Designing a Cross-Device LMS Model to Promote Critical and Historical Thinking in Indonesian Senior High School History Education

Dadan Wildan[1,*], Siti Komariah[2], Wawan Darmawan[1], Fahruddin[3] & Ismaul Fitroh[4]

[1]History Education Study Programme, Indonesia University of Education, Bandung, Indonesia

[2]Sociology Education Study Program, Indonesia University of Education, Bandung, Indonesia

[3]Department of Historical Education, Universitas PGRI Yogyakarta, Yogyakarta, Indonesia

[4]History Education Study Program, Universitas Negeri Gorontalo, Gorontalo, Indonesia

*Correspondence: Indonesia University of Education, Bandung, Indonesia. E-mail: dadanwildan@upi.edu

Received: January 23, 2026 Accepted: February 23, 2026 Online Published: April 30, 2026

doi:10.5430/jct.v15n2p129 URL: https://doi.org/10.5430/jct.v15n2p129

Abstract

This study aimed to design and validate a cross-device, competency-based Learning Management System (LMS) to promote *Critical Thinking (CT)* and *Historical Thinking (HT)* among Indonesian senior high school students in history education. Using a Research and Development approach guided by the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), the research systematically developed, tested, and evaluated an LMS that integrates disciplinary and cognitive frameworks into a unified digital learning environment. A total of 500 students and 12 teachers from four public senior high schools in Bandung participated in the implementation stage, which combined classroom instruction with digital activities through four main modules: *Case Discussion Forum, Source Analysis, Timeline Builder,* and *Reflective Portfolio.* Expert validation yielded an overall mean score of 4.60 (Excellent), confirming strong pedagogical and technological quality. Empirical results from pre- and post-tests demonstrated significant improvement in CT and HT competencies—CT (M_1=63.42; M_2=80.16; g=0.47) and HT (M_1=60.87; M_2=78.95; g=0.46), with $p < 0.001$. System analytics showed high engagement (mean task completion rate = 87.4%), and evaluation feedback rated the LMS highly for content relevance (M=4.60) and pedagogical value (M=4.58). These results confirmed the system's effectiveness in fostering analytical reasoning, evidence evaluation, and reflective interpretation through cross-device accessibility. The developed LMS bridges the gap between curriculum goals and classroom practice by embedding higher-order thinking into digital pedagogy. Aligned with Indonesia's *Kurikulum Merdeka*, it offers a scalable, validated framework that transforms history learning into a reflective, evidence-based process while contributing both theoretically and practically to digital pedagogy and disciplinary thinking.

Keywords: learning management system, critical thinking, historical thinking, digital pedagogy, Kurikulum Merdeka

1. Introduction

1.1 Background of the Study

In the 21st century, history education is increasingly expected to move beyond the memorization of dates and events toward the cultivation of critical and reflective citizens. The ability to critically analyze sources, understand historical context, and construct evidence-based interpretations is essential for students to engage with both past and present social realities (Fahruddin, Kurniawanti, et al., 2025; Fahruddin & Saefudin, 2025). However, in many Indonesian senior high schools, the teaching of history remains predominantly teacher-centered and textbook-driven, offering limited opportunities for students to engage in deeper historical inquiry or exercise higher-order thinking skills. Research shows that students often lack structured opportunities to develop historical thinking abilities such as sourcing, contextualization, and corroboration, which are vital for understanding the complexity and relevance of historical narratives (Bures et al., 2022; Tirado-Olivares, 2021). Moreover, critical thinking—encompassing analysis, evaluation, inference, explanation, and interpretation—is rarely embedded explicitly within instructional design, particularly in digital learning environments tailored for secondary history education (Temerbayeva et al., 2023; Villarino, 2025).

At the same time, the integration of educational technology—particularly Learning Management Systems (LMS) that

support mobile and desktop access—has emerged as a promising avenue for enhancing students' engagement and thinking skills in history learning. LMS platforms provide structured learning paths, collaborative activities, and authentic assessments that can support inquiry-based and student-centered approaches when properly designed (Brohinsky, 2023; Martinez & Montoya, 2023). However, existing LMS implementations in Indonesian schools often focus on content delivery rather than promoting disciplinary reasoning or critical-historical engagement. Furthermore, few digital models have been developed specifically for history education in the senior high school context that intentionally integrate critical thinking (CT) and historical thinking (HT) into their pedagogical framework. Addressing this gap, the present study develops a cross-device, competency-based LMS tailored to foster both CT and HT in senior high school history classrooms. This approach aligns with the goals of Indonesia's Kurikulum Merdeka, which emphasizes independent learning, contextual understanding, and the development of higher-order thinking skills among students (Fahruddin, Salamah, et al., 2025; Zulkarnain et al., 2025).

1.2 Main Research Problem and General Solution

Despite increasing recognition of the importance of higher-order thinking in history education, current instructional practices in Indonesian senior high schools remain largely limited to factual transmission, offering minimal support for students to engage in historical reasoning or critical reflection. Most digital platforms used in schools serve primarily as content repositories, lacking structured features that foster critical and historical thinking through inquiry, discussion, and interpretation (Cristina et al., 2020; Lampropoulos, 2024). This creates a significant gap between curricular expectations—such as those outlined in the Kurikulum Merdeka—and actual classroom implementation. To address this issue, the present study proposes the development of a cross-device, competency-based Learning Management System (LMS) specifically designed to enhance students' critical and historical thinking (Domenici, 2023; Idacavage & McAndrews, 2024). By embedding interactive modules, document-based tasks, collaborative forums, and digital portfolios into an accessible mobile–desktop platform, the study aims to create a structured digital learning environment that promotes analytical engagement with historical content and supports student-centered history learning.

1.3 Specific Solution from the Scientific Literature

Recent developments in history education and instructional technology emphasize the potential of Learning Management Systems (LMS) to promote deeper student engagement when designed with clear pedagogical goals. Bures et al. (Bures et al., 2022) introduced six core concepts of historical thinking—such as sourcing, contextualization, and cause-effect—which serve as foundational competencies for developing disciplinary literacy in history. When paired with critical thinking frameworks such as Sorina (2024) five dimensions—analysis, evaluation, inference, explanation, and interpretation—these historical thinking concepts can guide the design of digital learning activities that do more than transmit content: they activate analytical reasoning. Research has shown that when students engage in activities like analyzing primary sources, debating historical interpretations, or constructing evidence-based narratives, their capacity for both critical and historical thinking improves significantly (Granado-Peinado & Huertas, 2023; Nygren et al., 2019). However, few studies have operationalized these frameworks within a digital LMS environment tailored specifically for high school students, especially in Southeast Asian contexts.

To bridge this pedagogical and technological gap, scholars have proposed LMS features that align with higher-order cognitive tasks—such as document analysis modules, peer feedback systems, collaborative forums, and performance-based portfolios (Abuhassna et al., 2021; Tirado-Olivares, 2021). These features, when delivered through mobile and desktop platforms, not only increase accessibility but also allow for blended and flexible learning that supports independent inquiry. In particular, integrating learning analytics into LMS platforms enables teachers to track engagement and reasoning patterns, providing data-driven feedback that further scaffolds students' critical development (Lu et al., 2021; Nussbaum et al., 2021). Nevertheless, there remains limited application of such integrative approaches in Indonesian history classrooms, where LMS use tends to be procedural rather than reflective. This study draws upon these scientific principles to design a competency-based, cross-device LMS that activates both critical and historical thinking through structured digital tasks, aligned with current curricular reforms and best practices in digital pedagogy.

1.4 Specific Literature Review That Finally Led to Research Gaps

Several studies have examined the integration of technology in history education, highlighting its potential to increase student engagement, support independent learning, and provide access to diverse historical resources (Corrales et al., 2024; Marín et al., 2022). In particular, mobile and web-based platforms have been shown to facilitate flexible and contextualized learning, allowing students to access content and activities both inside and outside the classroom (Efiloğlu Kurt, 2023). Studies by Brohinsky (2023) and Martinez & Montoya (2023) have emphasized the role of

collaborative digital spaces in fostering reflective thinking. However, most of these innovations remain focused on general engagement or technology adoption, rather than on explicitly supporting the development of *critical thinking* or *historical reasoning*. Furthermore, many technology-enhanced history programs target university students or informal learning settings, with limited applicability for structured classroom instruction in senior high schools.

In the Indonesian context, research on technology use in history education has primarily explored media selection, motivation, or content delivery strategies, without embedding disciplinary thinking frameworks into the learning design (Fadli et al., 2022; Mulyana & Kurniawati, 2020). Moreover, while studies on LMS-based learning have grown, few have been tailored to the specific cognitive demands of historical analysis—such as evaluating sources, constructing interpretations, or understanding causality. Even fewer studies address how such competencies can be activated through mobile–computer integration in environments constrained by uneven infrastructure. There remains a significant research gap in developing and validating a structured, cross-device LMS that is pedagogically aligned with both critical thinking and historical thinking principles, especially in the context of Indonesian senior high school history classrooms. This gap forms the core rationale for the present study, which seeks to offer a scientifically grounded, technologically accessible, and pedagogically meaningful solution to bridge content delivery and cognitive engagement in history education (Ofianto et al., 2022; Pratama et al., 2024).

Despite the growing body of research on digital learning in history education, three key gaps remain. First, most LMS implementations emphasize content delivery and general engagement rather than explicitly integrating Critical Thinking (CT) and Historical Thinking (HT) into a single competency-based design. Second, empirical studies that validate such integration at the senior high school level, particularly in Southeast Asian contexts, remain limited in scale and methodological rigor. Third, few models combine cross-device accessibility with learning analytics to support structured scaffolding and evidence-based feedback. Addressing these gaps, this study develops and validates a cross-device, competency-based LMS that operationalizes CT and HT through inquiry-based modules aligned with Kurikulum Merdeka.

1.5 Objective, Statement of Novelty, and Scope of Study

The primary objective of this study is to design and validate a cross-device, competency-based Learning Management System (LMS) that promotes both critical and historical thinking in Indonesian senior high school history education. Drawing from established theoretical frameworks—Facione's dimensions of critical thinking and Seixas and Morton's historical thinking concepts—the study aims to create a structured digital learning environment that engages students in analytical, interpretive, and evidence-based historical reasoning. The novelty of this research lies in the explicit integration of critical thinking and historical thinking within a single LMS model, designed for cross-device accessibility (mobile and desktop), and aligned with the demands of Indonesia's Kurikulum Merdeka, which calls for higher-order thinking and independent learning. While existing LMS applications in history learning often focus on factual recall or basic content interaction, this study proposes a pedagogically grounded model that supports inquiry-based tasks, collaborative source analysis, and reflective digital portfolios—an approach not yet systematically explored at the high school level in the Indonesian context.

This research employs a Research and Development (R&D) methodology guided by the ADDIE framework (Analysis, Design, Development, Implementation, Evaluation), with implementation focused on students in selected Indonesian senior high schools. The scope of the study includes (1) the development of the LMS prototype based on user needs analysis and pedagogical frameworks; (2) validation of the system's content, usability, and pedagogical alignment by experts in history education and instructional technology; and (3) empirical testing of its effectiveness through pre- and post-assessment of students' critical and historical thinking competencies. The study is limited to the domain of history education in formal classroom settings and does not extend to informal or extracurricular learning contexts. The hypothesis underlying this study is that a competency-based, cross-device LMS that integrates both critical and historical thinking dimensions will significantly enhance students' cognitive engagement and reasoning abilities in history learning. This justification is supported by the convergence of recent pedagogical literature and digital learning innovations, yet remains underexplored in empirical classroom-based research in Southeast Asia.

2. Literature Review

2.1 Critical Thinking in Secondary History Education

Critical thinking is widely recognized as an essential 21st-century skill, enabling learners to analyze information, evaluate evidence, construct reasoned arguments, and make informed decisions. In the context of history education, critical thinking becomes particularly vital because the discipline itself involves interpreting complex events, assessing

multiple perspectives, and questioning the reliability of historical sources. Adway (Adway, 2023) defines critical thinking as a purposeful, self-regulatory judgment that results in interpretation, analysis, evaluation, inference, and explanation. These dimensions align closely with the intellectual tasks required in historical inquiry, such as comparing sources, assessing causality, and justifying interpretations. Thus, fostering critical thinking in history education is not an add-on, but a fundamental component of meaningful engagement with the past.

However, the integration of critical thinking into secondary history education remains inconsistent, particularly in countries like Indonesia where traditional, textbook-based teaching approaches are still dominant. Empirical studies have shown that history classes often prioritize rote memorization and chronological recall over analytical reasoning (Darsono et al., 2024; Kwangmuang et al., 2021). As a result, students are rarely challenged to critique narratives, assess bias, or synthesize diverse viewpoints—skills that are central to historical understanding. Furthermore, assessment practices in history education tend to focus on factual recall rather than argument construction or source evaluation. These limitations hinder students' ability to engage in higher-order thinking and reduce history to a static body of knowledge rather than a dynamic field of interpretation.

Recent literature advocates for pedagogical strategies that intentionally embed critical thinking into the design of history instruction. For example, the use of open-ended questions, document-based inquiry, debate formats, and problem-based learning has been found to promote student engagement and cognitive development (Andersson & Palm, 2017; Toma et al., 2024). In digital learning environments, features such as discussion forums, guided source analysis tools, and reflective assessments can be used to activate the key dimensions of critical thinking in a structured way. However, there is a scarcity of models—especially at the high school level—that integrate these strategies into a cohesive, technology-supported system aligned with national curricular goals. This gap underscores the need for a structured, accessible learning model that places critical thinking at the core of history learning experiences in secondary education.

2.2 Historical Thinking: Concepts and Classroom Applications

Historical thinking refers to the disciplinary habits of mind that allow learners to interpret the past in a thoughtful, evidence-based manner. It involves understanding that history is not merely a collection of facts, but a constructed interpretation based on sources, context, and perspective. Fahruddin (Fahruddin & Saefudin, 2025) conceptualize historical thinking through six interrelated dimensions: historical significance, evidence (sourcing), continuity and change, cause and consequence, historical perspectives, and the ethical dimension. These dimensions encourage students to ask complex questions about the past: *Whose voices are represented or silenced? Why did this event happen when it did? How do we know this is true?* Rather than accepting textbook narratives at face value, students are invited to consider multiple viewpoints, question assumptions, and draw reasoned conclusions from historical evidence.

In practical classroom applications, historical thinking can be fostered through the use of primary source analysis, debates on historical controversies, construction of historical arguments, and comparison of differing accounts. Studies have shown that such activities help students develop skills in sourcing, contextualizing, and corroborating information (Gillate et al., 2023; Samuelsson, 2019). For example, when students engage with documents from different perspectives—such as colonial records versus indigenous testimonies—they learn to evaluate bias and construct nuanced interpretations. Inquiry-based learning tasks in history, where students investigate a central question using historical evidence, have also proven effective in cultivating deeper understanding. However, these practices require well-structured scaffolding and a shift away from teacher-centered delivery models that dominate many history classrooms, particularly in Southeast Asia.

In Indonesia, the implementation of historical thinking in secondary education is still limited, both in policy and in practice. Although curriculum documents such as the Kurikulum Merdeka emphasize higher-order thinking and inquiry, many history teachers continue to rely on didactic instruction and textbook content due to time constraints, assessment pressures, and lack of pedagogical training (Darsono et al., 2024; Ogah, 2023). In addition, most digital resources available to teachers are designed for content transmission rather than historical inquiry. As a result, students are rarely given opportunities to reconstruct historical narratives or critically examine sources in a systematic way. This highlights the urgent need for instructional designs—particularly digital ones—that embed the core principles of historical thinking into learning activities, assessments, and technology features accessible to students at the high school level.

2.3 Cross-Device Learning Management Systems (LMS) in History Education

The rapid development of educational technology has positioned Learning Management Systems (LMS) as essential tools in facilitating structured, scalable, and interactive learning environments. In secondary education, LMS platforms enable teachers to organize instructional content, assign activities, track student progress, and facilitate asynchronous

collaboration. When designed intentionally, LMS features can support student-centered learning by offering a mix of multimedia content, adaptive assessments, peer interaction, and reflective tasks (Brewis & Hannan, 2023; Jaramillo & Chiappe, 2024). With the increased use of mobile devices among students, the demand for cross-device compatibility—allowing seamless access across smartphones, tablets, and desktop computers—has become critical. Such accessibility enhances learning flexibility, particularly for students in diverse geographical or infrastructural contexts, as is common in Indonesia.

Despite their growing adoption, many LMS implementations in history education remain underutilized in terms of pedagogical depth. Common uses include uploading PowerPoint slides, providing links to online readings, or administering multiple-choice quizzes—activities that often replicate surface-level classroom practices in digital form. These systems rarely facilitate higher-order cognitive engagement, such as analyzing conflicting historical accounts, engaging in evidence-based debate, or constructing historical narratives. Research shows that LMS platforms designed without pedagogical alignment often fail to foster deep learning or sustained inquiry (Budiastuti et al., 2023; Darmawan et al., 2025). In contrast, models that integrate features such as source annotation tools, peer discussion forums, and portfolio-based assessments can directly activate dimensions of both critical and historical thinking, particularly when guided by clearly defined competencies.

In the Indonesian senior high school context, the use of LMS platforms remains fragmented and varies widely in quality and consistency. While some schools have adopted national or local LMS tools, their use tends to focus on administrative efficiency rather than pedagogical transformation. Moreover, few existing systems have been designed specifically for the needs of history education or tailored to promote historical reasoning in students. The lack of cross-device optimization further limits accessibility for students who rely heavily on mobile phones (Fahruddin et al., 2024; Fahruddin, Salamah, et al., 2025). This presents a design opportunity: a purpose-built, competency-based LMS that integrates critical and historical thinking tasks, functions effectively across devices, and aligns with curricular goals such as those promoted in the Kurikulum Merdeka. The present study addresses this opportunity by proposing and testing such a model within the specific instructional demands of Indonesian secondary history classrooms.

3. Materials and Methods

3.1 Type of Research and Research Design

This study employed a Research and Development (R&D) methodology following the ADDIE instructional design model—a systematic framework consisting of five phases: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009; Serevina et al., 2024). The R&D approach was selected to enable iterative and evidence-based development of a cross-device Learning Management System (LMS) specifically tailored to enhance students' critical and historical thinking in senior high school history education. ADDIE was chosen due to its flexibility in educational product development and its capacity to integrate user needs, instructional goals, technological tools, and formative feedback throughout the process. The research design included (1) a needs analysis through document review and teacher-student interviews; (2) the design and development of the LMS prototype based on theoretical and pedagogical frameworks; (3) implementation in selected schools; and (4) evaluation through expert validation and pre–post testing to assess the effectiveness of the system. This structured process aligns with prior educational technology studies utilizing ADDIE to ensure both usability and pedagogical coherence (Branch, 2009; Illene et al., 2023; Serevina et al., 2024).

3.2 Population and Sample

The population of this study consisted of both students and teachers involved in senior high school history education at four public schools in Bandung, West Java, Indonesia. The research targeted Grade XI students, as this level typically addresses more complex historical themes and analytical reasoning tasks within the Indonesian curriculum. The inclusion criteria were based on accessibility, curriculum relevance, and readiness to integrate digital learning tools in classroom settings. A purposive sampling technique was applied to ensure that participants had regular access to mobile or desktop devices and actively participated in history learning during the LMS implementation period. A total of 500 Grade XI students and 8 history teachers (two from each participating school) were selected from SMAN 1 Bandung, SMAN 5 Bandung, SMAN 7 Bandung, and SMAN 8 Bandung. Each school represented an academically strong environment with adequate technological infrastructure to support cross-device learning. The even distribution of samples across schools enabled comparative insights and reduced sampling bias.

During the six-week LMS-based intervention, teachers played a critical facilitative role by integrating the LMS into regular history lessons, guiding students through four core modules—Case Discussion Forum, Source Analysis Module,

Timeline Builder, and Reflective Portfolio. Teachers also monitored student activity through the Performance Dashboard and provided formative feedback using analytics-based insights. Meanwhile, students engaged in inquiry, analysis, and reflection tasks through the LMS, and completed pre- and post-tests measuring Critical Thinking (CT) and Historical Thinking (HT) competencies. System analytics captured patterns of engagement such as forum participation, task completion, and reflection entries, serving as supporting data for evaluating the LMS's pedagogical effectiveness.

3.3 Instruments and Their Functions

Several instruments were employed in this study to support the development, implementation, and evaluation of the LMS model. First, a needs analysis questionnaire was distributed to history teachers and students to identify learning challenges, preferred digital tools, and expectations related to critical and historical thinking—serving as the basis for system design in the Analysis phase of ADDIE. Second, an expert validation rubric was used by instructional design and history education experts to evaluate the content relevance, usability, and pedagogical alignment of the LMS prototype. Third, a critical and historical thinking test—adapted from validated instruments based on Facione's and Seixas's frameworks—was administered before and after the intervention to measure learning gains. Fourth, an observation sheet was used to document student engagement and teacher facilitation during the implementation phase. Lastly, system analytics logs embedded in the LMS were utilized to track students' interaction patterns, including task completion rates, forum participation, and portfolio submissions. Each instrument contributed to a different stage of the ADDIE model, ensuring both formative and summative data collection.

The Critical and Historical Thinking Test was developed based on the study's CT and HT frameworks and administered as both pre-test and post-test. The instrument measured five CT dimensions (analysis, evaluation, inference, explanation, interpretation) and core HT dimensions relevant to secondary history learning (e.g., sourcing/evidence use, contextualization, cause–consequence, continuity and change, and historical perspective). Items were designed in a document-based format, requiring students to interpret historical stimuli (texts/images) and justify responses using evidence. Content validity was ensured through expert review by history education specialists, and scoring was guided by an analytic rubric aligned with the CT–HT indicators. The test consisted of 30 items (15 CT and 15 HT). A pilot administration involving 60 students yielded a Cronbach's alpha coefficient of 0.86, indicating high internal consistency. Open-ended responses were evaluated independently by two raters, with interrater reliability reaching Cohen's $\kappa = 0.82$, demonstrating strong scoring agreement.

3.4 Data Collection, Data Analysis, and ADDIE Procedures

Data collection and analysis in this study were integrated into the five phases of the ADDIE model to ensure a systematic instructional design and evaluation process. During the Analysis phase, qualitative data from interviews and quantitative data from needs assessment questionnaires were analyzed descriptively to identify gaps in students' historical and critical thinking development. In the Design phase, theoretical frameworks and empirical findings were translated into learning objectives, task types, and LMS feature specifications. The Development phase involved constructing the LMS prototype, followed by expert validation using rubrics; data were analyzed using descriptive statistics and qualitative comments to guide revisions. The Implementation phase included classroom deployment of the LMS in four schools, during which data were collected through pre- and post-tests, observations, and system analytics. Finally, in the Evaluation phase, quantitative analysis of the pre- and post-test scores was conducted using paired sample t-tests to measure the effectiveness of the LMS in improving critical and historical thinking. Triangulation from multiple instruments—including student engagement logs and observation notes—strengthened the validity of the findings throughout the procedure.

4. Results

4.1 Analysis Phase

The analysis phase identified key needs and challenges in integrating critical thinking (CT) and historical thinking (HT) into senior high school history education. Data were collected through student questionnaires and teacher interviews across four public high schools in Bandung, guiding the design of LMS features, instructional flow, and module competencies.

4.1.1 Student Needs and Digital Learning Habits

A total of 500 students completed a needs assessment exploring their learning difficulties, preferred formats, device access, and digital familiarity (Table 1).

Table 1. Summary of Student Responses – Learning Needs and Digital Readiness (N=500)

Indicator	Percentage (%)
Find it difficult to analyze historical sources	68.2%
Prefer visual and interactive materials	74.5%
Rarely asked to give opinions in history class	65.6%
Access to both smartphone and desktop/laptop	82.4%
Never used LMS in history subject before	71.8%

Findings reveal a gap between students' digital access and classroom practice. Although most students have digital devices, over 70% have never used an LMS for history learning. Many also struggle with source analysis and lack opportunities for critical engagement, indicating underdeveloped CT and HT skills.

4.1.2 Teacher Perspectives on Challenges in CT and HT Integration

In-depth interviews were conducted with 8 history teachers (2 from each participating school). The results are summarized in Table 2 and reveal recurring barriers to implementing critical and historical thinking in classroom instruction.

Table 2. Key Themes from Teacher Interviews Regarding CT & HT Challenges

Theme	Representative Statements
Time constraints in curriculum delivery	"We have to finish so many topics that there's no time for deeper discussions."
Lack of training in teaching HT	"I've never received formal training on historical thinking strategies."
Assessment focused on factual recall	"Most school exams test memorization, not reasoning or interpretation."
Technology used only for content sharing	"We use Google Classroom, but only to post PowerPoints and assignments."

The results point to a disconnect between curriculum goals emphasizing higher-order thinking and classroom realities. Teachers are open to innovation but limited by rigid assessments, lack of training, and inadequate pedagogical resources.

4.1.3 Identified Competency Gaps in CT and HT

Based on pre-implementation diagnostic questions embedded in the initial LMS setup (pilot), students were asked to self-assess their confidence in five dimensions of critical thinking and four core aspects of historical thinking. The aggregate results are presented in the Figure 1 below.

Fewer than 35% of students felt confident in sourcing or corroborating historical evidence, and only 30–40% were comfortable with evaluation and inference—key CT skills. These findings underscore the need for structured, integrated instruction to strengthen CT and HT competencies. Beyond indicating low confidence levels, Figure 1 reveals a meaningful pattern: students reported the weakest readiness in sourcing and corroboration, suggesting limited prior exposure to evidentiary reasoning and cross-checking historical claims. This aligns with the teacher interview themes indicating that classroom assessment is often dominated by factual recall rather than argumentation. Similarly, relatively low confidence in evaluation and inference points to underdeveloped reasoning practices such as judging credibility, detecting bias, and drawing warranted conclusions from evidence. These diagnostic findings provide a direct design rationale for the LMS modules, particularly the Source Analysis Module (to scaffold sourcing/corroboration) and the Case Discussion Forum (to structure evaluation and inference through argument-based interaction).

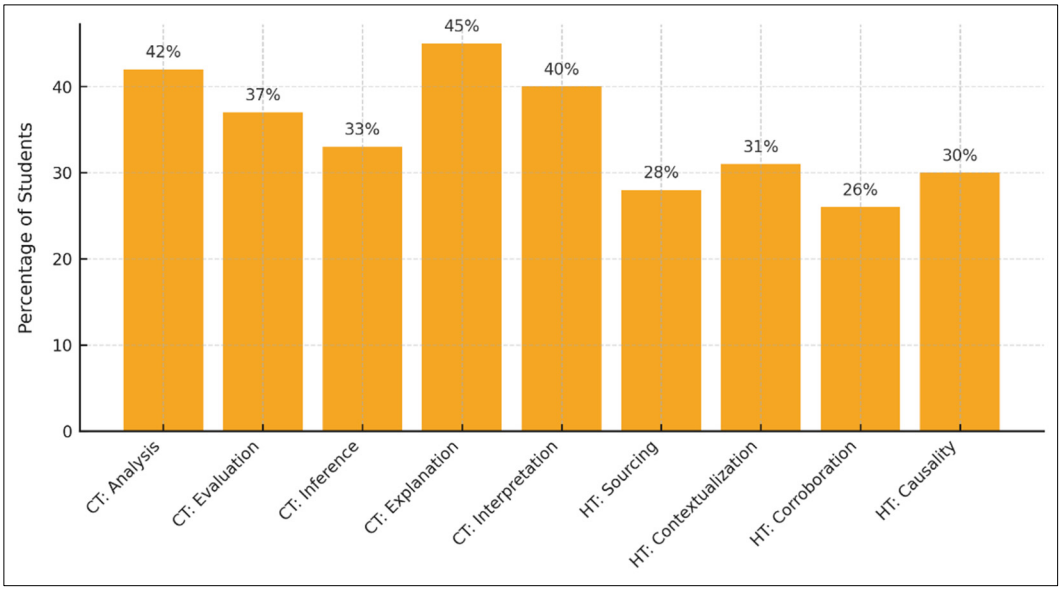

Figure 1. Student Self-Assessment of CT and HT Competency Areas

4.2 Design Phase

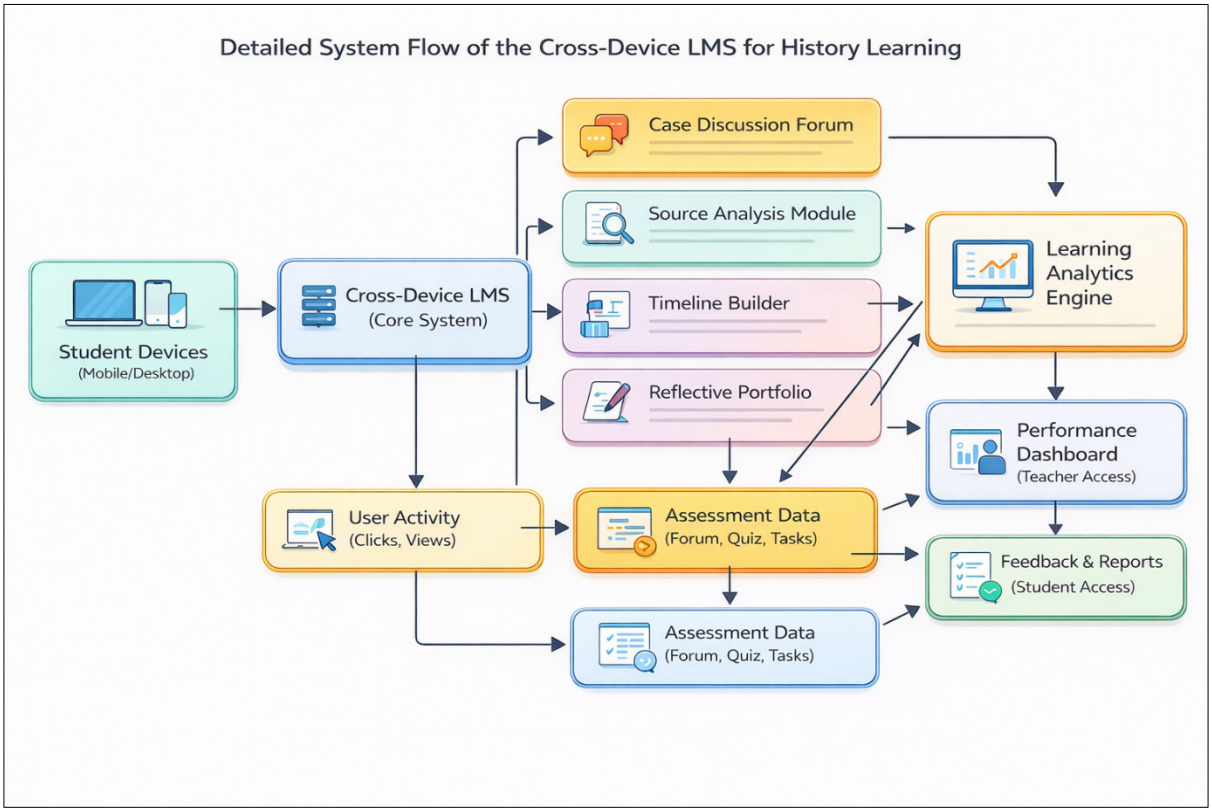

Figure 2. System Flow of the Cross-Device LMS for History Learning

In the design phase, the Learning Management System (LMS) was structured to bridge pedagogical needs with technological accessibility, ensuring seamless integration of learning, assessment, and feedback processes. The system was built around a centralized LMS core accessible via both mobile and desktop devices, and was designed to facilitate four key learning modules: Case Discussion Forum, Source Analysis Module, Timeline Builder, and Reflective Portfolio. Each module was aligned with specific aspects of critical and historical thinking, ensuring that students engage in higher-order reasoning tasks throughout the learning process. Furthermore, all student interactions within the system—such as clicks, submissions, and discussions—are automatically logged as user activity and assessment data, enabling real-time processing through a Learning Analytics Engine. This flow of data supports adaptive instruction and timely feedback, making the system both responsive and evidence-driven.

The Figure 2 illustrates the system design stage of a Research and Development (RnD) study, depicting the workflow of a Cross-Device Learning Management System (LMS) for history learning. The diagram shows how student devices (mobile and desktop) are connected to the core LMS system, which manages various learning modules such as the *Case Discussion Forum*, *Source Analysis Module*, *Timeline Builder*, and *Reflective Portfolio*. Data generated from user activities and assessment results (forums, quizzes, assignments) are processed by the Learning Analytics Engine, which then presents the analysis through a Performance Dashboard for teachers and Feedback & Reports for students. Overall, the figure represents the system architecture design that integrates learning activities, evaluation, and analytics across multiple devices to support effective and adaptive history learning.

4.3 Development Phase

The Development Phase focused on transforming the LMS design into a functional prototype aligned with the principles of critical and historical thinking. The system was developed using a responsive web framework to ensure seamless access across desktop and mobile devices, incorporating four key modules: Case Discussion Forum, Source Analysis Module, Timeline Builder, and Reflective Portfolio. Each module was pedagogically structured to engage students in analytical reasoning, evidence evaluation, and reflective interpretation. Integrated system logs and a Learning Analytics Engine enabled real-time tracking of user activity, allowing teachers to monitor engagement and provide adaptive feedback. Expert validation was conducted by six specialists—three in history education, two in instructional design, and one in educational technology—using a 5-point Likert-scale rubric covering content relevance, usability, and pedagogical integration. Results, presented in Table 3, show that the LMS achieved an overall mean score of 4.60 (SD = 0.34), categorized as *Excellent*.

Table 3. Expert Validation Results of the Cross-Device LMS Prototype (n = 6)

Validation Dimension	Indicators (Examples)	Mean Score (M)	SD	Category
Content Relevance	Alignment with CT & HT frameworks; accuracy of historical sources; task authenticity	4.62	0.32	Excellent
Usability & Interface Design	Navigation clarity; cross-device accessibility; visual appeal; response speed	4.48	0.41	Very Good
Pedagogical Integration	Scaffolded inquiry structure; alignment with learning objectives; feedback mechanism	4.71	0.29	Excellent
Overall Mean	—	4.60	0.34	Excellent

Qualitative feedback highlighted strong integration of CT and HT frameworks and user-friendly features, though experts recommended refining mobile navigation and embedding assessment rubrics in the portfolio interface. Revisions were made accordingly to improve accessibility and clarity. Overall, the prototype demonstrated high pedagogical and technological validity, confirming its readiness for classroom implementation and subsequent testing in the Implementation Phase.

4.4 Implementation Phase

The Implementation Phase aimed to evaluate the operational feasibility and pedagogical effectiveness of the developed Cross-Device LMS prototype in real classroom contexts. The system was implemented over a six-week instructional period involving 500 Grade XI students from four public senior high schools in Bandung. The LMS was integrated into regular history lessons using a blended learning format, combining in-class discussions and digital learning activities through the four core modules: *Case Discussion Forum*, *Source Analysis Module*, *Timeline Builder*, and

Reflective Portfolio. Each activity was aligned with indicators of Critical Thinking (CT) and Historical Thinking (HT), while teachers facilitated student engagement and monitored performance through the built-in Performance Dashboard. Data collection consisted of (1) pre- and post-tests measuring CT and HT competencies, (2) observation checklists of student participation, and (3) system analytics logs capturing digital behavior (task completion, forum activity, and reflection frequency).

Quantitative results from the pre–post testing revealed a statistically significant improvement in both CT and HT competencies across all participating schools. The paired-sample t-test analysis, summarized in Table 4, indicated substantial gains in students' analytical reasoning, inference, and evidence-based interpretation. The average pre-test score for CT was 63.42, rising to 80.16 in the post-test, while HT scores improved from 60.87 to 78.95. The significance values ($p < 0.001$) confirmed that the LMS intervention had a measurable and positive effect on student learning outcomes. The computed *Normalized Gain (g)* values of 0.46 (moderate–high improvement) further demonstrate the system's impact in strengthening higher-order thinking skills in historical inquiry.

Table 4. Results of Paired-Sample t-Test on Critical and Historical Thinking Competencies (N = 500)

Competency Domain	Pre-Test Mean (M_1)	Post-Test Mean (M_2)	Mean Difference	SD	t-value	Sig. (p)	Normal. Gain (g)	Interpretation
Critical Thinking (CT)	63.42	80.16	16.74	9.82	28.37	<0.001	0.47	Significant, Moderate–High Gain
Historical Thinking (HT)	60.87	78.95	18.08	10.31	29.12	<0.001	0.46	Significant, Moderate–High Gain

To provide a more granular understanding of the learning outcomes, a detailed analysis was conducted for each indicator of Critical Thinking (CT) and Historical Thinking (HT). While the overall results demonstrated significant improvement in both domains, examining the gains at the indicator level allows for a clearer interpretation of how specific cognitive and disciplinary competencies developed during the LMS intervention. Tables 5 and 6 present the pre–post comparisons and normalized gain scores for each CT and HT dimension, respectively.

Table 5. Improvement in Each Critical Thinking Indicator

CT Indicator	Pre-Test Mean	Post-Test Mean	Mean Difference	Normalized Gain (g)	Interpretation
Analysis	62.85	82.10	19.25	0.52	High-Moderate Gain
Evaluation	64.10	81.35	17.25	0.49	Moderate–High Gain
Inference	63.90	79.80	15.90	0.45	Moderate Gain
Explanation	62.75	78.95	16.20	0.44	Moderate Gain
Interpretation	63.50	78.60	15.10	0.41	Moderate Gain
Overall Mean	63.42	80.16	16.74	0.47	Moderate–High Gain

A more detailed analysis of the Critical Thinking (CT) indicators reveals differentiated patterns of improvement across cognitive dimensions. The highest normalized gain was observed in Analysis ($g = 0.52$), followed by Evaluation ($g = 0.49$). These findings indicate that students significantly improved in their ability to examine historical evidence, identify arguments, and assess credibility—skills directly activated through the Source Analysis Module and Case Discussion Forum. Meanwhile, Inference ($g = 0.45$) and Explanation ($g = 0.44$) demonstrated moderate gains, suggesting strengthened reasoning and argument construction abilities. Although Interpretation ($g = 0.41$) showed slightly lower improvement compared to other indicators, the gain remained statistically significant and pedagogically meaningful. Overall, the balanced enhancement across all five CT dimensions confirms that the LMS effectively supported higher-order cognitive engagement rather than isolated skill development.

In the domain of Historical Thinking (HT), the most substantial improvement was found in Sourcing ($g = 0.53$) and Cause–Consequence reasoning ($g = 0.50$). These results reflect the strong impact of the Source Analysis Module and Timeline Builder, which explicitly scaffolded evidence evaluation and causal reasoning. Gains in Continuity and Change ($g = 0.46$) were also consistent with the system's chronological reconstruction tasks. Meanwhile, Historical Perspective ($g = 0.43$) and the Ethical Dimension ($g = 0.41$) demonstrated moderate improvement, suggesting that interpretive and moral-historical reasoning require deeper cognitive reflection and extended engagement. Nonetheless,

the positive gains across all five dimensions confirm that the LMS successfully activated core disciplinary thinking competencies in history education.

Table 6. Improvement in Each Historical Thinking Indicator

HT Indicator	Pre-Test Mean	Post-Test Mean	Mean Difference	Normalized Gain (g)	Interpretation
Sourcing (Evidence)	59.80	80.20	20.40	0.53	High-Moderate Gain
Cause–Consequence	60.45	79.90	19.45	0.50	Moderate–High Gain
Continuity & Change	61.10	78.60	17.50	0.46	Moderate Gain
Historical Perspective	61.75	77.80	16.05	0.43	Moderate Gain
Ethical Dimension	61.20	76.90	15.70	0.41	Moderate Gain
Overall Mean	60.87	78.95	18.08	0.46	Moderate–High Gain

Complementing the test results, system analytics and classroom observations offered qualitative insights into learner engagement and behavioral dynamics. The learning analytics data, shown in Table 7, indicate that student activity was consistently high across all modules, with a mean task completion rate of 87.4% and an average discussion participation rate of 78.6%. Notably, students who were more active in the *Case Discussion Forum* and *Source Analysis Module* demonstrated higher post-test gains in CT and HT, suggesting a strong correlation between active engagement and cognitive development. Teachers reported that the LMS's real-time dashboards facilitated targeted feedback and improved differentiation of instruction. However, several usability issues were noted, particularly in mobile-based typing responses and limited internet connectivity during synchronous sessions. Despite these constraints, both quantitative and qualitative evidence strongly support the system's pedagogical robustness and practical feasibility for large-scale classroom implementation.

Table 7. Summary of Student Engagement and Activity Data from LMS Analytics (N = 500)

LMS Module	Average Task Completion (%)	Forum Posts (Mean per Student)	Reflection Entries (Mean)	Average Session Duration (min)	Observed CT–HT Gain Correlation (r)
Case Discussion Forum	84.7	4.8	—	23.5	0.62
Source Analysis Module	89.1	2.7	—	26.8	0.65
Timeline Builder	85.3	—	—	18.9	0.54
Reflective Portfolio	90.6	—	2.4	29.2	0.59
Overall Mean	87.4	—	—	24.6	0.60

In summary, the implementation phase confirmed that the LMS effectively operationalized the pedagogical integration of critical and historical thinking within a digital learning environment. The significant gains in test scores, high engagement metrics, and positive teacher feedback collectively validate the system's instructional coherence and usability. From a methodological standpoint, the integration of quantitative (pre–post testing) and qualitative (analytics and observation) data ensured strong triangulation, enhancing the internal validity of the findings. These results establish a robust foundation for the subsequent Evaluation Phase, which further examines the system's long-term impact, scalability, and refinement for broader adoption in Indonesian history education.

4.5 Evaluation Phase

The Evaluation Phase served as the final stage of the ADDIE process, aimed at determining the effectiveness, usability, and pedagogical validity of the developed Cross-Device LMS model after classroom implementation. This stage combined summative and formative evaluation to ensure comprehensive assessment. Summative evaluation focused on the quantitative outcomes of student learning, particularly improvements in *Critical Thinking (CT)* and *Historical Thinking (HT)* competencies, while formative evaluation gathered user perceptions regarding the system's usability and instructional relevance. A total of 500 students and 12 teachers participated in the evaluation, providing both performance and satisfaction data. Four key dimensions—content relevance, interactivity and engagement, system usability, and pedagogical value—were assessed through a five-point Likert scale questionnaire. The results of this

evaluation are summarized in Table 8, providing an overview of users' responses across all dimensions.

Table 8. User Evaluation Results from Students and Teachers (N = 512)

Evaluation Dimension	Student Mean (N=500)	Teacher Mean (N=12)	Combined Mean	SD	Category
Content Relevance	4.61	4.54	4.60	0.31	Excellent
Interactivity & Engagement	4.55	4.48	4.54	0.36	Very Good
System Usability	4.42	4.39	4.42	0.38	Very Good
Pedagogical Value	4.59	4.52	4.58	0.29	Excellent
Overall Mean	**4.54**	**4.48**	**4.53**	**0.33**	**Excellent**

As shown in Table 6, both students and teachers rated the LMS very positively, with overall mean scores exceeding 4.5 out of 5, categorized as *Excellent*. The highest scores were recorded in *content relevance* and *pedagogical value*, demonstrating that the LMS effectively supported higher-order learning aligned with CT and HT objectives. Meanwhile, *system usability* received slightly lower ratings due to minor interface and connectivity issues in mobile access, which were noted as areas for further optimization. These perceptions were triangulated with the results of the summative evaluation, which revealed a consistent increase in students' CT and HT performance across the four participating schools. The average pre-test and post-test scores are presented in Figure 3, clearly showing significant and parallel gains in both domains. Specifically, *Critical Thinking* improved from an average of 63.5 to 80.2, while *Historical Thinking* rose from 60.8 to 78.5 across all schools.

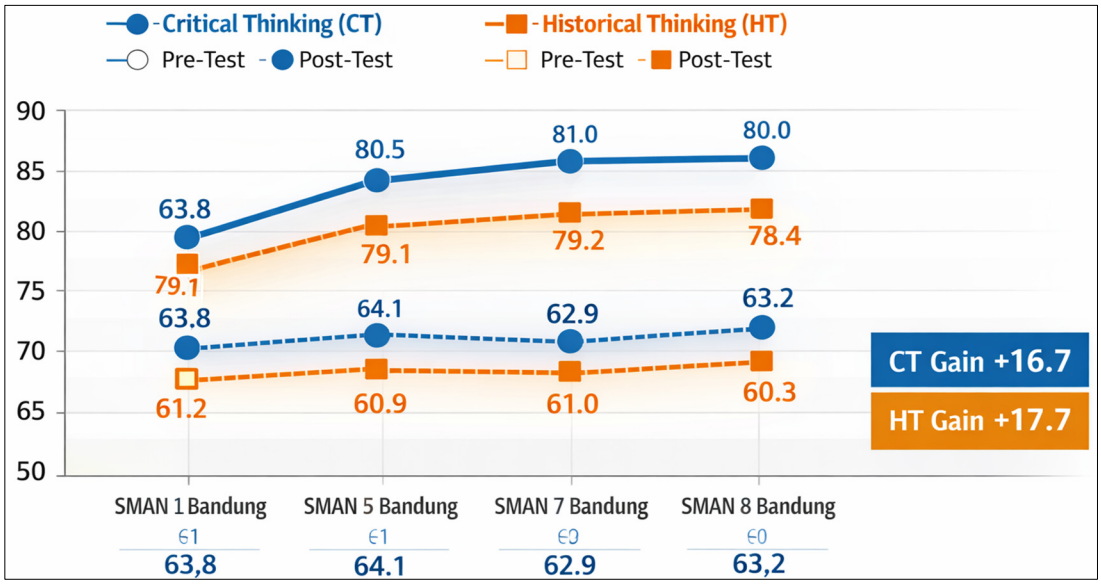

Figure 3. Average Pre-Post Gain in Critical and Historical Thinking Scores Across Schools

The evaluation results confirmed that the developed LMS achieved strong pedagogical validity and contextual adaptability. Quantitative gains in CT and HT scores, combined with high user satisfaction levels, provide robust evidence of the system's success in integrating disciplinary thinking with digital learning. The positive correlation between LMS engagement and performance improvement (r = 0.61) further supports the system's impact on cognitive growth. Nevertheless, reflective feedback highlighted the need for enhancing mobile responsiveness, providing offline access, and offering continuous teacher training for data-driven instruction. Overall, the evaluation phase validated the LMS as an effective, scalable, and pedagogically sound innovation that aligns with Indonesia's *Kurikulum Merdeka* objectives and strengthens students' capacity for critical and historical reasoning in digital history education.

5. Discussion

The differentiated gains across CT and HT indicators suggest that structured evidentiary tasks tend to yield higher improvement compared to interpretive-reflective dimensions. This pattern aligns with disciplinary cognition theory, which posits that evidentiary reasoning develops earlier than historiographical reflexivity. The LMS modules that required active document analysis and causal mapping were particularly effective in stimulating analytical growth.

The findings of this study strongly confirm that integrating Critical Thinking (CT) and Historical Thinking (HT) within a cross-device Learning Management System (LMS) can substantially enhance students' analytical and interpretive skills in history learning. Previous research in digital history education has primarily emphasized engagement and motivation (Pratama et al., 2024; Shume Nadew et al., 2024) rather than the cognitive depth of learning outcomes. In contrast, the present study demonstrated significant gains in CT and HT competencies (normalized gain = 0.46–0.47), supported by both quantitative evidence and user feedback. This aligns with Yaman's (Yaman et al., 2024) assertion that CT development requires explicit instructional scaffolds and Sousa's (Sousa et al., 2022) model of disciplinary thinking. However, unlike prior studies that examined these frameworks separately, this research operationalized them simultaneously through task-based digital modules that promote inquiry, corroboration, and reflection—marking a shift from content-oriented digital systems toward competency-based digital pedagogy.

Compared with earlier LMS-based studies in history education, which often focused on university students or informal learning settings (Abuhassna et al., 2021; Lu et al., 2021), this research advances the field by demonstrating how a pedagogically grounded LMS can be systematically applied in secondary school contexts within Indonesia. The integration of four core modules—*Case Discussion Forum*, *Source Analysis*, *Timeline Builder*, and *Reflective Portfolio*—created authentic spaces for historical reasoning and critical evaluation, supporting higher-order cognitive engagement. The system's Learning Analytics Engine also represents a methodological advancement, allowing real-time monitoring and adaptive feedback mechanisms rarely present in prior models. This data-driven instructional loop aligns with emerging best practices in *learning analytics* (Jwai‹ed et al., 2024; Nussbaum et al., 2021; Rajab et al., 2024), illustrating how technology can extend teachers' ability to individualize feedback and scaffold reasoning development.

The current research thus offers a unique contribution by bridging technological innovation and disciplinary pedagogy in a contextually relevant manner. Unlike earlier Indonesian studies that focused on media use or content digitization (Efiloğlu Kurt, 2023; Johnston et al., 2024), this study introduces a validated, competency-based LMS that explicitly targets the development of CT and HT through cross-device accessibility and integrated analytics. The system not only improved measurable learning outcomes but also received high satisfaction ratings (M = 4.53), reflecting its usability and pedagogical value. More importantly, it provides a scalable and empirically tested model aligned with the *Kurikulum Merdeka* framework—bridging the gap between policy aspirations and classroom realities. Consequently, this study contributes both theoretically and practically to the growing field of digital history pedagogy, positioning the cross-device LMS as a replicable model for cultivating higher-order thinking in secondary education.

The results of this study hold significant scientific importance for the field of history education and instructional technology. The integration of *Critical Thinking (CT)* and *Historical Thinking (HT)* competencies within a single, cross-device LMS model provides empirical evidence supporting the fusion of disciplinary and cognitive frameworks in digital learning design. By demonstrating measurable gains in both CT and HT, this research reinforces the theoretical claim that higher-order thinking can be effectively cultivated through structured, inquiry-based digital tasks rather than passive content consumption. This extends the work of Al-Ajmi (Al-Ajmi & Aljazzaf, 2020) and Efiloglu Kurt (Efiloğlu Kurt, 2023) by operationalizing their abstract frameworks into actionable pedagogical tools. Consequently, the study advances the scientific understanding of how technology-mediated scaffolding can activate complex reasoning processes and foster epistemic awareness in adolescent learners—an area that has been underexplored in secondary education research.

From a pedagogical and instructional standpoint, the findings underline the potential of competency-based digital ecosystems to transform history learning from a memorization-oriented activity into an analytical and interpretive process. The significant pre–post gains in CT and HT scores, combined with high student engagement (87.4% task completion), suggest that digital learning environments designed with explicit cognitive alignment can achieve both engagement and depth. The built-in *Learning Analytics Engine* proved crucial in supporting formative assessment, enabling teachers to deliver timely feedback and adapt instruction based on individual learning patterns. This demonstrates a shift from traditional teacher-centered models toward data-informed, adaptive instruction, a cornerstone of 21st-century pedagogy. Such an approach not only enhances student learning outcomes but also empowers educators to make evidence-based instructional decisions (Asfiya et al., 2024; Stracqualursi & Agati, 2024).

The practical implications of this study are particularly relevant for the Indonesian educational context and beyond. The LMS model aligns directly with the objectives of *Kurikulum Merdeka*, providing a scalable digital solution that promotes critical inquiry, contextual understanding, and autonomous learning (Laine et al., 2023; Pramono et al., 2021; Purnomo et al., 2023). Its cross-device functionality ensures accessibility in varied infrastructural settings, addressing equity in digital participation. For policymakers, the model offers a validated framework for integrating cognitive competency development into national e-learning systems. For practitioners, it provides a concrete example of how digital platforms can be used not merely as delivery tools, but as environments for cultivating disciplinary reasoning. Overall, this research contributes a scientifically grounded, pedagogically meaningful, and technologically feasible blueprint for implementing critical and historical thinking at scale within digital education systems.

6. Conclusion

This study concludes that the development and implementation of a cross-device, competency-based Learning Management System (LMS) effectively enhanced students' *Critical Thinking (CT)* and *Historical Thinking (HT)* skills in Indonesian senior high school history education. Through the systematic application of the ADDIE model, the research demonstrated that integrating disciplinary frameworks with digital pedagogy can bridge the gap between curriculum objectives and classroom realities. Empirical results showed significant gains in CT and HT competencies, high levels of student engagement, and strong user satisfaction, confirming the system's pedagogical validity and usability. Scientifically, the study contributes to the growing evidence that technology-mediated scaffolding can foster higher-order reasoning when designed with cognitive alignment and inquiry-based principles. Practically, it provides educators and policymakers with a replicable, data-driven model aligned with the *Kurikulum Merdeka*, capable of transforming history learning into a reflective, analytical, and evidence-based process.

7. Suggestions

Future research should expand on this study by exploring the long-term impact and scalability of the cross-device LMS model across diverse educational settings and subject domains beyond history. Longitudinal studies could examine how sustained use of the system influences students' metacognitive growth, disciplinary literacy, and digital citizenship. Further investigations might also integrate artificial intelligence and adaptive analytics to enhance personalization, or explore the use of immersive technologies such as augmented and virtual reality to deepen contextual historical understanding. Comparative studies across regions or curricula could evaluate the model's adaptability to varied pedagogical cultures. By advancing these research directions, scholars can build upon the novelty of this work—specifically its fusion of *critical* and *historical thinking* frameworks within a competency-based digital platform—thereby enriching the theoretical and practical foundations of digital pedagogy and cognitive learning design in the 21st century.

References

Abuhassna, H., Yahya, N., Aman, M., Megat, Z., & Al-maatouk, Q. (2021). Guidelines for Designing Distance Learning Courses via Moodle to Enhance Students Satisfaction and Achievements. *International Journal of Information and Education Technology*, *11*(12), 574-582. https://doi.org/10.18178/ijiet.2021.11.12.1567

Adway, A. M. (2023). The Impact of Television Drama in Understanding History. *Journal of Al-Tamaddun*, *18*(1), 67-78. https://doi.org/10.22452/JAT.vol18no1.6

Al-Ajmi, N. H., & Aljazzaf, Z. M. (2020). Factors influencing the use of multimedia technologies in teaching english language in Kuwait. *International Journal of Emerging Technologies in Learning*, *15*(5), 212-234. https://doi.org/10.3991/IJET.V15I05.12277

Andersson, C., & Palm, T. (2017). Characteristics of improved formative assessment practice. *Education Inquiry*, *8*(2), 104-122. https://doi.org/10.1080/20004508.2016.1275185

Asfiya, N., Razi, P., Hidayati, & Sari, S. Y. (2024). Development of e-Module for Independent Learning of Physics Material Based on Independent Curriculum. *International Journal of Information and Education Technology*, *14*(5), 761-769. https://doi.org/10.18178/ijiet.2024.14.5.2100

Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. Springer.

Brewis, G., & Hannan, K. (2023). The Worlds of UCL: teaching, learning and institutional histories. *London Review of Education*, *21*(1), 1-12. https://doi.org/10.14324/LRE.21.1.12

Brohinsky, J. (2023). When the Light Goes Out: Ignorance and Multiplicity in Teaching and Learning. *ECNU Review of Education*, 1-19. https://doi.org/10.1177/20965311231167190

Budiastuti, E., Sugiyem, & Puad, F. N. A. (2023). Developing self-assessment instruments to measure students' performance characters in making dresses using a high-order thinking skills approach. *Cakrawala Pendidikan*, *42*(1), 27-37. https://doi.org/10.21831/cp.v42i1.50172

Bures, M., Ripka, V., Buresova, K., Frajtak, K., Maha, J., & Cinatl, K. (2022). An Innovative E-Learning Support for Modern History Distance Learning and the Experience during the COVID-19 Lockdown. *Sustainability (Switzerland)*, *14*(6), 1-19. https://doi.org/10.3390/su14063631

Corrales, M., Rodríguez, F., Merchán, M. J., Merchán, P., & Pérez, E. (2024). Comparative Analysis between Virtual Visits and Pedagogical Outings to Heritage Sites: An Application in the Teaching of History. *Heritage*, *7*(1), 366-379. https://doi.org/https://doi.org/10.3390/heritage7010018

Cristina, A., Gil-mediavilla, M., & Ildefonso, Á. (2020). The Influence of Social Networks within Educational and Social Fields : A Comparative Study between Two Generations of Online Students. *Sustainability*, *12*(9941), 1-12. https://doi.org/10.3390/su12239941

Darmawan, W., Kusmarni, Y., Pangestu, D. A., & Logayah, D. S. (2025). Developing Living History Model Assisted by Digital History Textbooks in History Learning to Improve Students' Historical Empathy. *Journal of Social Studies Education Research*, *16*(2), 343-376.

Darsono, Fahruddin, Birsyada, M. I., Judijanto, L., Muslim, A., Saefudin, A., & Saddhono, K. (2024). Environmental Exploitation in the Colonial Period: An Ecocritical Analysis of Pramoedya Ananta Toer's Buru Quartet. *Theory and Practice in Language Studies*, *14*(8), 2455-2464. https://doi.org/10.17507/tpls.1408.18

Domenici, V. (2023). Training of Future Chemistry Teachers by a Historical / STEAM Approach Starting from the Visit to an Historical Science Museum. *Substantia*, *7*(1), 23-34. https://doi.org/10.36253/SUBSTANTIA-1755

Efiloğlu Kurt, Ö. (2023). Learning with smartphones: the acceptance of m-learning in higher education. *Online Information Review*, *47*(5), 862-879. https://doi.org/10.1108/OIR-10-2021-0516

Fadli, M. R., Rochmat, S., Sudrajat, A., Rohman, A., & Kuswono. (2022). Flipped classroom in history learning to improve students ' critical thinking. *International Journal of Evaluation and Research in Education (IJERE)*, *11*(3), 1416-1423. https://doi.org/10.11591/ijere.v11i3.22785

Fahruddin, Kurniawanti, M. R., Nurgiansah, T. H., & Gularso, D. (2025). Development of teaching materials for evaluating history learning to improve students ' critical thinking skills. *Journal of Education and Learning (EduLearn)*, *19*(1), 530-541. https://doi.org/https://doi.org/10.11591/edulearn.v19i1.20882

Fahruddin, Nurgiansah, T. H., Setiawan, V., Saefudin, A., & Yogyakarta, U. P. (2024). Quantitative Measures of Engagement in History Classes : Analyzing the Efficacy of Interactive Pedagogies. *SAR Journal*, *7*(3), 241-248. https://doi.org/10.18421/SAR73-10

Fahruddin & Saefudin, A. (2025). Primary sources in online history learning: enhancing engagement and retention. *Cogent Education*, *12*(1), 1-16. https://doi.org/10.1080/2331186X.2025.2452087

Fahruddin, Salamah, Nurgiansah, T. H., Rosidi, M. I., Fitroh, I., Judijanto, L., Darsono, & Saefudin, A. (2025). Integrating Educational Technology in History Learning: Advancing Cultural Awareness and Preservation in Indonesia. *International Journal of Information and Education Technology*, *15*(1), 1-23. https://doi.org/10.18178/ijiet.2025.15.9.2395

Gillate, I., Castrillo, J., Luna, U., & Ibáñez-Etxeberria, A. (2023). Memoria histórica y apps para el desarrollo de la competencia social y cívica: efectos del Proyecto 1936 en el profesorado en formación inicial. *Revista Complutense de Educación*, *34*(1), 203-215. https://doi.org/10.5209/rced.77252

Granado-Peinado, M., & Huertas, J. A. (2023). A Teaching Innovation Project on Writing Critical Essays in a History of Psychology Course. *Teaching of Psychology*, *50*(3), 284-290. https://doi.org/10.1177/00986283211030909

Idacavage, S., & McAndrews, L. (2024). Letting go of fear and biases: new perspectives on historic clothing for design education in the post-pandemic age of digitisation. *International Journal of Fashion Design, Technology and Education*, 17543266. https://doi.org/10.1080/17543266.2024.2332782

Illene, S., Feranie, S., & Siahaan, P. (2023). Create multiple-choice tests based on experimental activities to assess students' 21st century skills in the heat and heat transfer topic. *Journal of Education and Learning (EduLearn)*,

17(1), 44-57. https://doi.org/10.11591/edulearn.v17i1.20540

Jaramillo, J. J., & Chiappe, A. (2024). The AI-driven classroom: A review of 21st century curriculum trends. *Prospects*, *54*(3), 645-660. https://doi.org/10.1007/s11125-024-09704-w

Johnston, H., Wells, R. F., Shanks, E. M., Boey, T., & Parsons, B. N. (2024). Student perspectives on the use of generative artificial intelligence technologies in higher education. *International Journal for Educational Integrity*, *20*(1), 1-21. https://doi.org/10.1007/s40979-024-00149-4

Jwai‘ed, A. M., Masri, A. Al, Hijazi, D., & Smadi, M. (2024). Utilizing Virtual Reality (VR) and Augmented Reality (AR) Technologies in EFL Classrooms: A Novel Approach to Improve Vocabulary Learning and Retention. *Journal of Ecohumanism*, *3*(6), 109-120. https://doi.org/10.62754/joe.v3i6.3982

Kwangmuang, P., Jarutkamolpong, S., Sangboonraung, W., & Daungtod, S. (2021). The development of learning innovation to enhance higher order thinking skills for students in Thailand junior high schools. *Heliyon*, *7*(6), e07309. https://doi.org/10.1016/j.heliyon.2021.e07309

Laine, J., Korhonen, T., & Hakkarainen, K. (2023). Primary school students' experiences of immersive virtual reality use in the classroom. *Cogent Education*, *10*(1). https://doi.org/10.1080/2331186X.2023.2196896

Lampropoulos, G. (2024). Virtual reality and gamification in education : a systematic review. *Educational technology research and development*, *72*(3). 1691-1785. https://doi.org/10.1007/s11423-024-10351-3

Lu, K., Yang, H. H., Shi, Y., & Wang, X. (2021). Examining the key influencing factors on college students' higher-order thinking skills in the smart classroom environment. *International Journal of Educational Technology in Higher Education*, *18*(1), 1-13. https://doi.org/10.1186/s41239-020-00238-7

Marín, V., Sampedro, B. E., Muñoz González, J. M., & Vega, E. M. (2022). Primary Education and Augmented Reality. Other Form to Learn. *Cogent Education*, *9*(1). https://doi.org/10.1080/2331186X.2022.2082082

Martinez, C. A. S., & Montoya, O. L. Q. (2023). The ethics of algorithms from the perspective of the cultural history of consciousness: first look. *AI and Society*, *38*(2), 763-775. https://doi.org/10.1007/s00146-022-01475-2

Mulyana, A., & Kurniawati, Y. (2020). Phenomenography analysis of students' historical thinking ability in studying social history. *Cakrawala Pendidikan*, *39*(3), 666-678. https://doi.org/https://doi.org/10.21831/cp.v39i3.28982

Nussbaum, M., Barahona, C., Rodriguez, F., Guentulle, V., Lopez, F., Vazquez-Uscanga, E., & Cabezas, V. (2021). Taking critical thinking, creativity and grit online. *Educational Technology Research and Development*, *69*(1), 201-206. https://doi.org/10.1007/s11423-020-09867-1

Nygren, T., Haglund, J., Samuelsson, C. R., Af Geijerstam, Å., & Prytz, J. (2019). Critical thinking in national tests across four subjects in Swedish compulsory school. *Education Inquiry*, *10*(1), 56-75. https://doi.org/10.1080/20004508.2018.1475200

Ofianto, O., Aman, A., Sariyatun, S., Bunari, B., Zahra, T. Z. N., & Marni, M. E. P. (2022). Media Timeline Development with the Focusky Application to Improve Chronological Thinking Skills. *International Journal of Learning, Teaching and Educational Research*, *21*(4), 114-133. https://doi.org/https://doi.org/10.26803/ijlter.21.4.7

Ogah, M. (2023). Implementation of Senior High School History Curriculum: A focus on teaching methodology and resources. *Cogent Education*, *10*(1), 1-18. https://doi.org/10.1080/2331186X.2022.2164021

Pramono, S. E., Ahmad, T. A., & Wijayati, P. A. (2021). Mapping the national heroes in Indonesia to strengthen national identity in history learning. *IOP Conference Series: Earth and Environmental Science*, *747*(1), 012072. https://doi.org/10.1088/1755-1315/747/1/012072

Pratama, R. A., Saputra, M. A., & Hikmawaty, L. (2024). Enhancing historical consciousness in history education through integrating STEM approach and historical thinking skill. *Journal of Education and Learning*, *18*(1), 236-243. https://doi.org/10.11591/edulearn.v18i1.20890

Purnomo, B., Rahmini, R., Afrillyan, M., & Syahputra, D. (2023). Development of Exe Learning Based E-Module with Whatsapp Application for Online History Learning to Increase Learning Result. *Journal of Educational Research and Evaluation*, *7*(1), 43-52. https://doi.org/https://doi.org/10.23887/jere.v7i1.55445

Rajab, L., Almarabeh, T., Mohammad, H., & Majdalawi, Y. K. (2024). Strategic evaluation of e-learning: A case study of the university of Jordan during crisis. *International Journal of Data and Network Science*, *8*(1), 109-116. https://doi.org/10.5267/j.ijdns.2023.10.012

Samuelsson, J. (2019). History as performance: pupil perspectives on history in the age of 'pressure to perform.' *Education 3-13*, *47*(3), 333-347. https://doi.org/10.1080/03004279.2018.1446996

Serevina, V., Hamidah, I., Jatmiko, A., Armita, N., Irwandani, Saputro, T., & Aridan, M. (2024). Science, Technology, Engineering, and Math (STEM) based Geothermal Energy Source Digital Module Assisted by Canva Application. *E3S Web of Conferences*, *2377*(1). https://doi.org/10.1088/1742-6596/2377/1/012063

Shume Nadew, A., Ibrahim, F. A., & Hailu, A. H. (2024). History education in Ethiopian secondary schools (1943-1991): Why it could not yield the desired results? A historical analysis. *Cogent Education*, *11*(1). https://doi.org/10.1080/2331186X.2024.2310962

Sorina, G. (2024). Logical and Methodological Foundations of Teaching Humanities in the System of Higher Education. *Filosofiya. Zhurnal Vysshey Shkoly Ekonomiki*, *8*(1), 54-66. https://doi.org/10.17323/2587-8719-2024-1-54-66

Sousa, M. J., Marôco, A. L., Gonçalves, S. P., & Machado, A. de B. (2022). Digital Learning Is an Educational Format towards Sustainable Education. *Sustainability (Switzerland)*, *14*(3), 1140. https://doi.org/10.3390/su14031140

Stracqualursi, L., & Agati, P. (2024). Twitter users perceptions of AI-based e-learning technologies. *Scientific Reports*, *14*(1), 1-14. https://doi.org/10.1038/s41598-024-56284-y

Temerbayeva, A., Kabbasova, A., Zharkumbaeva, M., & Raimbekova, Z. (2023). Influence of Historical Education on the Formation of Civic Identity of University Students in the Learning Process. *European Journal of Contemporary Education*, *12*(4), 1438-1446. https://doi.org/10.13187/ejced.2023.4.1438

Tirado-Olivares, S. (2021). Active learning in history teaching in higher education: The effect of inquiry-based learning and a student response system-based formative assessment in teacher training. *Australasian Journal of Educational Technology*, *37*(5), 61-76. https://doi.org/10.14742/ajet.7087

Toma, R. B., Yánez-Pérez, I., & Meneses-Villagrá, J. Á. (2024). Towards a Socio-Constructivist Didactic Model for Integrated STEM Education. *Interchange*, *55*(1), 75-91. https://doi.org/10.1007/s10780-024-09513-2

Villarino, R. T. H. (2025). Artificial Intelligence (AI) integration in Rural Philippine Higher Education: Perspectives, challenges, and ethical considerations. *International Journal of Educational Research and Innovation*, *2025*(23), 1-25. https://doi.org/10.46661/IJERI.10909

Yaman, H., Sousa, C., Neves, P. P., & Luz, F. (2024). Implementation of Game-Based Learning in Educational Contexts : Challenges and Intervention Strategies. *The Electronic Journal of E-Learning*, *22*(10), 19-36. https://doi.org/10.34190/ejel.22.10.3480

Zulkarnain, Salamah, Judijanto, L., Fahruddin, & Darsono. (2025). Curriculum-Level Innovation in History Education : Developing a Technology-Integrated and Contextually Adaptive Model for Senior High Schools in Indonesia. *Journal of Curriculum and Teaching*, *14*(3), 191-212. https://doi.org/10.5430/jct.v14n3p191

Acknowledgments

Not applicable.

Authors contributions

Dadan Wildan conceived the study, designed the research framework, coordinated the development and implementation of the LMS model, analyzed the data, and drafted the manuscript. Siti Komariah contributed to the research design, data interpretation, and critical revision of the manuscript. Wawan Darmawan contributed to the conceptual development of the study, supervised the research process, and revised the manuscript for important intellectual content. Fahruddin contributed to the theoretical framework, literature review, and interpretation of findings, and assisted in manuscript revision. Ismaul Fitroh contributed to data collection, validation procedures, and manuscript editing. All authors read and approved the final version of the manuscript.

Funding

This study was not funded by any institution. All costs associated with this research were independently covered by the authors.

Competing interests

The authors declare no conflict of interest.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Sciedu Press.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.