

Development of Augmented Reality Learning Media Integrated with Experiential Learning to Enhance Students' Chronological Thinking in High School History

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e-ISSN: 2964-2981

ARMADA : Jurnal Penelitian Multidisiplin

<https://ejournal.45mataram.ac.id/index.php/armada>

Vol. 04, No. 07 Juli, 2026

Page: 2927-2935

DOI:

<https://doi.org/10.55681/armada.v4i7.3067>

Article History:

Received: Mei 21, 2026

Revised: Juni 22, 2026

Accepted: Juli 18, 2026

Abstract : *This study aimed to develop and evaluate Augmented Reality (AR)-based learning media integrated with Experiential Learning Theory (ELT) to improve students' chronological thinking skills. The study employed a Research and Development (R&D) method comprising needs analysis, design, development, expert validation, revision, and small- and large-group trials. The participants were Year 10 students (Phase E) at SMA Negeri 12 Padang. Data were collected through validation sheets, practicality questionnaires, and chronological thinking tests, then analysed using qualitative and quantitative descriptive techniques. The findings showed that the developed media met validity criteria based on assessments by subject-matter, media, and language experts, while also demonstrating high practicality for teachers and students. The media was also effective in improving students' ability to sequence events, understand temporal relationships, and interpret historical timelines. Therefore, integrating AR with ELT offers an innovative approach to meaningful, experience-based history learning in classrooms.*

Keywords : *Augmented Reality (AR); Experiential Learning Theory; Learning Media; Chronological Thinking; History Learning*

Abstrak : Penelitian ini bertujuan mengembangkan dan mengevaluasi media pembelajaran berbasis *Augmented Reality (AR)* yang terintegrasi dengan *Experiential Learning Theory (ELT)* untuk meningkatkan kemampuan berpikir kronologis siswa. Penelitian menggunakan metode *Research and Development (R&D)* melalui tahapan analisis kebutuhan, perancangan, pengembangan, validasi ahli, revisi, serta uji coba kelompok kecil dan besar. Subjek penelitian adalah siswa kelas X (Fase E) SMA Negeri 12 Padang. Data dikumpulkan melalui lembar validasi, angket praktikalitas, dan tes kemampuan berpikir kronologis, kemudian dianalisis secara deskriptif kualitatif dan kuantitatif. Hasil penelitian menunjukkan bahwa media yang dikembangkan memenuhi kriteria valid berdasarkan penilaian ahli materi, media, dan bahasa, serta memiliki tingkat kepraktisan yang tinggi bagi guru dan siswa. Media ini juga efektif meningkatkan kemampuan siswa dalam menyusun urutan peristiwa, memahami hubungan temporal, dan menginterpretasikan garis waktu sejarah. Dengan demikian, integrasi AR dan ELT dapat menjadi pendekatan

inovatif dalam pembelajaran sejarah berbasis pengalaman yang bermakna.

Kata Kunci : Augmented Reality (AR), Experiential Learning Theory, Media Pembelajaran, Berpikir Kronologis, Pembelajaran Sejarah

INTRODUCTION

In the context of 21st-century education, learning is no longer limited to the transmission of knowledge but is expected to develop students' higher-order thinking skills through meaningful and interactive learning processes. Learning is essentially an interaction between teachers, students, and learning resources designed to achieve specific educational goals and transform students' ways of thinking (Djamaluddin, 2019; Sudirman, 2020; Ananda, 2023). Therefore, instructional practices should move beyond conventional approaches and promote active student engagement. In history education, learning plays a strategic role in fostering historical awareness, critical thinking, and students' identity formation (Martdana & Atno, 2025). One of the fundamental components of historical thinking is chronological thinking, which enables students to understand the sequence of events, identify temporal relationships, and interpret historical developments coherently (Zed, 2018; Hastuti & Iqrima, 2021). Chronological thinking is considered a basic skill in historical inquiry, as it supports students in reconstructing events, analyzing causality, and comprehending the continuity and change within historical narratives (Khoiroh, 2025).

However, in practice, history learning in schools often remains dominated by memorization-oriented approaches, where students are required to recall dates, figures, and events rather than develop analytical understanding (Hastuti & Iqrima, 2021). Such practices limit students' ability to construct meaningful historical interpretations and weaken their chronological reasoning skills. Empirical findings from the research setting indicate that students still experience difficulties in identifying temporal structures, sequencing historical events, and interpreting timelines, which reflects the low level of their chronological thinking ability. To address these challenges, the integration of learning media has become increasingly important. Learning media serve as tools that facilitate the delivery of instructional content and enhance students' motivation and engagement (Asari, 2023; Pagarra, 2022). In the digital era, technology-based media offer opportunities to create more interactive and meaningful learning environments (Fikri & M, 2018; Firmansyah, 2024). The use of digital media in history learning has been shown to improve students' engagement and understanding by presenting content in more visual and contextualized forms.

One of the emerging technologies in education is Augmented Reality (AR), which integrates virtual objects into real-world environments in real time, enabling users to experience interactive and immersive learning (Huang, 2018). AR has significant potential in education as it can enhance student motivation, support conceptual understanding, and provide authentic learning experiences (Tan, 2022; Al-ansi, 2023). Furthermore, AR allows students to visualize abstract historical content, making it easier to comprehend complex events and processes (Arena, 2022; Thangavel, 2025). Despite its potential, previous studies indicate that the use of digital technology, including AR, is often limited to visualization purposes and lacks integration with a strong pedagogical framework. As a result, technology is frequently used as a supplementary tool rather than as a medium for meaningful knowledge construction. Moreover, existing research in history education tends to focus on general learning outcomes, with limited attention to specific historical thinking skills such as chronological reasoning.

To overcome these limitations, it is necessary to integrate technology with an appropriate learning theory. Experiential Learning Theory (ELT) provides a relevant framework, as it emphasizes learning as a process of knowledge construction through experience, reflection, conceptualization, and active experimentation (Sivagurunathan, 2025; Robinson & Leigh, 2025). ELT is rooted in constructivist and pragmatic perspectives, where learners actively construct knowledge through direct interaction with their environment (Nerita et al., 2023; Ratnasari, 2023). This approach aligns with the nature of historical learning, which requires students to interpret, reconstruct, and analyze past events actively. By integrating Augmented Reality with Experiential

Learning Theory, learning is expected to shift from passive reception to active knowledge construction. AR provides immersive and visual experiences, while ELT structures these experiences into meaningful learning processes. This combination enables students not only to observe historical phenomena but also to reflect, analyze, and reconstruct chronological sequences systematically.

Based on these considerations, this study aims to develop and evaluate an Augmented Reality-based learning media integrated with Experiential Learning Theory to improve students' chronological thinking skills in senior high school history learning. Specifically, this study examines the validity, practicality, and effectiveness of the developed media as an innovative and pedagogically grounded solution for enhancing historical thinking skills.

METHODS

This study employed a Research and Development (R&D) design to develop and evaluate an Augmented Reality (AR)-based learning medium integrated with Experiential Learning Theory (ELT) to enhance students' chronological thinking skills in history learning. The development process followed a systematic and iterative procedure, including needs analysis, product design, development, expert validation, revision, and field testing. This procedure was adapted to ensure that the resulting product met criteria of validity, practicality, and effectiveness. The initial stage involved a preliminary study through classroom observations and interviews with history teachers to identify existing problems in history learning, particularly students' difficulties in organizing historical events chronologically. Based on these findings, the AR learning media was designed using Assemblr Studio, incorporating ELT stages concrete experience, reflective observation, abstract conceptualization, and active experimentation into the learning activities. The product then underwent expert validation (content, media, and language experts), followed by revisions before being tested in real classroom settings.

The study was conducted at SMA Negeri 12 Padang, Indonesia, involving Grade X students (Phase E). The selection of this site was based on its digital learning environment, where students are equipped with personal laptops, allowing optimal implementation of technology-based instructional media. Furthermore, the school represents contextual challenges in history education, particularly the low level of students' chronological thinking skills, as identified in the preliminary study. The data sources consisted of the developed AR-based learning media, expert validation instruments, practicality questionnaires, and test instruments measuring chronological thinking skills. The indicators of chronological thinking included sequencing events, identifying temporal structures, interpreting timelines, and reconstructing historical narratives. Additional data were obtained through observations, interviews, and documentation to support the development and evaluation process.

Data collection techniques included observation, interviews, questionnaires, and tests. Observations and interviews were conducted during the needs analysis stage to explore instructional problems. Questionnaires were distributed to experts and users (teachers and students) to assess the validity and practicality of the developed media. To measure effectiveness, essay-based tests were administered before and after the implementation of the AR learning media. Data analysis employed both qualitative and quantitative approaches. Qualitative data from expert feedback, observations, and interviews were analyzed descriptively to refine the product. Quantitative data from validation sheets, practicality questionnaires, and test results were analyzed using descriptive statistics to determine the levels of validity, practicality, and effectiveness. The effectiveness of the product was evaluated based on the improvement in students' chronological thinking skills, as reflected in their post-test performance compared to the pre-test results.

RESULT AND DISCUSSION

The findings of this study reveal that students' chronological thinking skills were initially at a low level. This condition is supported by the preliminary test results, which show that only a limited number of students were able to correctly identify historical sequences and temporal structures. A significant proportion of students experienced difficulties in organizing events

chronologically and determining historical periodization. These results confirm that students tend to rely on memorization rather than developing analytical historical thinking skills. In history learning, such a tendency is problematic because chronological thinking serves as a fundamental component in understanding historical narratives and interpreting past events systematically (Ofianto & Ningsih, 2021).

Furthermore, classroom observations indicate that the learning process was still dominated by conventional methods, such as lectures, textbooks, and slide-based presentations. Although digital facilities were available, their utilization had not been optimized to promote active learning or higher-order thinking skills. As a result, students showed limited ability to relate past events to present contexts and encountered difficulties in analyzing causal relationships within historical narratives. This finding aligns with the argument that traditional history teaching often emphasizes the accumulation of facts rather than the development of historical thinking skills (Zed, 2018). To address these challenges, this study developed an Augmented Reality (AR)-based learning media integrated with Experiential Learning Theory (ELT). The results demonstrate that this integrated approach creates a more interactive and meaningful learning experience. The implementation of AR allows students to visualize historical content in three-dimensional formats, making abstract concepts more concrete and easier to understand. This supports the view that AR-based media can enhance students' engagement and facilitate deeper comprehension through immersive learning environments (Al-ansi, 2023; Thangavel, 2025).

In addition, the integration of ELT provides a structured pedagogical framework that encourages active student participation through four learning stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Through this cycle, students are not only exposed to historical information but are also guided to construct knowledge based on their experiences and reflections. This finding is consistent with the principles of experiential learning, which emphasize that knowledge is formed through the transformation of experience (Sivagurunathan, 2025; Lin & Yumiko, 2023). Compared to previous studies, this research offers a more comprehensive approach. Earlier studies on digital learning media in history education—such as multimedia, timeline applications, and e-booklets have shown positive effects on student engagement and learning outcomes. However, these studies tend to focus primarily on visualization and content delivery without integrating a strong pedagogical model. In contrast, this study combines AR technology with the experiential learning cycle, enabling students to actively construct chronological understanding through direct interaction and reflective processes. This integration represents a more holistic approach to learning, in line with constructivist perspectives that view learners as active agents in knowledge construction (Nerita et al., 2023; Tohari & Rahman, 2024).

Another important finding is that the developed AR-based learning media supports multiple indicators of chronological thinking skills. Students demonstrated improvements in identifying historical periodization, interpreting timelines, reconstructing sequences of events, and comparing alternative historical models. These indicators reflect essential components of chronological thinking as part of broader historical thinking skills. The improvement suggests that the integration of AR and ELT not only enhances engagement but also contributes to the development of core competencies in history education. Moreover, the findings indicate that the use of AR integrated with ELT helps bridge the gap between abstract historical content and students' real-life experiences. By combining immersive visualization with experiential learning processes, students are better able to connect historical events with contemporary contexts and develop a more meaningful understanding of history. This supports the notion that technology-enhanced learning, when combined with appropriate pedagogical frameworks, can significantly improve learning effectiveness (Kusuma et al., 2023; Firmansyah, 2024).

In summary, the results of this study confirm that the integration of Augmented Reality with Experiential Learning Theory provides an effective and innovative approach to improving students' chronological thinking skills. Unlike previous approaches that focus solely on technology or pedagogy, this study demonstrates that the combination of both elements creates a more structured, engaging, and meaningful learning experience. Therefore, this approach has strong potential to be

implemented as an alternative model in history education, particularly in supporting the development of higher-order historical thinking skills. In summary, the results of this study confirm that the integration of Augmented Reality with Experiential Learning Theory provides an effective and innovative approach to improving students' chronological thinking skills. Unlike previous approaches that focus solely on technology or pedagogy, this study demonstrates that the combination of both elements creates a more structured, engaging, and meaningful learning experience. Therefore, this approach has strong potential to be implemented as an alternative model in history education, particularly in supporting the development of higher-order historical thinking skills.

CONCLUSIONS

This study confirms that the development of Augmented Reality (AR)-based learning media integrated with Experiential Learning Theory (ELT) offers a significant contribution to enhancing students' chronological thinking skills in history learning. The developed product has been empirically validated as meeting the criteria of validity, practicality, and effectiveness, indicating that it is suitable for classroom implementation. Expert evaluations demonstrate that the content, design, and language are aligned with instructional objectives, while field implementation shows that the media is feasible and user-friendly for both teachers and students. The integration of AR technology with the experiential learning cycle comprising concrete experience, reflective observation, abstract conceptualization, and active experimentation creates a more interactive and meaningful learning environment. This approach not only supports the visualization of historical events but also facilitates students' ability to organize sequences, interpret timelines, and construct historical understanding more systematically. As a result, students demonstrate improved chronological reasoning compared to conventional learning practices that emphasize memorization.

From a pedagogical perspective, this study highlights that the effectiveness of digital learning media lies not only in technological innovation but also in its alignment with a robust learning theory. The combination of AR and ELT provides a structured framework that promotes active engagement and knowledge construction, representing a novel contribution to history education research. In terms of practical implications, the developed media can serve as an alternative instructional tool to support student-centered and experience-based learning, particularly for historical topics requiring strong temporal understanding. However, this study is limited to a specific context and subject matter. Therefore, future research is recommended to examine its applicability across different historical topics, educational levels, and learning environments, as well as to explore its long-term impact on broader dimensions of historical thinking skills.

ACKNOWLEDGMENTS

The completion of this research would not have been possible without the support, guidance, and contributions of many individuals and institutions. The author would like to express sincere gratitude to the academic advisors who provided continuous direction, constructive feedback, and intellectual encouragement throughout the research process. Their insights and expertise greatly contributed to the refinement and completion of this study. The author also extends appreciation to the lecturers and academic staff of the Graduate School of Universitas Negeri Padang for their valuable knowledge, administrative assistance, and academic support during the course of this study. Their contributions have played an essential role in shaping the author's academic journey. Special thanks are addressed to the school community of SMA Negeri 12 Padang, particularly the history teachers and students who willingly participated in this research. The cooperation, openness, and enthusiasm of the participants significantly supported the data collection process and the successful implementation of the developed learning media.

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