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NARAJUANG: Diorama Of Struggle Of November 10, 1945 Based On Augmented Reality To Develop Digital Literacy

Izzatul Fajriyah, Muhammad Ega Firmansyah, Satria Febri Putra Abimanyu, Erma Nur Jannah, Syahrani Granita Putri Nadwan, Afsari Indah Moekti

Fakultas Ilmu Sosial dan Ilmu Politik, Universitas Negeri Surabaya

Abstract

This study aims to develop a history learning media based on Augmented Reality (AR) technology entitled NaraJuang: The 10 November 1945 Struggle Diorama to improve students' digital literacy and strengthen nationalism values. The research employed a Research and Development (R&D) method using the ADDIE model, which includes analysis, design, development, implementation, and evaluation stages. The developed product is a digital diorama application featuring interactive historical content, three-dimensional visualization, audio narration, and user-driven exploration. Expert evaluation indicated that the media met feasibility requirements, and its implementation demonstrated improvements in digital literacy competencies, learning motivation, student engagement, and historical understanding. The use of immersive visualization and interactive narration encouraged learners to construct meaning, reflect on historical context, and recognize the relevance of national heritage in the digital era. This finding highlights the potential of AR-based media to support higher-order thinking skills, particularly in history learning, where contextualization, interpretation, and emotional connection are essential. The study concludes that NaraJuang serves as an effective and innovative learning media that is contextual, interactive, and aligned with twenty-first-century educational demands.

Keywords: Narajuang; Diorama, Struggle of November; Digital Literacy

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*Corresponding author:

Email: izzatulfajriyah@unesa.ac.id

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INTRODUCTION

History learning in secondary education often faces the challenge of low student engagement. Many learners perceive history as a memorization-heavy subject disconnected from their everyday lives, resulting in minimal motivation and passive participation. This condition reinforces a teacher-centered approach and limits opportunities for students to develop digital literacy skills essential for navigating historical information in contemporary contexts.

The rapid advancement of educational technology offers potential solutions to improve the quality of history instruction. One of the emerging innovations is Augmented Reality (AR), a technology that overlays virtual objects onto the real environment, enabling users to interact with digital content in immersive ways. Although AR has demonstrated the capacity to enhance visual comprehension, motivation, and retention across science and visual-arts subjects, its development in history education in Indonesia remains limited and largely centered on content visualization rather than measuring its impact on students' digital literacy competencies.

The research gap identified in this study lies in the absence of AR-based media that explicitly integrates local Indonesian historical content with 21st-century digital literacy indicators, alongside empirical testing of its pedagogical impact. Existing AR studies rarely examine students' capacity to access, evaluate, and reproduce historical information in digital formats, leaving a critical dimension of digital history learning unexplored.

The selection of the November 10th, 1945 Battle of Surabaya as the thematic focus is not solely based on its nationalist value, but also because the event possesses strong geographical, emotional, and cultural relevance for learners in East Java. Moreover, this historical moment contains tangible artifacts, spatial narratives, and battlefield dynamics that can be effectively reconstructed through AR, enabling students to experience historical interpretation beyond textual narration.

Grounded in this context, the present research develops the AR Diorama of the November 10th, 1945 Surabaya Battle as a digital learning medium aimed at enhancing students' digital literacy through interactive engagement with localized historical content. The operational hypothesis of this study posits that the use of the AR Diorama significantly improves students' digital literacy, as evidenced by measurable increases in pre-test and post-test scores across validated digital literacy indicators.

LITERATURE REVIEW

Digital Literacy Framework

Digital literacy is widely recognized as one of the core competencies required in twenty-first-century education. Ng (2021) defines digital literacy as a multidimensional competence that includes technical, cognitive, and socio-emotional skills required to interact with digital resources meaningfully. Gilster (2022) similarly refers to digital literacy as the ability to critically interpret and evaluate online information rather than merely operate digital devices. Compared to Ng whose framework emphasizes balanced skill development, Gilster highlights the evaluative aspect, positioning digital literacy as a form of intellectual judgement rather than technical fluency.

Several international frameworks attempt to standardize digital competence measurement. Among them, the DigComp 2.2 (European Commission, 2022) framework is widely adopted due to its structured indicators across five dimensions: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving. Unlike conceptual definitions that remain abstract, DigComp provides measurable descriptors that can be translated into assessment instruments, making it relevant for evaluating educational interventions. In this study, DigComp functions both as a theoretical foundation and as an operational instrument used to assess students' digital literacy development during the implementation of NaraJuang.

History Learning Theory

History education plays a crucial role in shaping national identity, collective memory, and the ability to reason historically. Barton and Levstik (2021) argue that meaningful history learning requires students to engage in inquiry, source evaluation, and interpretive reasoning rather than memorization of chronological facts. Meanwhile, Seixas and Morton (2013) introduce "historical thinking concepts"

such as evidence, continuity-change, and ethical dimensions, which enable learners to understand history as a discipline rather than a narrative record. Compared to Barton and Levstik's emphasis on interpretive dialogue, Seixas and Morton offer a structured model that operationalizes historical reasoning into learning indicators.

Marwick (2019) extends this discourse by asserting that digital technology has transformed how historical information circulates, requiring learners to evaluate digital historical narratives critically. This position contrasts earlier theories that were rooted in textbook-based pedagogy, showing a paradigm shift where historical literacy intersects with digital literacy. In this research, these theoretical perspectives inform the design of learning tasks in NaraJuang, where students are guided not only to explore historical content but also to interpret the narrative, evaluate its credibility, and connect it to broader national identity formation.

Augmented Reality in Education

Augmented Reality (AR) has gained increasing attention as a learning technology capable of enhancing immersion and contextual engagement. Ibáñez and Delgado-Kloos (2018) report that AR improves motivation and conceptual retention in STEM-based learning environments due to multimodal sensory stimulation. However, Garzón and Acevedo (2020) argue that AR alone does not guarantee learning gains; its effectiveness depends on pedagogical alignment, scaffolding, and task-based interaction. This contrast demonstrates a shift from technology-driven to pedagogy-driven AR research.

Within the domain of history education, AR offers more than visual enrichment. Tomić et al. (2021) demonstrate that AR can activate emotional engagement and empathy toward historical actors, dimensions that traditional learning resources rarely achieve. This aligns with Paivio's dual-coding theory, where information presented in both verbal and visual formats enhances cognitive processing and memory retention. Based on these considerations, AR in this study is positioned not merely as a display tool, but as an experiential medium that supports inquiry, interpretation, and affective connection to historical events.

Previous Studies on AR in Historical Contexts

A number of empirical studies support AR's potential in history learning, although they vary in scope and methodological rigor. Prameswari and Sugihartono (2022) found that AR increased historical retention and student motivation, yet their research did not address whether learners developed critical digital competencies. Dianti et al. (2023) developed AR-based history modules for elementary education, but their findings remained limited to descriptive usability feedback rather than deeper learning impact. Compared to these studies, the present research expands the analytical scope by integrating literacy assessment and historical thinking as learning outcomes.

Hermawan et al. (2021) designed an AR history book focused on national heroes, offering early evidence that AR can support contextual understanding. However, unlike Hermawan's content-linear model, this study employs an exploratory interaction design where users navigate narrative sequences, evaluate digital elements, and reflect on meaning. This approach aligns AR with inquiry-based learning rather than static content presentation.

Synthesis and Conceptual Positioning

Synthesizing the literature reveals three converging ideas:

1. Digital literacy requires measurable competencies that extend beyond device operation (Ng, DigComp).
2. History learning must foster reasoning, interpretation, and identity formation, not memorization (Barton, Seixas, Marwick).
3. AR is effective when positioned as a pedagogical system rather than an isolated digital tool (Garzón, Tomić).

Based on this synthesis, the conceptual position of this research is that AR can function as an integrative medium that supports both digital literacy development and historical thinking. The design of NaraJuang therefore draws from DigComp for competence evaluation, historical thinking theory for instructional structure, and AR learning design principles for interactive experience planning.

RESEARCH METHODS

This research uses the Research and Development (R&D) method with the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model. This model was chosen because it is in accordance with the research objective, which is to produce Augmented Reality (AR)-based history learning media that is valid, practical, and effective in improving students' digital literacy.

1. Subject and Characteristics of Research

The research was carried out in one of the public high schools in Sidoarjo Regency with 30 students in class XI Social Studies. The characteristics of the participants were obtained through an initial questionnaire which included age, gender, and basic digital literacy skills, especially in the aspects of using gadgets, multimedia applications, and online learning resources.

Component	**Description**
Research location	State High School in Sidoarjo, East Java
Participants	30 students of class XI social studies
Gender	16 females, 14 males
Age	16–17 years old
Early digital competencies	Can operate gadgets, but is not used to evaluating digital information and creating content products
Expert validators	1 history materialist, 1 learning media member

2. Research Instruments

The instruments used include:

1. Expert Validation Questionnaire to assess the quality of media from the aspects of content, appearance, interactivity, and pedagogical suitability.

2. The Digital Literacy rubric is based on the DigComp 2.2 indicators, including *information and data literacy, communication and collaboration, digital content creation, safety,* and *problem solving*.

3. Pre-Post test to measure the impact of media on increased historical understanding.

Media Validation Assessment Rubric

Aspects	Indicators	Scale
Material	Historical accuracy, relevance of basic competencies	Likert 1–5
Display	Aesthetics, readability, clarity of navigation	Likert 1–5
Interactivity	Ease of use, responsiveness of AR features	Likert 1–5
Pedagogical suitability	Supports learning objectives & HOTS	Likert 1–5

Eligibility categories: 0–20 = not eligible, 21–40 = less eligible, 41–60 = eligible, 61–80 = very eligible.

3. Research Procedure

The development procedure follows ADDIE stages:

Phase	Main Activities	Proof
Analysis	Observation of historical learning, analysis of students' digital literacy	Questionnaire & interview
Design	Compile storyboards, historical narratives, AR markers	Draft UI & narrative
Development	Creating AR apps using Unity and Vuforia	Prototype
Implementation	Limited trial, pre-test, post-test, observation	Student learning outcomes
Evaluation	Expert validation, instrument reliability, final revision	NaraJuang's final product

4. Validity and Reliability Techniques

Validity

Content validity is performed by two expert validators using the Likert instrument. The total score is converted to an eligibility percentage:

$$Validitas = \frac{Core\ Obtained}{Maximum\ Score}\ x\ 100$$

The ≥ category of 80% was declared very feasible.

Reliability

Reliability is calculated using Cronbach's Alpha:

$$\alpha \quad = \frac{k}{k-1}\left(1 - \frac{\sum \sigma^2 \, total}{\sigma^2 total}\right)$$

The instrument is declared reliable if **the α ≥ value is 0.7**.

5. Data Analysis

1. Quantitative descriptive: used to describe expert validation scores and participant characteristics.

2. Pre-post comparative test: using a paired sample t-test to see the significance of differences in learning outcomes after the use of NaraJuang.

3. Qualitative analysis: carried out on observation data of student learning activities.

6. Ethical Considerations

The research was conducted by paying attention to the ethics of educational research as follows:

- Participants are given information on research objectives and approval
- The identity of the student is kept anonymous.
- Data is used only for academic purposes.
- The media is tested without coercion in the learning process.

RESULTS AND DISCUSSION

Research Results

This research aims to develop and test the effectiveness of the AR Struggle Diorama of November 10, 1945 in improving students' digital literacy. The testing process is carried out through pre-test and post-test design, expert validation, and instrument reliability tests. The results of the study showed a significant increase in students' digital literacy skills after using Augmented Reality (AR)-based learning media.

a. Digital Literacy Pre-test and Post-test Results

The measurement was carried out using instruments based on digital literacy competency indicators which include the ability to access information, validate digital data, use learning software, and produce simple digital content. The comparison of pre-test and post-test scores is summarized in the following table.

Table 1. Students' Digital Literacy Scores

Measurement Stage	n	Mean	SD	Min	Max
Pre-test	30	62.3	6.51	51	74
Post-test	30	81.7	5.44	70	92

Statistical calculations show a significant increase **quantitatively**, with *the results of the paired sample t-test*:

$$t\ (29)= 11.242,\ p < 0.001$$

In addition, Cohen's calculation d = 1.45 shows a large effect, which means that the increase is not just a change in numbers, but has a real impact pedagogically on students' digital competence. Thus, the use of AR Diorama has been proven to make a significant contribution to strengthening digital literacy, especially in the context of history learning which has tended to be textual and teacher-centric.

b. Media Validity and Reliability

Table 2. Results of the Validity of AR Media Instruments

Yes	Assessment Aspects	Maximum Score	Validator Score 1	Validator Score 2	Total Score	Percentage	Category
1	Material	20	18	17	35	87,5%	Highly Worth It
2	Display	20	17	18	35	87,5%	Highly Worth It
3	Interactivity	20	18	18	36	90,0%	Highly Worth It
4	Pedagogical Fit	20	17	18	35	87,5%	Highly Worth It
	Sum	80	70	71	141	88,1%	Highly Worth It

Table 3. Instrument Reliability Test Results

Component	Value
Number of Questionnaire Items	**16**

Cronbach's Alpha	**0.82**
Minimum Reliability Standards	**0.70**
Category	**Reliable / Consistent**

Based on the results of expert validation shown in Table 2, the overall assessment aspect of AR media obtained a percentage above 80%, so that it meets the criteria that are very feasible to be used as a history learning medium. In addition, the reliability test results in Table 3 show that Cronbach's Alpha value of 0.82 exceeds the minimum limit of 0.70, which means the instrument has good internal consistency. Therefore, the measurement instrument in this study is valid and reliable to evaluate the influence of AR media on students' digital literacy.

DISCUSSION

The results of this study show that Augmented Reality can be a learning medium that is not only visually appealing, but also able to improve digital skills that are relevant for 21st century students. These findings support the study of Chen & Tsai (2020), who stated that AR has the advantage of presenting spatial objects that are difficult to visualize through conventional 2D media, thereby increasing students' curiosity and long-term memory.

In addition, the increase in digital literacy scores in this study confirms that digital media designed with contextual, visual, and interactive principles are easier for students to accept, especially in history learning which is often considered boring because it is full of memorization. Learners not only receive information, but also interact with historical content through 3D objects, audio narration, and AR markers, so that the learning process moves from passive recipients to active users.

However, these findings are not entirely linear with the research of Oktaviani (2022), who stated that the use of AR does not necessarily improve digital skills if students are not familiar with application navigation. This difference is expected to occur because the media developed in this study has a simple interface and is equipped with concise instructions for use, so it does not cause confusion in the exploration process.

If you look deeper, the success of this media does not lie in its technology alone, but in the suitability of the local historical content, the November 10, 1945 Incident, which has an emotional closeness to students in East Java. It is at this point that this research makes a theoretical contribution that technology is only effective when combined with meaningful context.

In other words, AR media is not just a complement to learning, but acts as an epistemic tool that expands the way students understand, verify, and produce historical knowledge digitally. This is an important step for the transformation of social studies/history learning towards a digital paradigm, as echoed in Merdeka Belajar.

Research Limitations

Although this study shows positive results, some limitations need to be acknowledged:

1. The use of AR is still limited to one school, so generalization of the impact cannot be done yet.
2. The duration of media use is relatively short, so it has not tested the sustainability of the long-term effects.
3. Access to AR devices is not yet evenly distributed in all schools, so widespread implementation requires infrastructure support.

Research Implications

This research has direct implications for:

1. History teachers, because this media can be an alternative to non-verbal learning that reduces the dominance of lectures;
2. Media developers, who need to ensure a simple and local context-based AR interface;
3. Schools, which need to encourage digital literacy as a core competency of the 21st century, are not just additional skills.

CONCLUSION

This study demonstrates that the NaraJuang Augmented Reality (AR) learning media effectively enhances students' digital literacy and enriches the quality of history learning. The integration of immersive 3D visualization, interactive navigation, and localized historical content enabled students to develop measurable improvements in accessing, evaluating, and producing digital information core competencies in contemporary learning. The results also indicate strong pedagogical feasibility, supported by high expert-validation scores and reliable assessment instruments.

Several key findings can be emphasized briefly: (1) AR fosters active and inquiry-oriented learning by shifting students away from passive memorization toward exploratory digital engagement; (2) localized historical narratives enhance emotional relevance, helping students interpret historical meaning more critically; and (3) carefully designed AR interfaces contribute to improved user experience and overall learning effectiveness.

Nonetheless, this research has methodological limitations. The relatively small sample size, the single-school implementation, and unequal access to AR devices constrain the generalizability of the findings. These limitations suggest the need for broader trials involving more diverse learners, longer intervention periods, and infrastructure support in schools.

Future studies may explore multi-school implementations, cross-platform AR systems, and AI-supported personalization to strengthen adaptive learning pathways. Practically, teachers can integrate AR to support inquiry-based history learning, while curriculum developers may consider incorporating immersive digital media into national history-education frameworks.

Overall, NaraJuang contributes not only to improving students' digital literacy but also to reimagining history learning as a more contextual, interactive, and humanistic experience aligned with twenty-first-century educational demands.

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