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Mechanism-based digital history instruction and student learning processes in Vietnam

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ABSTRACT

This study examines how digitally integrated instructional designs in history education co-occur with changes in students' learning processes through underlying cognitive mechanisms. Rather than comparing the effectiveness of instructional models, the study focuses on identifying the conditions under which such designs operate in classroom contexts. An exploratory mixed-method case study design was employed, drawing on data from a survey of 120 students, classroom observations, and analysis of student-generated learning products. The internal consistency of the survey instrument reached a Cronbach's alpha of 0.82. The findings indicate that higher levels of student engagement and improved information structuring are associated with tasks that require learners to make decisions about learning approaches, process multiple sources of information, and verify knowledge. These patterns are interpreted as manifestations of activated cognitive mechanisms under specific instructional conditions, rather than direct effects of digital tools. The results suggest that such task designs may be associated with indicators of creative competence, particularly when learners are required to organize, evaluate, and reinterpret historical information. The study proposes a mechanism-based approach to analyzing digital history instruction and contributes to understanding the relationship between instructional design and student learning processes in technology-rich environments.

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1. INTRODUCTION

Against the backdrop of digital transformation unfolding at a global scale, general education is shifting away from stable, pre-organized knowledge transmission toward more flexible, dynamic learning environments. This shift fundamentally recasts the learner's role from passive recipient to active agent engaging with diverse knowledge sources. In general schooling, it destabilizes the familiar assumption that students need only absorb what teachers and textbooks have pre-organized for them; among the competencies thereby foregrounded, creative competence is regarded as foundational, directly tied to the capacity for adaptation and problem-solving in contemporary society. In lower secondary history education, however, this imperative takes on a particular complexity. Unlike empirically oriented disciplines, historical knowledge is inherently indirect: it depends on documentary sources and interpretive frameworks and requires learners to reconstruct events within contexts that no longer exist. In classroom practice, this tends to reduce history teaching to information delivery and event memorization, foreclosing the very conditions under which independent and creative thinking might develop. The tension between competence-oriented aims and the convention of traditional instruction has, accordingly, become a persistent and structurally unresolved problem in Vietnamese history education.

In Vietnamese lower secondary history classrooms, this tension has a concrete curricular and pedagogical form. The 2018 General Education Curriculum expects students to inquire, interpret, evaluate, and creatively reconstruct knowledge rather than reproduce historical information. Yet, classroom practice often remains shaped by textbook dependence, event memorization, and limited opportunities for students to examine historical sources as evidence. The problem is therefore not simply that history lessons need more digital tools. The more demanding problem is whether learning tasks can move students from receiving historical content to selecting, organizing, questioning, and representing it with intellectual responsibility.

Digital learning environments alter the conditions under which students access historical knowledge, yet they do not automatically alter how history is learned. The gap between what tools make possible and what cognitive demands a task actually imposes lies at the very center of this study. Platforms such as virtual museums, digital archives, multimedia design tools, and most consequentially generative artificial intelligence (GenAI) now allow students to engage with historical materials in ways previously difficult to sustain in conventional classrooms, while also providing new means for learners to express their understanding through digital artifacts: videos, infographics, interactive models, historical scenarios. Yet the proliferation of tools does not automatically yield gains in learning quality. The central question is not whether digital technology adds something to history instruction, but whether it actually changes what students are required to do with knowledge. A visually richer lesson is not necessarily a cognitively deeper one, and the risk of mistaking format for substance is real. The 2018 General Education Curriculum provides the curricular basis for this competence-oriented shift [1]. Recent scholarship in history education and digital pedagogy has begun to map this territory with more precision. Research on project-based learning indicates circumstances under which students' engagement and cognitive investment may increase [2], [3], although the underlying mechanisms of these phenomena are not yet fully understood.

Studies of AI in history teaching offer a similarly qualified picture: AI tools appear capable of supporting information processing and critical thinking development, but primarily when embedded within tasks designed to make intellectual demand on the learner, not merely to make content more accessible [4], [5]. This cautious position is consistent with broader reviews of AI in education, which emphasize both potential benefits and persistent risks, including ethical use, teacher readiness, and digital dependency [6]. Nevertheless, existing studies have usefully examined project-based learning, digital tools, science, technology, engineering, arts, and mathematics (STEAM) activities, virtual learning environments, and AI applications in education. Yet much of this literature still treats these approaches as instructional methods or technological interventions. Less attention has been paid to the cognitive mechanisms through which digitally integrated task designs reshape students' learning processes in history classrooms. In particular, it remains insufficiently clear how learner autonomy, multi-source information processing, and knowledge verification are activated under specific task conditions.

Although these studies provide a useful basis, they leave a specific problem unresolved. In lower secondary history lessons, it remains unclear how digitally integrated tasks move students from access to information to active historical work such as selecting sources, organizing evidence, checking claims, and representing interpretations. The problem statement of this study is therefore the following: digital tools may broaden the learning environment, but their educational value depends on the cognitive mechanisms that task design activates. This gap calls for an analysis that moves beyond model comparison and examines the conditions under which learner autonomy, multi-source information processing, and knowledge verification become visible in students' learning processes.

On these grounds, the present study examines the implementation of digitally integrated history instruction at Cau Giay Secondary School in Hanoi over the period 2021–2026, focusing on four categories of instructional practice: interdisciplinary project-based learning, direct and online experiential activities, STEAM education incorporating historical content, and the pedagogical application of AI. Unlike conventional descriptive accounts of technology use in classrooms, this paper takes a different angle. Rather than cataloguing which digital tools appear in history instruction, the analysis asks something more specific: how do digitally integrated instructional designs reshape students' learning processes, and through what mechanisms does this reshaping occur? Three cognitive pathways serve as the primary lens: learner autonomy, multi-source information processing, and knowledge verification. A core argument running through the study is that digital technology integration does not, on its own, produce creative competence in students. In relation to the 2018 General Education Curriculum, creative competence becomes observable when learners generate questions, reorganize information, test interpretations, and represent knowledge in meaningful forms [1]. The three mechanisms examined in this study operationalize that curricular expectation: learner autonomy gives students responsibility for inquiry and representation; multi-source processing requires them to compare and structure historical evidence; and knowledge verification asks them to examine the accuracy and adequacy of claims before presenting them. The distinction matters because it shifts analytical attention away from tools themselves and toward the task conditions under which those tools are used. The proposed approach is a mechanism-based analytical framework, not an evaluation of one tool and not a claim of direct instructional effectiveness.

The study's novelty is limited but specific. It offers a mechanism-based explanation of digital history instruction in a Vietnamese lower secondary setting. Digital tools are not treated as direct causes of learning outcomes. They are examined through the task conditions that may activate learner autonomy, multi-source information processing, and knowledge verification. The contribution is theoretical and practical: the paper proposes an exploratory analytical framework and derives task-design principles for digital and AI-supported history teaching, while keeping the claims within the limits of a single case study.

From this argument, the study addresses three guiding research questions: first, which instructional design features are associated with observable changes in students' learning behavior? Second, what cognitive-pedagogical mechanisms account for the relationship between instructional design and learning outcomes? Third, what conditions shape the effectiveness with which these mechanisms operate? The question is not whether technology is brought into the history classroom, but when it transforms the nature of learning activity. When a task requires no more than re-presenting existing information in a new format, technology produces primarily surface-level novelty. When a task compels students to select sources, compare competing interpretations, and take intellectual responsibility for how they represent the past, technology begins to shape the cognitive conditions of learning. Accordingly, the study has three limited objectives: i) to identify task-design features visible in digitally integrated history lessons; ii) to interpret how learner autonomy, multi-source information processing, and knowledge verification appear in students' learning activity; and iii) to derive cautious implications for history teachers who use digital and AI-supported tasks without claiming direct causal effects.

2. THEORETICAL FRAMEWORK

2.1. Creative competence and history education

Creative competence is identified in the 2018 General Education Curriculum as one of the core competencies, reflecting a deliberate reorientation from content transmission toward the cultivation of learner character and capability [1]. In the context of history education, creative competence extends well beyond the narrow sense of generating what is novel; it encompasses the capacity to rethink and restructure historical information and to formulate inquiry questions that exceed the boundaries of received frameworks. Students with well-developed creative competence in history can synthesize and multi-dimensionally analyze sources embodying contradictory or complex perspectives and can reinterpret historical events through unfamiliar representational forms such as three-dimensional models or interactive scenarios. This demands not only historical knowledge but critical thinking and interdisciplinary synthesis, qualities that conventional teaching methods are structurally ill-equipped to cultivate in any systematic way.

Creativity-oriented education in history teaching entails more than intellectual activation; it requires organizing learning activities in an open-ended manner that encourages students to develop their own ideas, plan their execution, and produce diverse learning artifacts. Project-based instructional models are particularly well-suited to this aim, precisely because they extend genuine agency to students over their own learning trajectory and require the production of substantively meaningful outcomes. Research on project-based learning points to a fairly consistent pattern: when students have genuine autonomy over how they design and present their work, the depth of cognitive engagement tends to increase [2]. Recent meta-analytic evidence further suggests that project-based learning can support learning outcomes, academic achievement, affective attitudes, and thinking skills, although its effects remain sensitive to design and implementation conditions [3].

2.2. Collaborative learning and knowledge building in digital environments

One of the central theoretical foundations of this study is the knowledge building theory. It serves as a fundamental theoretical framework for the study and emphasizes students' collective responsibility for advancing community knowledge rather than concentrating exclusively on individual achievement. Research conducted in online learning environments lends some empirical weight to this orientation, suggesting that collaborative tools can render thinking processes more transparent and, in doing so, deepen the cognitive bonds among learners [7]. This point carries particular weight in history education, since historical understanding tends to grow out of dialogue, questioning, and sustained engagement with evidence rather than out of passive reception. It also fits the project-based activities run at Cau Giay Secondary School, where students approached historical topics through extended inquiry and worked together to produce their final outputs.

2.3. Digital competence in education and history teaching

Digital competence has come to occupy an increasingly central place in contemporary educational thinking, particularly as curriculum and teacher education research increasingly treats it as a condition for meaningful participation in technology-rich learning environments [8]. The volume of research alone, however, says less than its direction. At the national level, work in this area has moved toward identifying concrete opportunities for developing digital competence among lower secondary students and notably, history and geography have emerged as viable sites for this development [9]. The implication is consequential: such competence need not be confined to information technology instruction. When instructional design is appropriately conceived, social studies subjects can serve as meaningful contexts for cultivating it in their own right. This aligns with a broader shift in international scholarship that digital competence matters not only for learners but equally for teachers, as reflected in the DigCompEdu framework for educators' professional digital competence [10].

2.4. History education in the digital age

The digital age, defined by the explosive expansion of the fourth industrial revolution, has brought into being a new learning environment that demands history education move decisively beyond the constraints of textbook-based instruction. Integrating technology into history teaching is not a matter of deploying digital tools as illustrative devices; it constitutes a pedagogical strategy aimed at situating students at the center of the knowledge-discovery process. In digitally mediated experiential activities, the learning value lies not in students gaining access to more materials, but in tasks that compel them to compare, select, and organize those materials into a structured historical interpretation.

From the standpoint of educational researchers, empirical findings in this study indicate that students can actualize their creative ideas from digital storytelling via filmmaking software, infographic design, and interactive timelines to the construction of interactive maps charting historical campaigns or heritage sites. More consequentially, these activities compel students to process information at higher cognitive levels, since representing knowledge through digital forms demands purposeful synthesis, selection, and organization [7], [11]. When students explain, design, and present history in their own way, learning may move beyond passive memorization toward more active forms of historical interpretation. Research on AI-assisted design of digital learning materials underscores the importance of ensuring scientific accuracy and pedagogical intentionality throughout technology integration [4]; the five-step procedure proposed in that scholarship, spanning from the identification of competency objectives to product assessment, serves as the foundation that the present research team adapts and applies at the lower secondary level with correspondingly greater cognitive complexity. Research on virtual field trips in history learning emphasizes that digital access becomes educationally valuable when students are guided to read, analyze, and use primary source evidence [12]. Similarly, research on digital learning environments in secondary history education shows that digitized historical sources can support student engagement and historical understanding when they are embedded in inquiry-oriented learning designs [11].

2.5. STEAM education and interdisciplinary integration in history teaching

STEAM education has emerged as a significant force in global educational reform. Recent work on STEAM educational strategies also stresses that interdisciplinarity requires purposeful task design rather than the mere juxtaposition of disciplinary components [13]. It traces the formation and development of the science, technology, engineering, and mathematics (STEM), STEAM, and science, technology, reading, engineering, arts, and mathematics (STREAM) paradigms from both international and Vietnamese perspectives, generating reflections on implementing STEM educational strategies in Vietnamese schools operating under the 2018 curriculum's competence and character development orientation [14]. In the context of history education, STEAM is emphatically not about coupling discrete subjects additively; it is about creating integrated learning situations in which historical knowledge becomes the meaningful substrate for engineering, artistic, and technological activity. The proposed STEM instructional model for developing collaborative problem-solving competence in general school students emphasizes the interplay among practical mathematics, elementary engineering, engaging science, and optimal technology [15]. When transposed to the historical domain, the arts dimension of the STEAM framework plays a particularly prominent role, for it is the hinge connecting historical knowledge to students' expressive and aesthetic capacities.

The study's analytical framework centers on mechanism rather than method. An instructional model carries analytical significance only insofar as it generates specific cognitive demands on students, including source selection, information reorganization, reliability evaluation, and independent interpretation. This point explains why the same digital tool can support different forms of learning when the task demands imposed on students are different.

The three mechanisms were selected because they link the competence-oriented aims of history education with observable classroom activity. Learner autonomy reflects the shift from teacher-organized reception to student responsibility for inquiry, planning, and representation, a shift supported by project-based and knowledge-building perspectives [2], [3], [7]. Multi-source information processing reflects the disciplinary nature of history learning, in which students must compare materials, arrange evidence, and construct an account rather than rely on a single text [11], [12]. Knowledge verification reflects the epistemic demand of digital and AI-supported environments, where learners must check the accuracy and adequacy of generated or digital information before using it [4]–[6]. These mechanisms were therefore not selected as separate psychological traits. They were selected as task-sensitive processes that can be observed across survey responses, classroom interaction, and student products.

Figure 1 functions as the analytical model guiding data interpretation in this study. It does not present a decorative conceptual illustration, nor does it assume that task characteristics produce outcomes directly. Instead, it shows that task characteristics such as source plurality, product orientation, authentic audience, and verification requirements may mediate students' learning processes through learner autonomy, multi-source information processing, and knowledge verification. The figure therefore directs the analysis from the question of whether technology is used to the more precise question of what cognitive work students must perform when technology is embedded in history learning tasks.

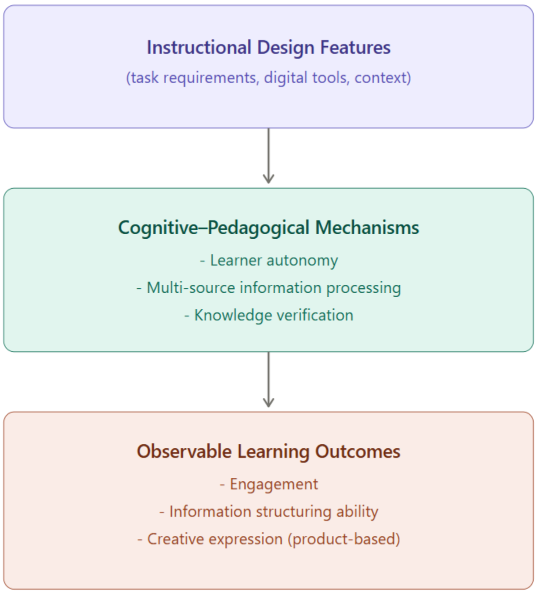

Figure 1. Mechanism-based analytical framework linking instructional design features, cognitive-pedagogical mechanisms, and observable learning outcomes in digital history instruction

3. RESEARCH METHOD

3.1. Research design

This study adopts an exploratory mixed-method case study design. The purpose is not to test causal effects or compare treatment and control groups, but to identify patterned associations between digitally integrated task design and students' learning processes in a real classroom context. The case study approach is appropriate because the phenomenon under investigation is embedded in a specific school setting and shaped by interacting factors, including task design, teacher facilitation, student collaboration, and digital resource availability. The design is exploratory in two senses. First, it examines a single school context in which digital history instruction had been sustained over several years. Second, it uses multiple sources of evidence to interpret how particular task conditions may activate cognitive mechanisms. Because the study does not include a control group, its findings should be read as associational and context-bound rather than causal or statistically generalizable. The three sources of evidence were not treated as parallel findings. They were used to check and interpret one another during the mechanism-based analysis. The quantitative strand was used to describe response patterns, while the qualitative strand was used to interpret the classroom processes behind those patterns. This design therefore fits the exploratory purpose of the study: it seeks explanatory plausibility within a bounded case, not statistical generalization.

3.2. Research site and data collection
3.2.1. Research site and participants
The study was conducted at Cau Giay Secondary School in Hanoi, where technology-integrated history instruction had been implemented over several years. The survey involved 120 students who participated in the "Designing Infographics on Ancient Civilizations" project. Participants were selected purposively because they had direct experience with the digitally integrated learning task examined in the study. The sample should therefore be understood as context-bound rather than statistically representative of secondary students in Vietnam. The participating students were from Grades 7 to 9 and were drawn from four classes included in the project implementation. The project was implemented over 35 weeks, and classroom observations were conducted during 10 learning sessions. The school was therefore treated as an information-rich case rather than as a typical or statistically representative Vietnamese school.

3.2.2. Survey instrument
The survey used a 5-point Likert scale to capture two self-reported constructs: learning engagement and information structuring. Learning engagement referred to students' perceived attention, participation, and willingness to invest effort in the digital history task. Information structuring referred to students' perceived ability to select, classify, sequence, and organize historical information into coherent digital products. The instrument drew its conceptual basis from the mechanism-based framework adopted in this study and was tailored to the specific task conditions observed in the classroom. Internal consistency was acceptable, with Cronbach's alpha at 0.82 [16]. However, no independent validation study was conducted beyond this internal consistency test. For this reason, the survey results are interpreted cautiously as self-reported indicators rather than as standardized measures of learning outcomes. The survey data were complemented by classroom observations and student product analysis to strengthen interpretive triangulation. No claim of full construct validation is made. The instrument is used here only as a case-specific measure of students' perceptions related to the two constructs.

3.2.3. Classroom observation protocol
Classroom observations focused on predefined indicators corresponding to the proposed mechanisms. These indicators included students' source selection, comparison of materials, organization of historical information, role negotiation within groups, revision of product drafts, and verification of digital or AI-generated information. Observation notes were used to interpret learning processes rather than to provide independent proof of competence development. The observation notes were then compared with survey patterns and product evidence to clarify how the proposed mechanisms appeared in classroom activity.

3.2.4. Student product analysis
Student products, including videos, infographics, interactive maps, and other digital artifacts, were examined using a rubric covering historical accuracy, information organization, creativity, digital representation, and source verification. The rubric was aligned with the three proposed mechanisms and with the competence-oriented logic of the 2018 General Education Curriculum. Because some assessments were conducted within the instructional context, product analysis is treated as supplementary interpretive evidence rather than as an independent standardized measure of creative competence. Each product was read against the criteria summarized in the rubric, with attention to observable evidence in the artifact rather than to a general impression of quality. Table 1 summarizes the rubric used to examine observable features of student products and their links to the proposed mechanisms.

Inter-rater reliability was not calculated in the present study. This is acknowledged as a limitation, and product assessment results are therefore interpreted cautiously. To reduce the risk of overinterpretation, product assessment was not interpreted in isolation. It was read together with survey patterns and observation notes to support a cautious mechanism-based interpretation. Future studies should include independent raters and report inter-rater reliability to improve methodological robustness.

Table 1. Rubric used for student product analysis

Criterion	Description	Link to mechanism
Historical accuracy	Correctness of historical facts, chronology, concepts, and interpretation	Knowledge verification
Information organization	Logical sequencing, classification, and coherence of historical content	Multi-source information processing
Creativity	Meaningful reinterpretation or representation of historical knowledge	Learner autonomy
Digital representation	Appropriate use of digital tools to communicate historical understanding	Digital competence
Source verification	Evidence of checking, correcting, or comparing information	Knowledge verification

3.3. Data analysis

Quantitative survey data were analyzed using descriptive statistics to identify response patterns in learning engagement and information structuring. Because the study did not use a control group, the quantitative analysis did not aim to establish causal effects. Qualitative data from classroom observations and student products were analyzed through inductive thematic analysis [17]. The coding process involved three stages: initial coding of observed learning behaviors and product features, grouping of codes into mechanism-related categories, and comparison across data sources. The final themes were organized around three mechanisms: learner autonomy, multi-source information processing, and knowledge verification. Triangulation was used to examine whether similar patterns appeared across different sources of evidence. For example, survey-reported improvement in information structuring was interpreted together with observation notes and product evidence showing source selection, classification, and content organization. This procedure allowed the study to develop a mechanism-based interpretation while avoiding unsupported causal claims. The mixed-method interpretation followed a convergence logic: survey data provided broad response patterns, observations helped explain the classroom processes behind those patterns, and product analysis showed whether the expected forms of organization, representation, and verification appeared in students' artifacts.

4. RESULTS AND DISCUSSION

Rather than treating pedagogical models as self-contained units, this section analyzes the findings through the learning mechanisms activated during instruction: learner autonomy, multi-source information processing, and knowledge verification. Descriptive results are first presented as indicators of students' reported engagement and information structuring. Interpretive claims are then introduced with explicit signaling language so that descriptive evidence is not mistaken for causal explanation.

4.1. Interdisciplinary project-based learning with digital outputs

Learning tasks requiring students to design digital products, including videos, infographics, and related artifacts, were associated with heightened learner autonomy because students had to select, organize, and present information according to their own logic. The fact that 85% of students reported increased learning engagement suggests that product-oriented task designs may be associated with deeper participation. This result does not establish causal effects, but it is consistent with classroom observations of a role shift: students moved from recipients of information to active organizers of it.

Results are organized according to the cognitive mechanisms that emerged during the learning process. Descriptive statistics from the student survey reveal general trends in engagement and information structuring ability. These figures provide an empirical entry point for the subsequent interpretation, but they do not by themselves establish the effect of the instructional design.

Table 2 should be read as descriptive evidence, not as proof of causal impact. The 85% increase in reported engagement becomes meaningful only when interpreted together with observation data showing that students were required to make decisions about sources, digital formats, group roles, and presentation strategies. Similarly, the 71.6% improvement in information structuring suggests that students perceived gains in organizing historical knowledge when they had to transform dispersed materials into coherent digital artifacts. This suggests a relationship between engagement and information structuring, since students appeared more invested when the task also required them to impose order on historical information. The survey did not directly measure knowledge verification. For this mechanism, the study relies mainly on observation notes and product evidence, especially in AI-supported tasks where students were required to check and revise generated information.

These results serve as preliminary indicators to orient deeper analysis of the learning mechanisms that follow, rather than as evidence of causal effects. They can be interpreted as a shift from surface participation toward more demanding forms of task engagement. What distinguishes this approach from conventional project-based learning is the nature of the required output. Rather than producing a journal or standard poster, students created digital products intended for wider dissemination and interaction. One illustrative example is the 'Journey through the Ancient Capitals' project. In this project, students constructed a digital artifact to communicate their historical understanding. This required a sequence of cognitive decisions involving source selection, information organization, and interpretation. The activity integrated knowledge from history, literature, and information technology/arts within a unified learning process, positioning students in the role of digital communicators. Products were first exhibited at the class level and then at a school-wide exhibition where students participated in evaluation. This authentic audience reinforced the accountability of students' representational choices.

Table 2. Students' self-reported learning engagement and information structuring ability

Variable	Category	Frequency	Percentage (%)
Learning engagement	Increased significantly	58	48.3
	Increased	44	36.7
	No change	12	10.0
	Decreased	6	5.0
Total increased		102	85.0
Information structuring ability	Improved significantly	34	28.3
	Improved	52	43.3
	No change	24	20.0
	Decreased	10	8.4
Total improved		86	71.6≈72

From a theoretical standpoint, these patterns align with the core argument of project-based learning: when students exercise genuine autonomy over the planning, execution, and presentation of their work, both motivation and cognitive investment may increase. This interpretation is also consistent with meta-analytic evidence showing that project-based learning can contribute to academic achievement, affective attitudes, and thinking skills, while remaining dependent on design features such as subject area, group organization, class size, and implementation duration [3]. Integrating digital skills into the project output also created a context of real-world meaning for historical learning. Requiring students to publish and share their products placed them in the role of communicators, not only classroom respondents. This may help explain why product quality and student investment became more visible during the project.

4.2. Experiential history learning in digital environments

4.2.1. Direct experiential learning with digitized outputs

Direct experiential activities, including field visits to historical sites and museums as well as historical role-play, were redesigned to require students to produce digitized artifacts instead of conventional handwritten reflection reports [18], [19]. Following field visits to the Museum of Ethnology, Vong Village, Hoa Lo Prison, and the Thang Long Imperial Citadel, students completed documentary videos, digital travel journals via personal blogs or Google Sites, site infographics, or interactive maps built using Google Maps and ThingLink. This requirement not only documented learning outcomes but also created opportunities for students to practice digital competence through production, consistent with the subject-based digital competence development orientation analyzed in prior research [9]. In historical dramatizations, such as the reenactment of the Capital Liberation Day of October 10, 1954, students were encouraged to write their own scripts while incorporating sound effects, image slideshows, and video to improve the quality of their performances. This differs from traditional role-play. Technology did not replace student preparation and creativity. It became the medium through which that preparation was expressed more clearly.

4.2.2. Online experiential learning and digital collaboration

In online learning environments, the history teaching team at Cau Giay Secondary School researched and incorporated virtual museums into the teaching of Hanoi's local history curriculum. Students were able to visit and engage with three-dimensional interactive virtual museums and Hanoi-affiliated websites including the Vietnam National Museum of History and the Thang Long Imperial Citadel website directly in the classroom or independently at home. Of particular note, the teaching team independently constructed an interactive virtual museum devoted to the architectural art and sculpture of Dai Viet during the Ly, Tran, and Early Le dynasties using Artstep software. This product was awarded first prize at the Hanoi City Information Technology Festival. These achievements should be interpreted as contextual support rather than independent empirical evidence.

Following visits to virtual museums of civilizations around the world, students produced collaborative group artifacts in the form of magazines, videos, or websites introducing ancient civilizations. All individual and group products were published on a school-wide Padlet platform where students read, commented on, and critiqued one another's work. This process supported collaborative competence and the practice of evaluating peers' products, an important metacognitive activity. Some of these instructional initiatives received external recognition, including recognition in the StarT competition in 2021. Such recognition is retained only to describe the broader instructional context in which the school's digital history practices developed. It is not treated as evidence of learning effectiveness. The empirical interpretation in this study rests on student survey responses, classroom observations, and student products. These collaborative online activities are interpreted together with the survey patterns reported in Table 2 and the observation evidence. Their value does not lie in the digital platform itself, but in the way the task required students to publish, read, comment on, and evaluate one another's historical representations.

4.3. STEAM education integrated with history

At Cau Giay Secondary School, STEAM education was not implemented as a standalone extracurricular activity. It was integrated into the regular instructional structure through products that combined historical and cultural value with modern technology. This distinguishes the school's approach from many Vietnamese contexts in which STEAM is still treated mainly as a technical club activity disconnected from subject-specific content. Research on STEAM in the Vietnamese context indicates that implementation continues to face significant challenges related to interdisciplinary integration and resource conditions [14]. This deliberate integration reflects a STEM model in which the constituent elements do not merely coexist but interact and mutually reinforce one another across the learning process [15]. The distinction is not trivial because it shapes how students come to understand the relationship between disciplinary knowledge and practical making.

The STEAM-based history tasks are analytically relevant not because several products received external recognition, but because they required students to transform historical knowledge into material, visual, or interactive representations. In such tasks, students had to decide which historical elements to select, how to organize them, and how technological or artistic choices could communicate historical meaning. External recognition is therefore mentioned only as contextual illustration. It is not used as independent evidence of competence development.

Teachers working with this model need both interdisciplinary design capacity and practical skills in supporting students' use of programming or technical tools. For social studies teachers, these are substantial demands, and the professional development infrastructure to meet them is not yet reliably in place. There is also a resource problem that cannot be ignored: digital learning materials covering cultural heritage, historical sites, and national events remain limited in quantity, and what exists is often poorly integrated or difficult to use in classroom settings. Within the current landscape of Vietnamese education, these are objective constraints. Acknowledging them makes the broader argument more credible.

4.4. AI applications in history teaching

4.4.1. Using AI as a tool for research and critical thinking

In this study, AI was not treated merely as a source of information retrieval. It was positioned as an object of critical evaluation, requiring students to verify, revise, and contextualize AI-generated outputs against historical evidence. This use of AI is consistent with emerging research suggesting that AI-generated texts can support critical evaluation when learners are required to assess their accuracy, limitations, and disciplinary adequacy [20]. It is also important because recent work on generative AI suggests that confidence in AI outputs may reduce critical engagement unless users are required to verify, integrate, and take responsibility for the final response [21]. Students were directed to use generative text tools such as Gemini and ChatGPT to summarize extended historical documents or synthesize information about a particular historical period and were subsequently assigned the task of verifying and evaluating the accuracy of that information against primary historical sources. This process creates opportunities for students to practice critical evaluation and information verification. The approach carries significant pedagogical weight and aligns with established principles for integrating AI into instructional material design: rather than prohibiting students from using AI (a measure difficult to enforce and likely counterproductive in practice), teachers design learning tasks that compel students to position themselves as reviewers, correctors, and critical commentators on AI-generated outputs [4], [5]. In the process, students learn to identify hallucinations in AI outputs, come to understand that AI can produce factually inaccurate information about specific historical events, and thereby develop the habit of verifying information across multiple sources. This emphasis on verification also corresponds to recent work on GenAI literacy in schools, which identifies critical evaluation of AI-generated outputs as a core competency for responsible educational use [22].

4.4.2. Designing an AI integration process for developing creative competence

The proposed AI integration procedure consists of five steps: i) identifying the competency objectives to be developed; ii) exploring and selecting appropriate AI tools; iii) designing application ideas anchored to specific learning tasks; iv) organizing instruction and practice; and v) assessing products against competency-based criteria. This procedure is modular in design and can be flexibly adapted to different lesson types across the lower secondary history curriculum. Its purpose is not to promote AI use for its own sake, but to ensure that AI-supported work remains tied to explicit cognitive and curricular demands.

A concrete example is the Grade 8 history lesson on "The English Bourgeois Revolution and the War of Independence of the Thirteen British Colonies in North America". Students used the Humy.ai application to hold a dialogue with the historical figure George Washington. From there, they turned to ChatGPT and drafted a memoir narrative in his voice. They checked the output against the historical record, corrected its errors, and used Clipchamp to produce a short film reenacting the events. Each phase made heavier cognitive demands than the one before: locating and evaluating information, then analysis and synthesis, and finally creation and presentation. This progression maps onto the upper tiers of Bloom's taxonomy. Classroom observation suggested that students stayed focused and engaged throughout the AI-supported task. The final products also indicated that students had engaged with the historical context and significance of the events studied. These patterns are consistent with prior research on the potential of AI in history teaching oriented toward problem-solving and creative competence [5].

A point of principle warrants emphasis: the effectiveness of AI application in history teaching does not depend on the technological sophistication of the tools employed but on the quality of learning task design. A well-designed task ensures that students cannot simply reproduce AI outputs verbatim but must actively process, adjust, and critically evaluate the information. This concern is consistent with recent reviews of GenAI in educational assessment, which show that assessment design must be reconsidered when AI tools become part of students' learning and production processes [23]. This is the foundational pedagogical principle that teachers must internalize before introducing any AI tool into the classroom.

4.5. Discussion

The findings suggest that digital technology matters in history education only when it is embedded in task designs that alter the cognitive work students are required to perform. Digital tools may expand access to historical materials, diversify forms of representation, and make learning products more visible. Yet these affordances do not, by themselves, produce deeper historical learning. What appears more consequential in this case is the structure of the learning task. As Figure 1 indicates, task characteristics are interpreted as meaningful only when they activate cognitive mechanisms that mediate students' learning processes. When students were required to select sources, organize information, compare materials, verify claims, and represent historical meaning through digital artifacts, technology became part of a more demanding learning environment. This interpretation is consistent with the mechanism-based framework of the study: the value of digital history instruction lies less in the tools themselves than in the cognitive mechanisms activated through task design. It also aligns with project-based learning research showing that learning effects depend on task design and implementation conditions rather than on the project label alone [3].

The first mechanism is learner autonomy. Product-oriented digital tasks required students to make decisions about sources, formats, group roles, and modes of representation. This decision-making structure changed the student's position in the learning process. Students were no longer asked only to receive or reproduce historical information. They had to decide what information was relevant, how it should be organized, and how historical meaning could be communicated to an audience. This helps explain why increased engagement should not be attributed simply to the novelty of digital tools. Rather, the reported increase in engagement is more plausibly associated with the autonomy built into the task. The digital product became a site where students had to exercise judgment, not merely a more attractive format for presenting textbook content.

The second mechanism is multi-source information processing. Although much of this evidence comes from higher education, it helps clarify why digital history tasks should foreground source evaluation rather than mere access to digital materials [24]. Virtual museums, online materials, digital archives, and multimedia resources expanded the range of historical information available to students. Access alone, however, does not explain the observed learning patterns. The key task demand was that students had to compare, classify, select, and synthesize materials before producing a coherent artifact. In this respect, the task did not simply expose students to more information. It required them to impose order on dispersed historical materials. This interpretation is consistent with research on virtual field trips and source-based history learning, where digital access becomes educationally valuable when students are guided to analyze and use evidence rather than merely view materials [12], [25]. This mechanism helps explain the reported improvement in information structuring. Students' perceived gains in organizing historical knowledge are therefore best understood as being associated with the requirement to transform multiple sources into a meaningful historical representation. This interpretation is also supported by historical reasoning research. Students' work with the past involves asking historical questions, using sources, contextualizing information, and building arguments from evidence [26]. Recent evidence on secondary students' evaluation of historical and internet sources further shows that source trustworthiness needs explicit attention in history classrooms [27]. Research on civic online reasoning reaches a similar conclusion: learners need structured opportunities to practice evaluating digital content rather than mere exposure to online information [28].

The third mechanism is knowledge verification. AI-supported tasks made verification especially visible because students could not treat generated outputs as final historical accounts. They had to check factual accuracy, compare AI responses with historical sources, and revise the narrative before using it in a learning product. In this sense, AI was pedagogically useful not as a shortcut to content, but as an object of critical evaluation. This reading is supported by recent studies suggesting that AI-generated texts can foster critical evaluation only when learners are asked to assess, verify, and take responsibility for the final response [20], [21]. This interpretation also explains why AI integration requires careful task design. Without explicit verification requirements, students may rely on fluent outputs without developing stronger historical understanding. With such requirements, however, AI-supported learning can create opportunities for students to practice checking, correcting, and contextualizing historical information. This point is especially important in AI-supported learning. Large language models can broaden access to explanations and examples, but they also require human oversight, fact checking, and pedagogical guidance [29]. Empirical work on AI text generators likewise warns that gains in critical thinking are not automatic; they depend on how learners are asked to question, revise, and justify AI-assisted outputs [30].

These mechanisms do not operate automatically. They depend on enabling conditions inside and beyond the classroom. At the classroom level, teachers need to design tasks with clear cognitive demands, guide students in working with sources, and create assessment criteria that value accuracy, organization, interpretation, and verification. At the school level, students need access to usable digital materials, appropriate platforms, and sufficient time to revise their products. The Vietnamese general education context also matters. Schools differ considerably in teacher capacity, digital infrastructure, interdisciplinary collaboration, and access to quality digital learning resources. The findings should therefore be treated as a plausible account of how these mechanisms operated in one sustained school context, not as evidence that similar outcomes will occur whenever digital tools are introduced into history lessons.

The theoretical contribution of this study lies in its mechanism-based analytical framework. Instead of treating digital tools or instructional models as direct causes of learning outcomes, the framework explains how task conditions may activate learner autonomy, multi-source information processing, and knowledge verification. This shifts the analysis from the question of whether a particular model works to the more precise question of how, under what conditions, and through which cognitive processes it may support learning. The practical contribution lies in task-design principles for history teachers. Digital and AI-supported tasks should require students to select sources, compare interpretations, verify information, and produce historically meaningful artifacts. For schools and policymakers, the implication is equally clear: digital transformation in history education should not be reduced to equipment provision, platform adoption, or visually impressive products. It requires sustained support for teachers to design tasks that make students think historically with, through, and sometimes against digital tools.

At the level of classroom implementation, the framework can be translated into several modest routines. Teachers can require a source-comparison sheet before product design, an AI verification log when generative tools are used, and a short revision note in which students explain what they changed after feedback. Professional development should therefore focus less on tool demonstrations and more on task design: how to write source-based prompts, how to make verification visible, and how to assess digital products with criteria for accuracy, organization, interpretation, and representation. Although the case is situated in history education, the framework may be cautiously adapted to subjects that also require evidence use and representation, such as geography, civic education, and literature. The transfer is not automatic. Each subject has its own knowledge structure, so the mechanisms need to be reworked around the kinds of sources, claims, and products that matter in that subject. For educational research, policy, and practice, the implication is modest but important. Investment in digital infrastructure should be accompanied by professional learning that helps teachers design source-based tasks, make verification evidence visible, and assess the quality of students' historical reasoning. This matters beyond the Vietnamese case because many school systems are adopting digital and AI tools before stable classroom routines for evidence checking have fully developed.

4.6. Limitations

The limitations of this study are important for interpreting the findings with appropriate caution. Because the research was designed as an exploratory case study, its findings should not be read as causal evidence or as statistically generalizable claims. Instead, they provide a context-bound explanation of how particular task conditions may be associated with students' learning processes in one sustained school setting. This study has several limitations that should be acknowledged. The work was carried out in a single school, and the findings cannot be assumed to transfer to other educational settings. The absence of a control or comparison group is a further constraint, since it rules out causal inference altogether: what the data reveal are patterned associations between task design and learning processes, not evidence that any particular instructional choice produced any particular outcome. The survey instrument introduces its own interpretive limits. Responses were drawn from students' self-reports and therefore remain susceptible to recall bias as well as to social desirability bias. Internal consistency was tested, but the instrument was not independently validated beyond that, so the figures reported here are better read as self-reported indicators of student experience than as standardized measures of learning outcomes. Product analysis carries caveats of a different kind. Inter-rater reliability was not computed, and conclusions drawn from student artifacts therefore rest on weaker evidentiary ground. Because the products were assessed within the instructional context itself, some degree of teacher subjectivity is unavoidable. For that reason, product evidence is not treated on its own; it is read in conjunction with survey responses and observation notes. A final point concerns creative competence. Because no standardized instrument was used to measure it, the relevant findings should be read as exploratory signals about learning processes rather than as definitive evidence of competence development.

5. CONCLUSION

This study examined how digitally integrated history instruction is associated with students' learning processes through a mechanism-based lens. Evidence from student surveys, classroom observations, and student products suggests patterned associations between task designs requiring learner decision-making, multi-source information processing, and knowledge verification and positive indicators of engagement and information structuring. These findings should be read as exploratory and associational, not causal, because the study was conducted in a single school and did not include a control group.

The study's main theoretical contribution is a mechanism-based framework for analyzing digital history instruction. Instead of treating digital tools as direct causes of learning outcomes, the framework explains how task conditions may activate learner autonomy, multi-source information processing, and knowledge verification. The practical contribution lies in task-design principles for history teachers. For digital and AI-supported tasks to serve as genuine learning experiences rather than efficient information delivery systems, they need to place epistemic demands on students: selecting sources, comparing interpretations, verifying claims, and constructing historically meaningful artifacts. Task design, in this sense, is not a peripheral concern.

Looking ahead, the mechanisms identified here warrant testing under more rigorous conditions, including larger and more diverse student samples, multiple school contexts, and controlled or quasi-experimental designs. Further work is also needed to develop more robust instruments for assessing creative competence in digital-age history education. Future studies should also include independent raters for student products and report inter-rater reliability, especially when digital artifacts are used as evidence of learning processes. A remaining question is whether the same mechanisms operate with different teachers, different age groups, and subjects with different epistemic demands.

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AUTHOR CONTRIBUTIONS STATEMENT

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
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R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest relevant to this study.

INFORMED CONSENT

Informed consent for survey participation was obtained from students and from the parents or guardians of students under 18 years of age prior to data collection. Participants were informed that the survey was used for research purposes connected to the instructional activities described in the study. Participation in the survey was treated separately from ordinary classroom assessment.

ETHICAL APPROVAL

The study was conducted within the framework of official instructional activities at a general education school, in compliance with participant rights protection regulations established by the Vietnamese Ministry of Education and Training. Parents and students were informed of the purposes of data collection and had the right to decline participation in the survey. No additional experimental intervention outside the normal instructional framework was introduced for the purpose of this study.

DATA AVAILABILITY

The data supporting the findings of this study are archived at Cau Giay Secondary School, Hanoi. They are available upon reasonable request to the corresponding author. Access may be subject to school-level permission and participant confidentiality requirements.

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