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Augmented Historical Simulation through Adaptive AI: A Learning Model for Developing Historical Thinking and Empathy

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Abstract. Contemporary history learning is still dominated by linear narratives and rote memorization that limit students' historical thinking and empathy. This study aimed to develop an Augmented Historical Simulation (AHS) model using adaptive Artificial Intelligence (AI) to improve historical reasoning and empathy. The study employed a sequential explanatory mixed-methods design involving 500 eleventh-grade students from four provinces in Indonesia. Quantitative data were collected using the Historical Thinking Test and Historical Empathy Scale at four measurement stages: pre-test, mid-test, post-test, and delayed post-test. The study adopted a non-equivalent control group quasi-experimental design involving experimental and control groups. The data were subsequently analyzed using ANCOVA and growth curve modeling. In contrast, qualitative data from interaction logs, student reflections, and group discussions were analyzed thematically. The intervention consisted of AI-based AHS activities involving branching historical scenarios, reflective decision-making tasks, source analysis, and AI-guided discussions aligned with the *Merdeka Belajar* Curriculum. The results showed that the experimental group gained significantly higher historical thinking skills than the control group (M = 85.9 vs. 77.6; F(1,492) = 40.68; $p < 0.001$; $\eta^2 = 0.314$) and maintained their achievements at the follow-up stage (M = 84.1 vs. 74.8). Historical empathy also increased significantly (M = 86.5 vs. 79.3; F (1,492) = 37.84; $p < 0.001$). These findings indicated that AHS could transform history learning from passive

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information transmission into a reflective inquiry process underpinned by decision-making, thereby strengthening historical literacy and empathy. This study contributes by offering an AI-based adaptive history-learning model to strengthen historical literacy and empathy in a multicultural education context.

Keywords: augmented historical simulation; artificial intelligence; history education; historical empathy; historical thinking

1. Introduction

Linear chronological memorization and single-narrative approaches have long dominated history education, neglecting the epistemological foundations of historical knowledge construction (Birsyada et al., 2024; Van Boxtel et al., 2020). This approach positions students as passive learners and weakens their ability to evaluate sources, understand various perspectives, and construct multicausal historical arguments (Basri et al., 2022; Schwartz, 2017). The politicization of national historiography further reinforces a hegemonic narrative centered on the state.

It marginalizes the perspectives of ethnic minority groups, thereby hindering the development of historical empathy and higher-order thinking skills needed to understand the complexities of the past (Elsayed et al., 2025; Garcia, 2017). In response to these conditions, the *Merdeka Belajar* Curriculum in Indonesia encourages a pedagogical shift towards reflective history learning by strengthening sourcing, contextualization, corroboration, and empathy skills (Saefudin et al., 2024). In a multicultural society, the development of inclusive and critical historical literacy is crucial for building a democratic national identity (Davison, 2017).

Despite the ongoing development of digital technology, most innovations in history learning still focus on visualization and access to archives, rather than on strengthening epistemological reasoning (Jamaludin et al., 2025). E-learning platforms generally reconstruct events linearly without facilitating adaptive decision-making or critical analysis, thus maintaining passive learning patterns (Roper, 2014). In Southeast Asia, particularly Malaysia, various learning tools tend to reproduce state-centered narratives and ignore ethnic dilemmas and multi-stakeholder perspectives (Azizoon et al., 2025; Lah et al., 2024; Yin et al., 2025).

The limitations of existing adaptive simulations in Malaysia, Vietnam, and Thailand highlight the need for artificial intelligence-based history learning models that promote reflective inquiry, historical empathy, and multicausal reasoning (Kadir et al., 2025; Ul Haq et al., 2026). In response to these gaps, the Adaptive AI-based Augmented Historical Simulation (AHS) model developed in this study enables students to engage in bounded agency and counterfactual reasoning through branching historical scenarios, real-time feedback, and reflective decision-making activities aligned with the *Merdeka Belajar* Curriculum in Indonesia.

The integration of learning analytics into the Adaptive AI-based AHS platform enables personalized learning by longitudinally analyzing student interaction logs, including decision-making paths, the frequency of use of the AI Narrator feature, engagement duration, and the quality of historical argumentation (Jang & Oh, 2026). By recording more than 7,000 branching decisions during the intervention, this system maps individual epistemic profiles while providing adaptive formative feedback based on real-time analytics. Within this framework, AI functions not merely as a content provider but as a cognitive-epistemic engine that orchestrates the development of higher-order historical thinking skills on cognitive and affective dimensions (Kim & Lu, 2026; Wang, 2026).

Therefore, this model offers an innovative pedagogical approach that addresses the limitations of conventional and linear history learning by transforming instruction from passive memorization into reflective, inquiry-based, and adaptive historical learning through AI-supported decision-making and multiperspective analysis, thereby strengthening 21st-century historical literacy. Although international studies have emphasized the importance of developing historical thinking, historical empathy, and AI-supported learning environments (Buñay-Guisñan et al., 2026; Li et al., 2026; Wen, 2026), most digital history learning technologies globally still focus on archive repositories, conventional e-learning, virtual visualization, and augmented reality for content delivery rather than reflective historical reasoning (Jamaludin et al., 2025; Saefudin, 2025; Sariyatun et al., 2018).

In Southeast Asia, particularly in Indonesia, Malaysia, and Thailand, previous studies have mainly examined augmented reality and digital learning platforms to improve engagement and visualization (Kadir et al., 2025; Ul Haq et al., 2026). However, research that positions AI as an adaptive epistemic scaffolding system to support reflective historical reasoning, bounded agency, and counterfactual decision-making remains limited. In addition, longitudinal studies using learning analytics to investigate the long-term impact of AI interventions on students' historical thinking and empathy in Southeast Asian educational contexts have not yet been systematically developed.

To address this gap, this study aimed to develop and evaluate the effectiveness of an Adaptive AI-based AHS model for supporting historical thinking and empathy within the Indonesian history curriculum. This study not only assesses improvements in sourcing, contextualization, and corroboration skills but also analyzes the longitudinal development of students' historical empathy. Through a mixed-methods sequential explanatory design, this model is expected to operationalize the epistemology of history learning in an adaptive, reflective, and personalized manner. In addition to strengthening national history pedagogy, this study introduces an AI-based learning model that promotes reflective, inquiry-based, and student-centered history learning and may be adapted to Southeast Asian contexts facing similar historiographical challenges.

Scientifically, this research contributes to the development of AI-based history education by presenting longitudinal empirical evidence on the effectiveness of

adaptive history simulations within the *Merdeka Belajar* Curriculum in Indonesia. In addition to strengthening the epistemological historical literacy model at the national level, these findings also have potential transferability to multicultural contexts in Southeast Asia facing similar historiographical challenges, such as Malaysia, Vietnam, and Thailand. Thus, this model has the potential to become a reference for AI-epistemic, machine-based digital history pedagogy that supports the development of a global history curriculum aligned with 21st-century competencies. Based on these considerations, this study seeks to answer the following research question: How effective is the Adaptive AI-based AHS model in supporting students' historical thinking and historical empathy within the Indonesian history curriculum?

2. Literature review

2.1 Historical thinking and historical empathy in history education curriculum

The study of historical thinking has become a central paradigm in 21st-century history education reform, emphasizing the development of epistemological skills for critically reading, analyzing, and constructing historical meaning (Lévesque & Clark, 2018; Saefudin, 2025; Saigal, 2023). These skills go beyond understanding the chronology of events and include cognitive dimensions such as sourcing (assessing the credibility of sources), contextualization (placing events in relevant contexts), and corroboration (comparing and synthesizing various sources) (Marshall & Gram, 2022; Mathis & Parkes, 2020).

These competencies are essential for dealing with the ambiguous, biased, and interpretive nature of historical sources. To minimize the risk of biased or misleading interpretations, the AHS platform incorporated expert-validated historical content, teacher supervision, and source verification features throughout the learning process. History is therefore understood not merely as a collection of facts, but as a discursive space in which actors, motives, and consequences are analyzed within complex historical contexts across time and space (Tirado-Olivares et al., 2024; Van Boxtel et al., 2020).

Beyond cognitive aspects, historical empathy is a crucial component that enriches historical thinking (Ablovatski, 2023). Historical empathy requires an understanding of the motives, values, and moral dilemmas of historical actors within their socio-cultural context (Kozhevnikova, 2019; Nash, 2010). This ability requires students to balance contemporary moral judgments with the limitations of the choices available to actors at the time (bounded agency) (Gómez-Carrasco et al., 2022). The integration of historical empathy not only strengthens analysis but also develops the affective dimension through moral awareness, tolerance, and recognition of the diversity of human experiences in the past, a need that is increasingly relevant in a multicultural society (Charoensilp, 2024).

The historical thinking paradigm and historical empathy align with the *Merdeka Belajar* Curriculum, which emphasizes strengthening historical literacy as part of the critical, reflective, and multiperspective thinking competencies (Saefudin et al., 2024; Wulandari et al., 2020). In the pluralistic context of Indonesia, these skills

are important to prevent the reproduction of a single hegemonic historical narrative. Through the internalization of these skills, students not only memorize events but also reflect on narratives epistemologically, consider alternative decisions made by historical actors, and critically evaluate the validity of historical claims (Corredor-Aristizábal, 2020; Torres-Barreto et al., 2025). Thus, historical thinking and historical empathy become the foundation for reconstructing history education that is academically, pedagogically, and socially relevant in the 21st century.

2.2 Limitations of current digital history learning models

Despite ongoing digital innovation, most history education technologies still focus on improving visualization rather than reconstructing the epistemological processes involved in historical reasoning (Carbajal et al., 2025). E-learning platforms generally rely on digital archives, interactive multimedia, and augmented reality (AR) and virtual reality (VR) applications, without substantially developing the reflective and analytical dimensions of historical thinking (Liestøl, 2019; Nguyen et al., 2019). The use of VR to visually reconstruct events increases the appeal of learning. However, it often does not encourage deep epistemic engagement because students are not required to evaluate sources or construct critical historical arguments (Jamaludin et al., 2025). As a result, core skills such as sourcing, contextualization, corroboration, and counterfactual reasoning are still poorly integrated into digital history learning systems.

These limitations are evident in Southeast Asia, including Indonesia and Malaysia, where digital history initiatives tend to focus on delivering content through videos, question banks, and electronic textbooks (Azizoon et al., 2025; Lah et al., 2024; Mustafa et al., 2025). In Indonesia, adaptive simulations and AI-based epistemic devices are still limited (Andriyandi et al., 2020; Jamaludin et al., 2025). In Malaysia, digital history platforms generally maintain a state-centered narrative, leaving no space for exploring ethnic dilemmas, political controversies, and the complexity of multicausality (Samaden et al., 2025). Both contexts demonstrate a lack of adaptive epistemic scaffolding to facilitate complex decision-making through branching scenarios and contextual moral dilemmas. This gap underscores the need for AI-based innovations that integrate scenario-based learning, real-time feedback, and student-interaction-log analytics to support the reflective and multiperspective goals of the *Merdeka Belajar* Curriculum.

2.3 Artificial intelligence as an adaptive epistemic scaffolding machine

The development of artificial intelligence (AI) in education opens up transformative opportunities to shift history learning from linear content delivery to a branching decision-making model that reflects the complexity of historical actors' actions (Lai, 2026; Maleki, 2026). AI-based systems enable the development of adaptive scenarios that place students as decision-makers, requiring them to navigate historical consequences based on bounded agency, multicausality, and counterfactual reasoning (Allal-Chérif, 2022; Paro et al., 2022). Through these simulations, students no longer simply memorize chronologies; they are actively engaged in moral dilemmas and geopolitical strategies, thereby developing high-level historical thinking skills.

The main advantage of AI lies in its ability to provide real-time adaptive epistemic scaffolding in the decision-making process through expert-validated feedback, reflective prompts, and source-verification mechanisms that support authentic and context-based historical inquiry (Hoy, 2018; Huang & Rust, 2018; Yildizdag et al., 2026). Features such as AI Narrator provide reflective feedback, narrative analysis, and critical questions that encourage evaluation of long-term consequences. At the same time, the Source Verification Engine assesses the validity of historical sources, and the Empathy Prompt activates the affective dimension by adopting actors' perspectives in complex socio-political dilemmas (Tak et al., 2023). Therefore, AI integration not only operationalizes the epistemology of historical learning but also opens a new paradigm for the development of adaptive historical reasoning relevant to the multicultural context in Indonesia.

3. Methodology

3.1 Research design

This study employed a mixed-methods sequential explanatory approach within a non-equivalent control group quasi-experimental design to evaluate the effectiveness of Adaptive AI-based Augmented Historical Simulation (AHS) in improving students' historical thinking and historical empathy in Indonesian secondary schools. The mixed-methods approach integrated quantitative and qualitative phases sequentially, with quantitative findings serving as the basis for qualitative exploration of students' cognitive, affective, and epistemic changes during the intervention (Creswell & Clark, 2011).

The quantitative phase employed a non-equivalent control group quasi-experimental design, with group assignment conducted at the school level to minimize treatment contamination. Initial equivalence was assessed using pre-test scores and key demographic characteristics. Measurements were conducted at four stages: pre-test (week 0), mid-test (week 7), post-test (week 15), and delayed post-test conducted ten weeks after the intervention. This longitudinal structure enabled the analysis of students' historical thinking and historical empathy development over time, including learning retention following the intervention.

3.2 Participants and sampling

The research participants consisted of 500 eleventh-grade students from four provinces in Indonesia (Central Sulawesi, Jakarta, Banten, and West Java) who were purposively selected based on socio-cultural diversity, implementation of the *Merdeka Belajar* Curriculum, and the availability of digital learning infrastructure. A total of 260 students were assigned to the experimental group, while 240 students were included in the control group. The attrition rate during the study was 6.4%, and no significant differences were found between participants who completed all measurement stages and those who withdrew from the study, indicating that the data met the missing-at-random assumption. Fifteen history teachers facilitated the intervention after completing a one-week technical and pedagogical training program on the AHS platform. In addition, four curriculum and history education experts validated the simulation scenarios

and research instruments to ensure alignment with the *Merdeka Belajar* Curriculum and the historical thinking indicators employed in this study.

3.3 Intervention procedure

The intervention was carried out over 15 weeks in regular history lessons in the odd semester of the 2025 academic year. The experimental group used the AHS platform, which included branching historical scenarios, AI-generated reflective feedback, empathy prompts, source evaluation features, and learning analytics to monitor students' historical reasoning development. In contrast, the control group followed conventional learning based on textbooks, class discussions, and multimedia presentations without adaptive AI support. To maintain consistency in implementation, periodic classroom observations and treatment-fidelity monitoring were conducted to ensure the intervention adhered to protocol (Creswell & Clark, 2011). During the intervention, the system recorded more than 12,000 branching decisions, including decision-making paths, AI feature usage frequency, engagement duration, and students' reflective responses during the simulation.

3.4 Instruments and data collection

The main research instruments included the Historical Thinking Test, which consisted of scenario-based items adapted from the Seixas and Morton framework to measure sourcing, contextualization, corroboration, and counterfactual reasoning skills, as well as the Historical Empathy Scale, which assessed the cognitive and affective dimensions of students' historical empathy. The test items were designed to measure higher-order historical reasoning through analytical and reflective tasks aligned with the objectives of the intervention (Edling et al., 2020; Seixas, 2004). The construct validity of both instruments was assessed using confirmatory factor analysis, with model fit indices meeting the required criteria (CFI > .90 and RMSEA < .08). At the same time, internal reliability was assessed using Cronbach's alpha, with values between .82 and .91 (Gestsdóttir et al., 2018).

Additional data were obtained from the platform's interaction log system, which recorded students' decision paths, frequency of AI feature usage, engagement duration, and the complexity of historical arguments generated during the simulations. The AHS platform also provided real-time reflective feedback, branching historical scenarios, and source evaluation activities to support students' historical reasoning and empathy development. In addition, teacher reflection journals and Focus Group Discussions conducted after the intervention were used to enrich the qualitative data regarding students' learning experiences and cognitive engagement during the use of AHS.

3.5 Data analysis

Quantitative analysis was performed using ANCOVA to test differences in post-test and delayed post-test scores between the experimental and control groups, with pre-test scores as covariates, and the effect size was reported as partial eta squared. The longitudinal development of historical thinking and historical empathy skills was analyzed using Growth Curve Modeling to map the trajectory of change at four measurement points, with estimates made using Full Information Maximum Likelihood to handle missing data robustly. Model fit

indices such as CFI, TLI, RMSEA, and SRMR were reported to ensure the suitability of the longitudinal model (Creswell, 2009). Qualitative data obtained from student narratives, Focus Group Discussions and teacher reflection journals were analyzed using thematic and discourse analysis through open, axial, and selective coding procedures. These approaches were employed to identify patterns in students' historical reasoning, reflective thinking, and learning experiences during the intervention. Inter-rater reliability was tested using Cohen's Kappa ($\kappa = .84$), indicating strong coding consistency.

The system log was analyzed using Sequence Analysis to identify decision-making patterns and the relationship between the duration of involvement and the increase in HTT scores. Quantitative and qualitative data were integrated at the interpretation stage through triangulation of cognitive, affective, and interactional dimensions to produce a comprehensive understanding of the pedagogical impact of AHS on students' epistemic development (Miles et al., 2014).

4. Results and findings

4.1 The impact of augmented historical simulation through adaptive AI on Historical thinking skills

The results of the study indicated that the implementation of Augmented Historical Simulation (AHS) through Adaptive AI significantly improves the historical thinking skills of secondary school students in Indonesia. The evaluation was conducted using the Historical Thinking Test at four measurement stages, namely before the intervention, mid-intervention (week 7), after the intervention (week 15), and a follow-up assessment approximately ten weeks after the intervention ended. This instrument measured students' competence across three main dimensions of historical thinking: sourcing, contextualization, and corroboration.

ANCOVA analysis showed that after controlling for initial scores, the experimental group obtained significantly higher post-test scores than the control group ($M = 85.9$, $SD = 5.4$; $M = 77.6$, $SD = 5.9$), with $F(1,492) = 40.68$, $p < 0.001$ and a large effect size ($\eta^2 = 0.314$). This advantage remained evident in the follow-up assessment, where the experimental group maintained a mean of 84.1 ($SD = 5.8$), while the control group obtained a mean of 74.8 ($SD = 6.4$), with $F(1,492) = 36.95$, $p < 0.001$ and $\eta^2 = 0.289$. Details of the statistical analysis results are presented in Table 1.

Table 1: ANCOVA analysis results for historical thinking skills

Measurement Stage	Group	Mean (M)	SD	F	p-value	Partial Eta Squared
Post-test	Experimental	85.9	5.4	40.68	< 0.001	0.314
Post-test	Control	77.6	5.9			
Follow-up Assessment	Experimental	84.1	5.8	36.95	< 0.001	0.289
Follow-up Assessment	Control	74.8	6.4			

The development of historical thinking scores over time is visualized in **Figure 1** using the Growth Curve Modeling approach to map the development trajectories of both groups. The results of the analysis showed that the experimental group experienced steady improvement throughout the intervention period, through the end of the semester, and maintained relatively high achievement levels at the follow-up stage. In contrast, the control group showed a tendency to stagnate after the mid-semester evaluation, indicating the limitations of conventional learning approaches in supporting the continuous development of high-level historical thinking skills.

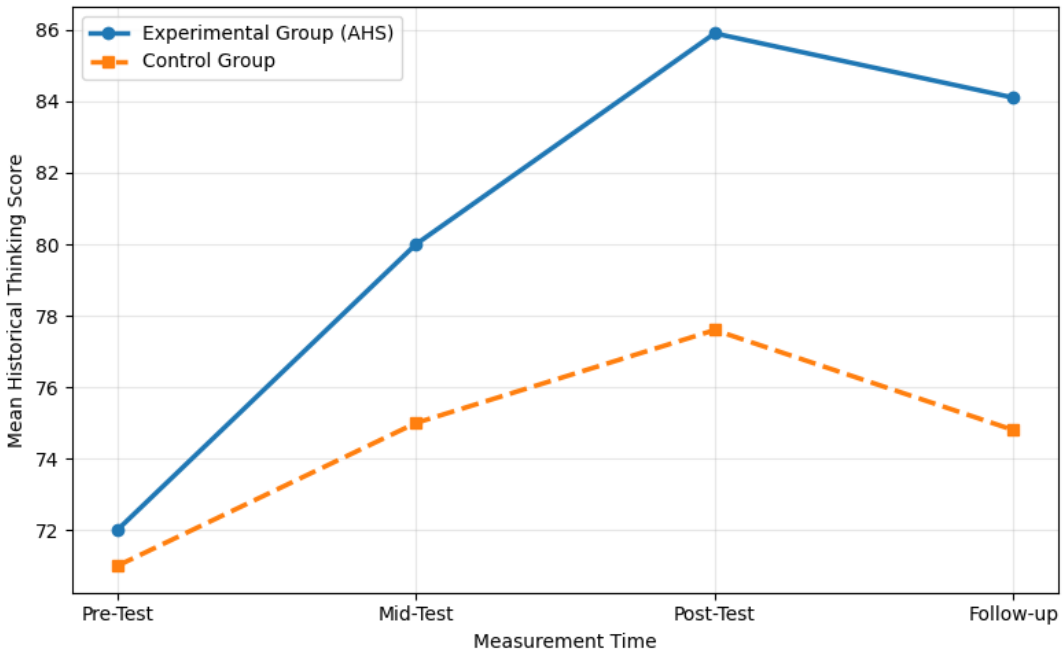

Figure 1: Growth curve development of historical thinking skills across four measurement points

Analysis based on the historical thinking skill dimensions showed that the implementation of AHS consistently improves students' competence in sourcing, contextualization, and corroboration in secondary education in Indonesia. At the post-test stage, the experimental group obtained significantly higher scores than the control group in all dimensions: sourcing ($M = 87.6$ vs. 77.2; $p < 0.001$), contextualization ($M = 86.1$ vs. 75.8; $p < 0.001$), and corroboration ($M = 86.4$ vs. 76.9; $p < 0.001$). These findings indicated that the adaptive AI-supported branching simulation framework in AHS effectively strengthens students' ability to evaluate historical sources critically, place events in a broader socio-political context, and analytically synthesize various historical evidence. Details of the statistical results are presented in **Table 2.**

Table 2: Mean post-test scores on historical thinking skill dimensions

Dimension	Experimental (M)	Control (M)	p-value
Sourcing	87,6	77,2	< 0,001
Contextualization	86,1	75,8	< 0,001
Corroboration	86,4	76,9	< 0,001

Pedagogically, these findings were significant because the adaptive simulation scenarios are designed to align with the Indonesian secondary school history curriculum, which covers major themes such as colonialism, Japanese occupation, independence, diplomacy, and early republican conflicts. Through a process of reflective decision-making in a branching narrative, students were encouraged to move beyond factual memorization toward analytical and multiperspectival historical reasoning. Thus, AHS not only improves academic achievement in historical thinking skills but also strengthens students' sustained epistemic engagement with history learning at the secondary education level.

4.2 Development of students' historical empathy during simulation

The implementation of AHS through Adaptive AI significantly improved students' historical empathy, particularly in understanding historical perspectives, evaluating moral dilemmas, and interpreting actions within their historical contexts. Measurements using the Historical Empathy Scale at four stages (pre-test, mid-test, post-test, and delayed post-test) showed that at the initial stage, both groups had relatively equivalent levels of empathy ($M = 72.1$ in the experimental group and $M = 71.4$ in the control group; $p > 0.05$). After the intervention, the experimental group showed a significant increase, with a post-test mean of 86.5, compared to the control group's 79.3 ($F(1,492) = 37.84$; $p < 0.001$; $\eta^2 = 0.287$). This improvement persisted at the delayed post-test stage, where the experimental group maintained a mean of 84.9 while the control group scored 77.1 ($F(1,492) = 35.62$; $p < 0.001$; $\eta^2 = 0.271$). Details of the statistical analysis results are presented in Table 3.

Table 3: Historical empathy measurement results

Measurement Stage	Group	Mean (M)	SD	F	p-value	Partial Eta Squared
Pre-test	Experimental	72,1	5,5	–	> 0,05	–
Pre-test	Control	71,4	5,7			
Post-test	Experimental	86,5	5,2	37,84	< 0,001	0,287
Post-test	Control	79,3	5,8			
Delayed Post-test	Experimental	84,9	5,4	35,62	< 0,001	0,271
Delayed Post-test	Control	77,1	5,9			

The difference in historical empathy levels between the two groups is also visualized by comparing post-test scores in Figure 2**.** The visualization shows a consistent achievement gap between the experimental and control groups, reinforcing the finding that AHS is effective in significantly and sustainably improving students' historical empathy in secondary education in Indonesia.

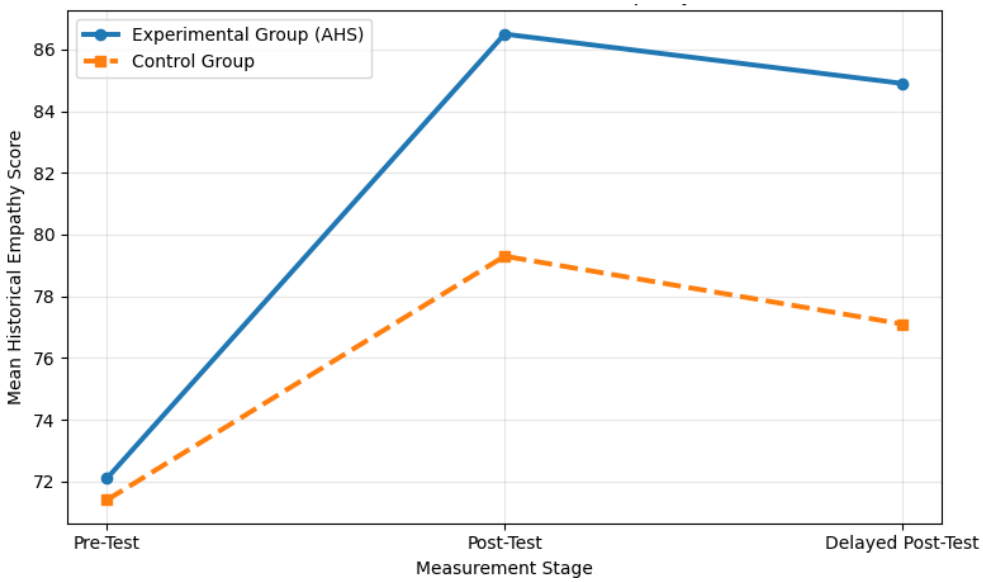

Figure 2: Growth curve development of historical empathy across measurement stages

The increase in historical empathy in the experimental group did not occur mechanically. However, it was influenced by the AI Narrator feature design in AHS, which systematically presented moral dilemmas during the simulation. In the Indonesian independence scenario, students were faced with the choice between pursuing diplomacy with Japan and the risk of armed revolution, accompanied by reflective questions from the system, such as the possibility of diplomatic failure and its impact on civilians and on international legitimacy. This approach encouraged students to understand that historical decisions were not simply right or wrong, but were influenced by risks, geopolitical pressures, and complex social conditions.

Teacher observations indicated that the simulation sparked in-depth discussions about the positions of figures such as Soekarno, Sjahrir, and Tan Malaka, who faced international pressure and domestic dilemmas. Student reflections showed the development of greater contextual historical empathy, such as awareness that the proclamation of independence entailed military risks, diplomatic pressure, and the people's suffering. These findings confirmed that strengthening historical empathy through AHS not only affects the affective dimension but also enhances higher-order cognitive competencies, as students not only understand historical facts but also authentically reflect on historical debates by considering the geopolitical consequences and complexities of national leaders' decisions.

4.3 Learning interaction patterns in digital simulation

The implementation of Augmented Historical Simulation (AHS) through Adaptive AI not only presented historical material but also systematically recorded the learning process through the integration of learning analytics. During the 15-week intervention period, student interaction data were collected longitudinally, enabling in-depth analysis of cognitive, affective, and metacognitive engagement patterns in various branching scenarios aligned with the Indonesian history curriculum.

The main interface of the AHS platform, as shown in **Figure 3**, organized the learning path through several modules, including Generate Scenario, AI Narrator, Student Progress, Scenario Trends, Knowledge Retention, and Performance Analytics. This structure provided an integrated dashboard that allowed students and teachers to continuously monitor the development of historical thinking and empathy skills during the simulation process.

Figure 3: Main interface of the augmented historical simulation through the adaptive AI platform

During the learning process, students began the simulation by selecting a historical period and location that corresponds to the national curriculum. For example, when studying the topic "Proclamation of Indonesian Independence," students selected the 1940s as the period and Indonesia as the location, as shown in **Figure 4.** This selection process then determines the next branch of the scenario path, which is constructed algorithmically based on the real historical challenges faced by national actors.

Figure 4: Student scenario selection interface of the augmented historical simulation through adaptive AI

Throughout the learning process, the AHS system not only recorded student interactions in the scenario but also performed real-time performance analysis through the Performance Analytics module. At the end of the learning period, teachers and students received structured feedback that included task completion status, assessment scores, and formative feedback to reinforce learning. The feedback dashboard display is shown in **Figure 5.**

Figure 5: Performance analytics dashboard of the augmented historical simulation through adaptive AI

Each scenario-based task in the system (such as Timeline Creation, Essay on Colonialism, Source Analysis, and Declaration of Independence) was automatically evaluated by the AHS algorithm, which recorded students' scores and provided adaptive feedback ranging from "good effort" to "excellent analysis" based on the quality of the response. The system also monitored the duration of student engagement, averaging about 3 hours per simulation phase. This information allowed teachers to provide more targeted pedagogical interventions by identifying students who need additional support, addressing misconceptions that arise, and adjusting follow-up scenarios in a more personalized manner.

In addition, the platform integrates various artificial intelligence-based features during the decision-making process, particularly through AI Narrator, which provides real-time narrative explanations, reflective questions, rhetorical analysis of historical figures, and source verification. The AI Narrator interface, as shown in Figure 6, demonstrates how the system analyzes Soekarno's Independence Proclamation speech by highlighting linguistic elements such as nationalism, autonomy, and unity.

Figure 6: AI narrator interface for real-time speech analysis within the augmented historical simulation through adaptive AI

The AI Narrator feature was widely used by students, with 92% using it to deepen their narrative understanding and evaluate alternative scenarios. In addition, 78% of students useed the Empathy Prompt when faced with branching dilemmas (such as choosing between accelerating the declaration of independence or continuing diplomatic negotiations). In comparison, 64% utilised the Source Verification Engine to validate historical sources before making important decisions. Correlation analysis showed a significant positive relationship between

student engagement duration (5–40 hours) and increased Historical Thinking Test scores, indicating that higher engagement correlates with improved historical thinking skills.

Teacher reflections also indicated that students' decision-making processes became more argumentative and source based. In the scenario leading up to the proclamation, students considered complex factors, including geopolitical dilemmas, Japanese military threats, domestic public pressure, and international legitimacy. One student stated that the decision to proclaim independence was not merely a heroic act but the result of complex calculations involving military pressure, diplomacy, and social conditions. These findings showed that AHS effectively promotes an epistemological understanding of history as a process of negotiating interests and interpretations, while strengthening multiperspective historical reasoning in line with the objectives of the *Merdeka Belajar* Curriculum.

4.4 Reflections on historical argumentation, cognitive dynamics, and multicultural implications

Qualitative analysis of the system log, student reflections, guided group discussions, and teacher observations showed that AHS shifted the learning pattern from a memorization-based approach to reflective historical reasoning that engaged with moral dilemmas, the diversity of perspectives, and complex causal relationships. A thematic analysis of 500 student narratives identified five main themes: ethical dilemmas, diplomatic consequences, sociopolitical multicausality, local narratives, and bounded agency.

In the 1945 independence simulation, students understood that Sukarno and Hatta's decisions were influenced by various factors, including military threats, international pressure, and public expectations, as reflected in one student's reflection: "*If the proclamation had been delayed, Indonesia might have fallen back into Dutch hands, but if it was declared too early without international support, it could have triggered greater internal conflict.*" In the Round Table Conference simulation, students from Banten also highlighted the limitations of regional representation in the narrative of sovereignty negotiations, with reflections such as: "*The national narrative often oversimplifies the struggle, while Papua, Kalimantan, and Aceh also made sacrifices that are rarely discussed in textbooks*."

In addition, students demonstrated the development of counterfactual reasoning by exploring possible alternative outcomes outside the chronological sequence of events. A student from Central Sulawesi stated: "*If the Indonesian delegation at that time had insisted without compromise, sovereignty might not have been recognized quickly, but our economy could have collapsed due to the embargo.*" Further discourse analysis showed an increase in the use of epistemic vocabulary, visualized in Word Cloud (Figure 7), with the emergence of terms such as diplomacy, multicausality, international legitimacy, and public sacrifice. The emergence of this terminology indicated the development of high-level reflective historical thinking skills in students during the simulation process.

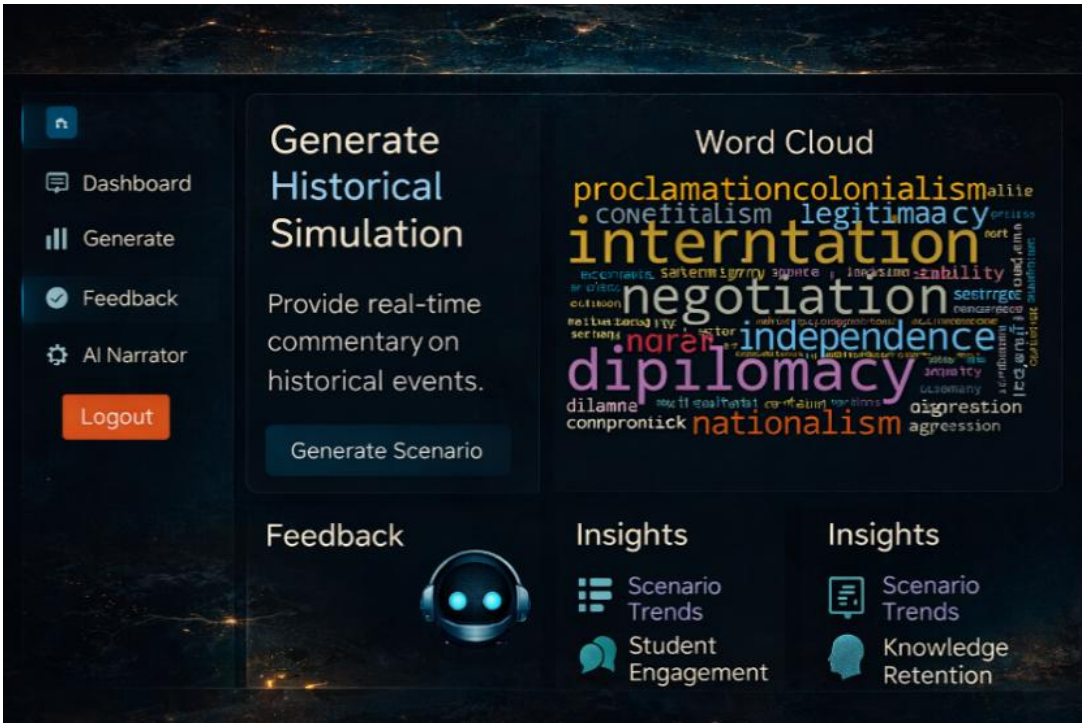

Figure 7: Word cloud visualization of students' epistemic vocabulary in the augmented historical simulation through adaptive AI

The change in vocabulary usage reflected an increase in students' mastery of epistemic language, marked by the use of abstract terms such as bounded agency, international negotiation, sovereignty legitimacy, and sociopolitical multicausality. The use of this terminology indicated the development of more reflective and conceptual historical reasoning skills. Teachers' observations reinforce these findings by noting increased classroom discussion dynamics and the emergence of student-initiated reflective questions, a phenomenon relatively rare in conventional learning. In these discussions, students not only discussed the roles of historical figures but also debated the moral and political consequences of various historical decisions, proposed alternative scenarios, and connected local experiences with the national narrative (Nuraedah & Saefudin, 2024; Utomo et al., 2024).

A teacher from Central Sulawesi noted that "*their discussions are no longer simply about who played a role, but why decisions were made, what considerations shaped those decisions, and how they affected different regions*." Cross-provincial data showed multicultural engagement among students. Participants from Banten emphasized the role of Islamic movements in the national struggle, students from Sulawesi highlighted political representation, and students from Jakarta discussed regional marginalization and post–World War II diplomacy. These findings indicate that AHS supported diverse historical perspectives across sociocultural contexts.

More broadly, the pattern of students' argumentative discourse indicated the transferability of this model to multicultural countries in Southeast Asia (such as Malaysia, Vietnam, the Philippines, and Thailand) that face similar historiographical challenges. These reflections confirmed that AHS not only

produces statistically significant impacts but is also epistemologically transformative by encouraging history learning as a process of meaning negotiation, ethical reasoning, and inclusive historical awareness.

5. Discussion

This study showed that Augmented Historical Simulation (AHS) through Adaptive AI significantly improves the historical thinking skills of secondary school students in Indonesia. Longitudinal analysis using ANCOVA and growth curve modeling showed consistent improvement in the post-test and delayed post-test stages, reflecting a strengthening of factual knowledge as well as higher-level historical thinking skills, including sourcing, contextualization, and corroboration (Carbajal et al., 2025). In addition, AHS strengthens students' historical empathy by fostering a deeper understanding of historical perspectives, moral dilemmas, and the sociopolitical implications of various historical decisions. The branching simulations supported by AI Narrator and Empathy Prompt encouraged deeper reflection and multiperspective learning, aligning with the objectives of the *Merdeka Belajar* Curriculum. Data collection over one semester (15 weeks) allows for longitudinal analysis of the development of these skills.

In addition to strengthening cognitive and affective dimensions, learning analytics data recorded more than 12,000 branching decisions that reflect students' active exploration of various historical scenario possibilities. Student engagement duration also correlated positively with increased historical thinking scores, confirming the effectiveness of AHS in encouraging engagement through decision-based learning. Interaction with branching scenarios not only strengthens chronological understanding but also develops historical argumentation through counterfactual reasoning, bounded agency, and multicausality (Ablovatski, 2023; Torres-Barreto et al., 2025). Overall, AHS transforms history learning from a linear narrative to a reflective approach grounded in epistemological dilemmas, more in line with the demands of 21st-century historical literacy.

These findings are consistent with several previous studies showing that simulation- and scenario-based learning can improve students' historical thinking skills and cognitive engagement (Chashyn et al., 2024; Dvorak et al., 2024; Li et al., 2026; Wen, 2026). However, unlike previous studies that mainly focused on visualizing historical events through interactive multimedia, virtual reality (VR), or augmented reality (AR), the AHS model emphasizes adaptive and reflective historical decision-making during the learning process. The findings showed that students in the experimental group achieved significantly higher historical thinking and empathy scores than those in the control group. These results suggest that integrating AI-based branching simulations with real-time epistemic scaffolding not only supports historical observation but also strengthens students' ability to evaluate historical alternatives and consequences critically.

This research also presented conceptual and technological innovations by developing AHS as an artificial intelligence-based history learning system, which remains relatively underexplored in the history pedagogy literature (Tak et al., 2023). Unlike most digital history platforms that primarily function as content delivery media or archive repositories, AHS integrates adaptive branching simulations with real-time epistemic scaffolding to support reflective historical reasoning. Students engaged in historically plausible decision-making through the Scenario Generator module by reconstructing historical events based on the perspectives and choices of historical actors (Alzate & Vásquez, 2020; Saefudin, 2025). The findings further indicated that this approach encouraged students to analyze historical dilemmas more critically and develop stronger metahistorical reasoning skills.

The novelty of AHS is further strengthened by the integration of the AI Narrator, Empathy Prompt, and Source Verification Engine as metacognitive scaffolds in the decision-making process (Kim & Lu, 2026). AI Narrator provides real-time reflective questions and narrative analysis, Empathy Prompt encourages consideration of the moral and social implications of each choice, while Source Verification Engine connects students' decisions to credible academic sources to strengthen the validity of historical arguments (Huang & Rust, 2018; Kim & Lu, 2026). The synergy between these features positions AHS not merely as a historical information delivery system, but as an epistemic cognitive engine that supports the development of high-level historical reasoning (Ablovatski, 2023; Torres-Barreto et al., 2025).

The findings of this study also revealed pedagogical advantages that differ significantly from those of most digital history learning models developed globally and in Southeast Asia (Azizoon et al., 2025; Lah et al., 2024; Yin et al., 2025). In general, international digital history development remains dominated by content presentation approaches, such as interactive multimedia, digital archives, and linear narrative-based simulations. In many historical e-learning platforms, students are often treated as passive consumers of content. Hence, the development of high-level historical thinking epistemology (such as counterfactual reasoning, bounded agency, and multicausality) is not optimally supported (Kadir et al., 2025; Ul Haq et al., 2026).

In Southeast Asia, particularly in Malaysia, similar challenges in the development of digital history learning remain evident. Digital history programs such as Sejarah Digital Malaysia generally focus on providing online archives, interactive visual documentation, and reinforcing linear, centralized official historical narratives (Azizoon et al., 2025; Yin et al., 2025). Compared to this context, AHS presents more substantive innovations through the integration of branching scenarios, the AI Narrator, the Empathy Prompt, and the Source Verification Engine, which enable students to reflectively evaluate historical dilemmas and understand the complexity of historical actors' decision-making (Tak et al., 2023).

The findings of this study have important implications for the development of history education in Indonesia and other multicultural Southeast Asian contexts. The results showed that the AHS model supported students' historical thinking and empathy through reflective and decision-based learning activities. These findings suggest that history learning can move beyond chronological memorization toward adaptive, inquiry-based, and student-centered historical reasoning (Andriyandi et al., 2020; Jamaludin et al., 2025). This approach is also in line with the 21st Century Global Competence History Curriculum framework, which emphasizes the importance of historical empathy, source literacy, and multiperspectival understanding in contemporary history education (Jang & Oh, 2026; Li et al., 2026; Wang, 2026; Wen, 2026).

Future research could expand the implementation of the AHS model to various educational contexts and countries with different historiographical characteristics to test its cross-cultural adaptability and effectiveness. In addition, future studies could explore integrating more advanced AI technologies, such as generative AI and adaptive narrative systems, to develop historical simulations that are more dynamic and responsive to students' reasoning processes.

6. Limitations

Although this study contributes to the development of AI-based history learning, several limitations should be acknowledged. First, the study was conducted within the context of Indonesian secondary education; therefore, the generalizability of the findings to other educational settings should be interpreted cautiously. Second, the intervention was implemented over one semester, limiting the ability to fully examine the long-term development of students' historical thinking and historical empathy. Future studies are encouraged to employ longer intervention periods and broader cross-cultural contexts to strengthen the external validity of the findings.

7. Conclusion

This study showed that Augmented Historical Simulation (AHS) using Adaptive AI is an effective pedagogical innovation for improving historical thinking and empathy skills in secondary education in Indonesia. Through the integration of adaptive branching simulations with AI-based epistemic scaffolding (via the AI Narrator, Empathy Prompt, and Source Verification Engine features), history learning shifts from linear narrative delivery to reflective historical reasoning based on decision-making.

The results of the study showed that students not only developed higher-order historical thinking skills, including sourcing, contextualization, corroboration, multicausality, and counterfactual reasoning, but also demonstrated historical empathy through engagement with moral dilemmas and bounded agency in authentic socio-political contexts. Longitudinal findings indicated that these improvements are sustainable, suggesting that AI-based adaptive simulations can promote stable epistemic development, rather than merely short-term performance gains.

Theoretically, this research contributes to operationalizing the epistemology of history learning through AI-mediated decision-making mechanisms. Methodologically, this study expanded the evaluation of AI-based history learning through a longitudinal mixed-methods design that integrates statistical analysis and qualitative discourse analysis. In practice, this model offers a learning framework aligned with the principles of *Merdeka Belajar* Curriculum and the development of 21st-century global competencies. Overall, AI-based AHS has the potential to transform history pedagogy in multicultural societies by encouraging reflective, ethical reasoning and a more inclusive historical awareness.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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