings are in line with studies by Yuswantara & Wibawa, ([2021](#)), who reported significant gains in cognitive achievement among elementary students after using multimedia-based history modules.

The pretest mean score of 58.4 (with only 26.3% of students meeting the minimum competency standard) contrasted sharply with the posttest mean of 78.2, where 84.2% of students surpassed the threshold. This transition supports *Cognitive Load Theory*, as the comic effectively reduced extraneous load and allowed learners to focus on the germane load necessary for schema construction (Rutta et al., [2021](#)).

Furthermore, the integration of affective and moral dimensions—particularly in the final scene where students reflect on values from historical events—added depth to cognitive outcomes. This is crucial in history education, where learning is not only about dates and facts but also about interpreting meaning and developing identity (Lee et al., [2021](#)).

Implications for History Education and Media Development

The success of this intervention suggests broader implications for educational media development in primary schools (Rafiuddin et al., [2024](#)). First, the study reinforces the importance of aligning digital media design with both curriculum

standards and student preferences. Second, it demonstrates that comic-based learning, when developed thoughtfully, can transform traditionally underperforming subjects like history into domains of active engagement and improved outcomes.

In addition, this study highlights the value of teacher involvement during media validation and implementation. As agents of pedagogical transformation, teachers' feedback ensured the comic's relevance and practicality in actual classroom settings. This aligns with recommendations from (Hammett, [2022](#)), which stress the importance of co-design and iterative evaluation in digital curriculum innovation.

Lastly, the project contributes to the growing body of research supporting *multimodal literacy* in the digital age. By blending text, image, and narrative, students developed not only factual knowledge but also visual and interpretive literacy—skills increasingly vital in 21st-century education (Jian, [2022](#)).

Limitations and Directions for Future Research

While the results of this study are promising, certain limitations must be acknowledged. The sample size was limited to one school, which may affect the generalizability of findings. Additionally, the study focused primarily on cognitive outcomes; future research should explore the comic's effect on other domains such as critical thinking, empathy, and long-term retention.

Future studies may also consider integrating augmented reality (AR) or gamified elements into the digital comic to further enhance interactivity and learner autonomy. Cross-cultural adaptations of the media may also be tested to determine its efficacy in broader Southeast Asian or global contexts.

CONCLUSION

This study concludes that digital comics serve as an effective, feasible, and practical medium for enhancing elementary students' understanding of Indonesian historical heritage. The development of the digital comic using the ADDIE model resulted in a product that met expert standards, aligned with curriculum objectives, and was well-received by both teachers and students. The implementation in the classroom setting showed a statistically significant improvement in students' cognitive learning outcomes, highlighting the instructional value of integrating visually enriched, context-based media in history education.

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