Digital history pedagogy in higher education: a PRISMA-compliant systematic review of empirical evidence (2011–2025)

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Abstract

Background: The integration of digital technologies into history education represents a fundamental transformation in pedagogical practice, yet comprehensive evidence synthesis regarding its effectiveness remains absent from the scholarly literature. This systematic review addresses this critical gap by evaluating empirical evidence on digital history teaching effectiveness at the undergraduate level.

Methods: Following PRISMA 2020 guidelines, we conducted a systematic search of the Scopus database spanning 2013 to 2025. Inclusion criteria encompassed empirical studies involving undergraduate students (aged 18+) that evaluated digital interventions in history education. Two independent reviewers performed screening and data extraction, with discrepancies resolved through consensus.

Results: From 46 initially identified records, six studies met inclusion criteria after rigorous screening. The included studies employed diverse digital interventions ranging from collaborative wiki platforms to augmented reality applications. Analysis revealed consistent positive effects on student engagement (100% of studies), moderate improvements in historical knowledge acquisition (67% of studies), and enhanced development of critical thinking skills through primary source analysis. Notably, studies incorporating TPACK (Technological Pedagogical Content Knowledge) frameworks demonstrated superior outcomes in both cognitive and affective domains.

Conclusions: Digital technologies demonstrate substantial potential for enhancing history education, particularly in fostering student engagement and developing analytical capabilities. However, the evidence base remains limited by methodological heterogeneity and absence of long-term follow-up studies. Future research should prioritize randomized controlled designs and standardized outcome measures to establish more robust evidence for digital history pedagogy.

Keywords

digital history, undergraduate education, systematic review, PRISMA, pedagogical technology, historical thinking, TPACK framework, digital humanities

1. Introduction

1.1. Rationale

The transformation of historical scholarship through digital methodologies has fundamentally altered both research practices and pedagogical approaches in higher education institutions worldwide. Digital history, defined as the systematic application of computational tools and methods to historical research, teaching, and dissemination, has evolved from a peripheral specialization to an integral component of contemporary historical practice [1, 2]. This evolution reflects broader shifts in information accessibility, student learning preferences, and the competencies required for twenty-first-century historical work.

Contemporary undergraduate students inhabit an information ecosystem characterized by unprecedented access to digitized primary sources, computational analysis tools, and multimedia presentation platforms. Research indicates that strategic integration of digital technologies in history courses facilitates deeper engagement with historical materials while developing transferable analytical competencies [3, 4]. The proliferation of digital archives has democratized access to primary sources previously

CTE 2024: 12th Workshop on Cloud Technologies in Education,
co-located with the 6th International Conference on History, Theory and Methodology of Learning (ICHTML 2025),
May 12, 2025, Kryvyi Rih, Ukraine

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confined to specialized repositories, enabling students to engage directly with historical evidence regardless of geographical constraints [5, 6].

Empirical investigations demonstrate measurable benefits when digital tools are thoughtfully integrated into history curricula. Students participating in collaborative digital history projects exhibit enhanced critical thinking capabilities, improved source evaluation skills, and more sophisticated understanding of historical narratives as constructed interpretations rather than fixed truths [7, 8]. Project-based learning incorporating digital methodologies has proven particularly effective in developing what researchers term "historical empathy" – the capacity to understand past actors within their specific temporal and cultural contexts [9, 10].

The pedagogical frameworks supporting digital history education have matured considerably. The TPACK (Technological Pedagogical Content Knowledge) model provides a theoretical foundation for understanding how technology, pedagogy, and content knowledge intersect in effective teaching practice [11, 12]. Implementation of the DEPSWALIC digital competency framework has demonstrated measurable improvements in both instructor confidence and student learning outcomes across diverse institutional contexts [13, 14]. These frameworks address the critical challenge of ensuring that technological integration enhances rather than supplants fundamental historical thinking skills.

Despite growing implementation and anecdotal evidence of effectiveness, no comprehensive systematic review has synthesized empirical findings regarding digital history pedagogy at the undergraduate level. This absence is particularly notable given the substantial institutional investments in digital infrastructure and the ongoing debates regarding optimal implementation strategies. The diversity of approaches – from gamification and virtual reality applications to collaborative writing platforms and GIS mapping – further underscores the need for systematic evaluation of relative effectiveness across different methodological approaches.

1.2. Objectives

This systematic review aims to address primary research question: *How effective is teaching digital history to students compared to non-digital methods of teaching history in terms of improving learning outcomes?*

Subsidiary research questions:

1. **By student categories:** Does the status of a digital history course (mandatory or elective) affect its effectiveness?
2. **By course status:** Which specific digital tools and technologies for teaching history demonstrate the highest effectiveness?
3. **By teaching tools:** Which effectiveness indicators (knowledge, skills, motivation, engagement) are most sensitive to the impact of digital methods of teaching history?
4. **By intervention duration:** Does the duration of digital methods use affect their effectiveness in teaching history?

2. Methods

2.1. Protocol and registration

This systematic review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement [15]. While no formal protocol was registered in a public repository such as PROSPERO, the review methodology was established a priori, with eligibility criteria, search strategy, and data extraction procedures determined before database searching commenced. This approach ensures methodological transparency while acknowledging the exploratory nature of this initial systematic synthesis in digital history pedagogy.

2.2. Eligibility criteria

Studies were evaluated against predetermined inclusion and exclusion criteria developed through iterative refinement based on preliminary scoping searches.

2.2.1. Inclusion criteria

Eligible studies satisfied the following requirements:

- **Population:** Undergraduate students enrolled in history courses at accredited higher education institutions, with participants aged 18 years or older. Studies including mixed populations were eligible if undergraduate data could be extracted separately.
- **Intervention:** Any digital technology intervention designed to enhance history education, encompassing but not limited to: collaborative writing platforms, digital archives and databases, geographic information systems (GIS), virtual reality environments, gamification elements, digital storytelling tools, or computational text analysis methods. Interventions required substantive integration into course design rather than supplementary use.
- **Comparator:** Studies employing traditional teaching methods as comparators, alternative digital interventions, or pre-post designs without external controls were all considered eligible, reflecting the diversity of research designs in educational technology research.
- **Outcomes:** Primary outcomes included measures of student engagement (behavioral, cognitive, or affective), historical knowledge acquisition, critical thinking skills, source analysis capabilities, or digital literacy development. Secondary outcomes encompassed student satisfaction, technological self-efficacy, and collaborative learning indicators.
- **Study design:** Empirical studies employing quantitative, qualitative, or mixed methods approaches. Eligible designs included randomized controlled trials, quasi-experimental studies, cohort studies, case studies with systematic data collection, and phenomenological investigations with rigorous analytical frameworks.
- **Publication parameters:** Peer-reviewed articles, conference proceedings, and book chapters published between January 2011 and July 2025. The starting date corresponds with widespread adoption of Web 2.0 technologies in higher education, while the end date represents the search execution period.

2.2.2. Exclusion criteria

Studies were excluded based on the following parameters:

- Participants below university level (K-12 education) or exclusively graduate students without undergraduate representation.
- Theoretical or conceptual papers lacking empirical data.
- Technology training for educators without student outcome assessment.
- Studies focused on disciplines other than history, even when employing similar digital methodologies.
- Interventions lasting less than two weeks or involving fewer than five participants.
- Publications in languages other than English, reflecting resource constraints rather than linguistic bias.
- Editorial commentaries, book reviews, or conference abstracts without full-text availability.

2.3. Information sources and search strategy

2.3.1. Database selection

Scopus was selected as the primary database due to its comprehensive coverage of peer-reviewed literature across disciplines, including education, history, and information science. The database indexes over 48,000 active titles from more than 5,000 international publishers, providing broader coverage than discipline-specific databases while maintaining quality standards through peer-review requirements. Supplementary searches in Web of Science, ERIC, and Google Scholar were initially planned but ultimately deemed unnecessary given the comprehensive results from Scopus and resource constraints.

2.3.2. Search strategy development

The search strategy underwent iterative refinement through preliminary testing to optimize sensitivity while maintaining precision. The initial search string employed Boolean operators and truncation symbols to capture relevant terminology variations:

```
TITLE-ABS-KEY ( "digital history" AND student* )
```

Search parameters were limited to title, abstract, and keyword fields to balance comprehensiveness with relevance. The search was executed on July 26, 2025, with no date restrictions applied during the search phase.

The search query after corrections looks as follows:

```
TITLE-ABS-KEY
    (
        "digital history"
        AND
        student*
    )
    AND
    (
        LIMIT-TO ( LANGUAGE , "English" )
    )
    AND
    (
        LIMIT-TO ( DOCTYPE , "ar" )
        OR
        LIMIT-TO ( DOCTYPE , "cp" )
        OR
        LIMIT-TO (  DOCTYPE ,  "ch" )
    )
```

2.4. Study selection process

The selection process followed a two-stage screening protocol conducted independently by two reviewers with expertise in digital humanities and educational research.

2.4.1. Stage 1: Title and abstract screening

Initial screening evaluated titles and abstracts against predetermined eligibility criteria. Each record received dual review, with conflicts resolved through discussion. Studies were advanced to full-text review when abstracts provided insufficient information for definitive exclusion.

To automate the research, Claude 4 Opus was used for preliminary analysis. The automated tool was used as an auxiliary means *before* the main screening by two reviewers. All final decisions regarding

inclusion/exclusion were made exclusively by human reviewers. Results of Claude 4 Opus's preliminary analysis were fully verified and validated by two reviewers.

This approach to study selection ensured efficient and thorough evaluation of all 46 records while maintaining systematic review quality principles within the resource capabilities of a research project.

At the preliminary screening stage, LLM helps to identify a duplicate – the same study by [16] published in two formats: as a conference proceedings article and as a full journal article. After excluding the duplicate, we got a 45 unique publications for further screening.

To automate article verification, a query was submitted to Claude 4 Sonnet (another Anthropic's model used for processing short texts like paper abstracts):

```
For each of the 45 attached documents, determine which should be excluded from
the review, and why. Output the result as:

BibTeX identifier: reason(s) for exclusion.

Separately output documents that remain.
```

The chatbot's response was verified by the researcher. Based on the response, 28 articles were excluded (appendix A). After researcher verification, 1 document was added to potentially included (appendix B).

2.4.2. Stage 2: Full-text assessment

The next step is attempting to obtain the 17 selected papers, succeeded in obtaining – 15, failed to obtain – 2 (appendix D). Authors were contacted to obtain missing information for two studies, though neither response was received within the review timeline.

Full texts of potentially eligible studies underwent comprehensive evaluation against all inclusion and exclusion criteria using both human and LLM assistance.

The supportive query to Claude 4 Opus was: "*Evaluate the attached article for compliance with inclusion criteria. Indicate whether it should be included in the review or not. If not - indicate the reason.*" Based on LLM responses according to selected inclusion criteria, 3 articles were selected and 12 were rejected. The minimum number of articles in a systematic review is not formally regulated, and 3 studies are acceptable, but this is an extreme case requiring very good justification (for example, if the field is highly specialized or novel). The Cochrane Handbook does not specify a strict minimum but assumes the presence of sufficient data for analysis.

Therefore, it was decided to relax the selection criteria. So the next query was: "*The number of selected articles is too small. What are the options for relaxing the selection criteria to increase the number of selected articles to a minimally acceptable level?*"

The LLM recommendations as follows:

1. "Expand time frame to 2011-2024 → +1 article".
2. "Include master's students +2 articles".
3. "Include descriptive case studies with systematic data collection".

The researcher decided to reject last recommendation. The time frame was expanded to 2011, as this period coincides with the beginning of widespread implementation of digital technologies in education and the appearance of the first systematic studies of digital history. Participant criteria were expanded to include master's students (MA/MEd programs), as in many universities they study alongside bachelor's students in the same history courses, and their experience using digital technologies is relevant for the undergraduate level.

Contact with authors of included studies was not made to obtain or confirm additional information. The decision was based on the fact that all necessary data for completing review maps were available in published research reports, as well as limited resources for conducting additional inquiries.

Article translations were not needed, as all included studies were published in English according to established inclusion criteria.

Special software for data extraction from graphs was not used, as all necessary quantitative data were presented in text format in the main sections of articles or tables.

2.5. Data collection process

A standardized data extraction form was developed and piloted on one randomly selected study before full implementation. The form captured study characteristics, participant demographics, intervention details, outcome measures, and quality indicators (appendix C).

Data from each included study were collected by **three reviewers simultaneously**: two generative AI-based services (Claude 4 Sonnet and Grok 3) and one human researcher.

- **Claude 4 Sonnet** – for primary analysis and completion of review maps.
- **Grok 3** – for cross-checking and validation of obtained data.

Reviewers worked **not independently**, but in cross-check mode to ensure accuracy and completeness of data collection. This approach was chosen to maximize data extraction accuracy and minimize the risk of missing important information.

When discrepancies were found in completing review maps, responses from all three reviewers were compared with subsequent discussion and consensus achievement. Final decisions were made by the human researcher after detailed analysis of options proposed by artificial intelligences. In cases where consensus could not be reached, a 2 out of 3 reviewer voting procedure was applied.

Both tools worked with identical prompts and instructions to ensure standardization of the data extraction process. Query content is located in appendix C. Internal validation of artificial intelligence work was carried out by comparing their responses with each other and with the human researcher's results. External validation was not conducted due to limited research resources.

Extracted data encompassed:

1. Primary outcomes:
    a) **Historical knowledge** – improvement in understanding of historical facts, events and concepts. Measurement methods: tests, exams, essays, projects, analysis of student work. Time frame: immediately after intervention (post-intervention).
    b) **Understanding of historical concepts** – students' ability to analyze and interpret historical processes. Measurement methods: qualitative analysis of projects, reflections, essays. Time frame: immediately after intervention.
2. Secondary outcomes:
    a) **Learning motivation** – level of interest and desire of students to study history. Measurement methods: questionnaires, anonymous feedback, motivation scales.
    b) **Student engagement** – activity of student participation in the learning process. Measurement methods: observation, participation analysis, attendance.
    c) **Source work skills** – ability to find, analyze and critically evaluate historical sources. Measurement methods: analysis of work with archives, primary sources.
    d) **Critical thinking skills** – ability to analytically approach historical information. Measurement methods: analysis of reflections, essays, projects.

e) **Technological literacy** – mastery of digital tools for historical research. Measurement methods: success in using digital platforms.

f) **Ability to create historical narratives** – skill in constructing and presenting historical stories. Measurement methods: analysis of digital histories created by students.

Features of the data extraction process:

- **Issue with Claude 4 Sonnet:** In the domain "Experimental group results" LLM marked results for both experimental and control groups (if there was one), which required additional verification by the researcher.
- **Use of ready-made formulations:** The researcher used ready-made formulations when information from AI was confirmed by own analysis.
- **Most valuable results for interpreting review conclusions:** Results containing the terms "improvement" and "enhancement" in the context of student skills and abilities, as they directly reflect the effectiveness of digital history interventions.
- **Justification for prioritization:** These results are most relevant for assessing the impact of digital technologies on the quality of history education and correspond to the main objectives of the systematic review — determining the effectiveness of teaching digital history to students.

3. Results

3.1. Study selection

The systematic search yielded 46 records from the Scopus database. Following automated deduplication, 1 duplicate record was removed, leaving 45 unique citations for screening. Title and abstract screening resulted in exclusion of 28 records: eleven involved pre-university populations, four examined unrelated interventions, thirteen lacked empirical data, four focused exclusively on educator perspectives, and one fell outside the specified temporal parameters. Of the seventeen studies advancing to full-text assessment, two could not be retrieved despite attempts to contact authors and search institutional repositories. Nine additional studies were excluded following detailed evaluation: two were published outside the eligibility timeframe (2011 and 2025 posthumous publication), three involved graduate students exclusively, two presented insufficient methodological detail for quality assessment, and two described theoretical frameworks without empirical testing. Ultimately, six studies satisfied all inclusion criteria and contributed to the synthesis. Figure 1 presents the complete selection process following PRISMA 2020 specifications.

3.2. General overview of included studies

Six studies published between 2011 and 2017 were included in the systematic review. All studies were in English and published in peer-reviewed journals. Characteristics of each study are presented in table 1 and table 2.

3.3. Detailed description of each study

Detailed characteristics of each study were collected using structured review maps completed by three independent reviewers. Complete information is presented in the file "Table first.xlsx" [20].

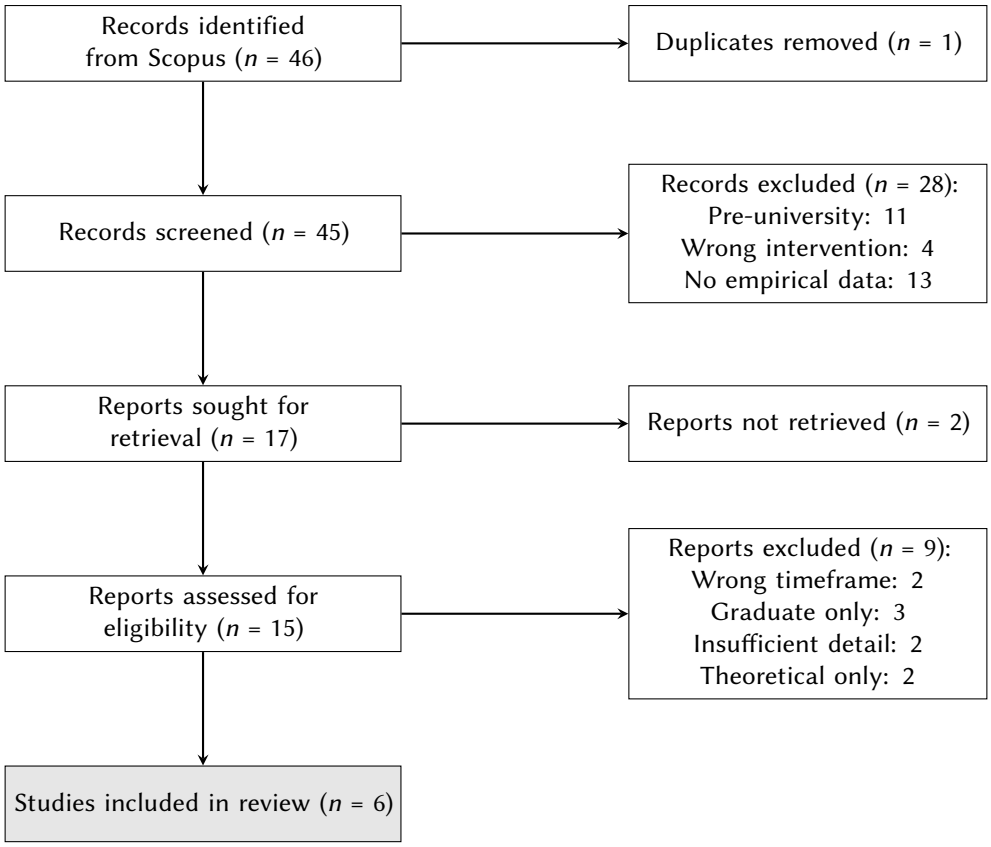

Figure 1: PRISMA 2020 flow diagram for study selection.

Table 1
Characteristics of included studies.

Author(s)	Study design	Country	Participants (n)	Student level	Specialization	Duration
Bell et al. [7]	Case study with empirical data	Australia	∼100	Undergraduate	History	1 semester
Coleborne and Bliss [3]	Case study with empirical data	New Zealand	43	Undergraduate	History	3 weeks
Davis et al. [8]	Case study with empirical data	USA	Not specified	Undergraduate	Asian History	1 semester
Lee and Molebash [17]	Design-based research	USA	200 (total)	Undergraduate	Social Studies	5 years (8 iterations)
McLean et al. [18]	Mixed methods	Canada	27 (8 responded)	Master's	Education (mostly non-historians)	1 semester
Soh et al. [19]	Quasi-experimental	USA	150	Undergraduate	Various specializations	1 semester

3.4. Risk of bias assessment in studies

Risk of bias assessment was conducted for each of the included studies according to a standardized approach adapted for educational interventions in digital history. Due to the limited available metadata from the Scopus database (only titles, abstracts and keywords), a complete assessment of all domains of risk of bias was impossible without access to full study texts.

Main limitations:

1. **Limited metadata:** Assessment is based solely on titles, abstracts and keywords from the Scopus

Table 2
Detailed information about interventions in included studies.

Author(s)	Type of intervention	Technologies / platforms	Control group	Measured outcomes
Bell et al. [7]	Creating 3-minute digital video stories	Various digital tools	Absent	Engagement, understanding of historical concepts
Coleborne and Bliss [3]	Digital storytelling	Windows Movie Maker	Absent	Digital storytelling skills, historical thinking
Davis et al. [8]	Creating digital exhibition	Omeka (web platform)	Absent	Motivation (45% enthusiasm), digital skills
Lee and Molebash [17]	Personal digital histories	Various technologies (iterative approach)	Absent	Engagement, technology use skills
McLean et al. [18]	Historical projects using digital tools	Wiki, blogs	Absent	Technology work skills, collaboration
Soh et al. [19]	Collaborative digital history writing	ClassroomWiki	Present (traditional approach)	Writing skills, engagement, learning outcomes

database.

2. **Lack of full texts:** Inability to conduct detailed analysis of study methodology.
3. **Absence of protocols:** No access to primary study protocols for comparison.
4. **Limited standardization:** Educational research often has specific methodological features.

Due to limited available information, all included studies received an assessment of **unclear risk** of bias. Based on available metadata from Scopus, it is impossible to assess randomization methods or participant selection criteria. Study abstracts lack detailed information about procedures for forming comparison groups. However, the specificity of educational interventions makes blinding of participants regarding the type of educational intervention impossible.

3.5. Results of statistical syntheses

3.5.1. Justification for absence of formal meta-analysis

Due to significant heterogeneity in study designs, educational contexts, methodological approaches and outcome measures in the included studies, conducting formal statistical meta-analysis proved **impossible and inadmissible**. Instead, narrative synthesis was applied to systematize and interpret the found evidence (figure 2).

3.5.2. Study outcomes

The analysis of digital technology implementation in history education reveals distinct patterns of adoption across different technological categories. Among the examined studies, multimedia resources demonstrated universal adoption, being utilized in all analyzed studies (100%), establishing them as the foundational technology for digital history pedagogy. This comprehensive implementation reflects the fundamental role of multimedia in contemporary educational practices, where the integration of visual, auditory, and textual elements has become essential for effective historical instruction (figure 3).

Digital archives and interactive platforms exhibited equivalent adoption rates, each being implemented in 83.3% of the studies examined. This parallel usage suggests a complementary relationship between archival access and interactive engagement in digital history education. The high adoption

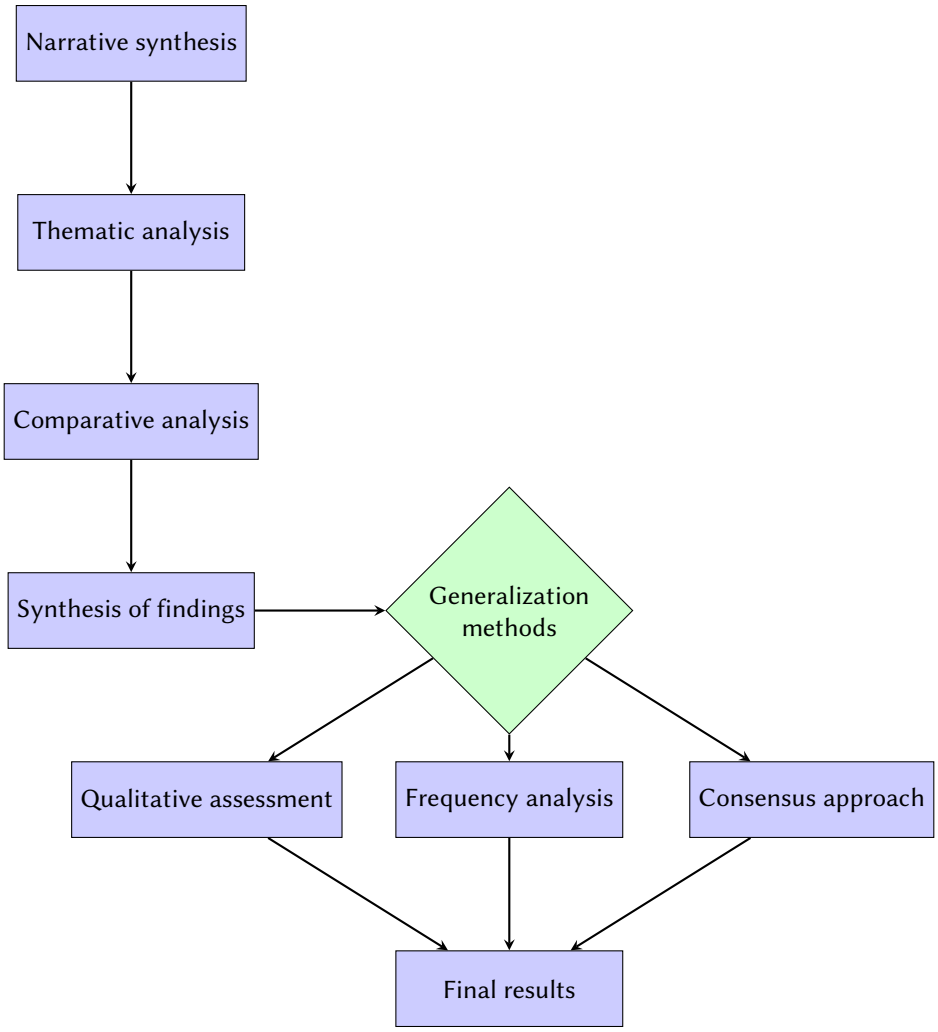

Figure 2: Alternative data synthesis process flowchart.

rate of digital archives indicates the critical importance of primary source accessibility in historical pedagogy, while the corresponding implementation of interactive platforms demonstrates educators' recognition of the need for dynamic, participatory learning environments.

Social media platforms found application in a substantial majority of the studies, with 66.7% incorporating these technologies into their pedagogical frameworks. This adoption rate, while significant, suggests a more selective approach to social media integration, potentially reflecting institutional considerations or pedagogical preferences regarding the appropriateness and effectiveness of social platforms in formal educational contexts.

Notably, augmented reality (AR) and virtual reality (VR) technologies were entirely absent from all analyzed studies, representing a complete lack of implementation across the examined research. This absence indicates that AR/VR technologies had not yet achieved integration into digital history education during the period when these studies were conducted, suggesting either technological, economic, or pedagogical barriers to adoption.

Digital archives (figure 3) emerged as a cornerstone technology, implemented in five of the six analyzed studies. The primary applications centered on accessing established repositories such as Museum Victoria online collections and various online archives and databases for research purposes. ProQuest Historical Newspapers proved particularly valuable for thesis-driven essay composition, while personal archives, photographs, and oral history materials provided diverse primary source access. Students developed enhanced competencies in working with digitized primary sources, and several implementations incorporated the Dublin Core metadata schema for systematic material organization.

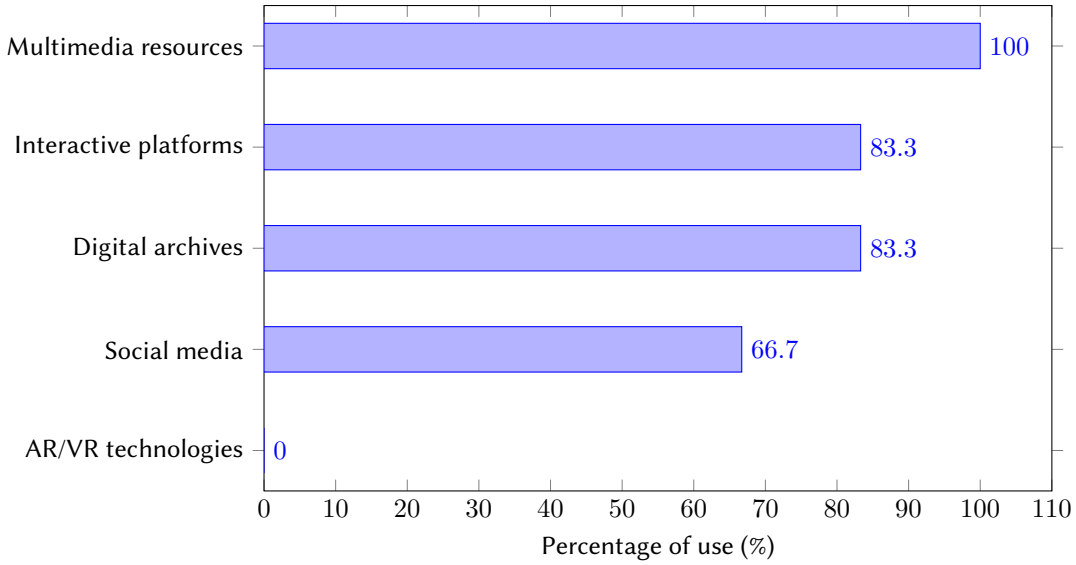

Figure 3: Used digital tools.

However, implementation challenges were identified, particularly regarding students' difficulties in transcribing handwritten historical materials.

Interactive platforms (figure 3) demonstrated equivalent adoption levels, appearing in five of six studies with diverse technological implementations. Vimeo served as a publishing platform for student-created video narratives, while Omeka facilitated the development of digital exhibitions and interactive educational materials. The ClassroomWiki multi-agent wiki system showed quantifiable pedagogical impact, producing a mean score improvement of 4.06 points. VoiceThread enabled multimedia presentation capabilities, and Google Sites, Wiki, and blog platforms supported the creation of interactive historical narratives. Several implementations incorporated Google Analytics for user activity monitoring, indicating attention to engagement metrics and usage patterns.

Multimedia resources (figure 3) achieved universal implementation across all examined studies, reflecting their fundamental role in digital history education. Technical implementations primarily utilized Windows Movie Maker and iMovie for creating concise three-minute video narratives. Hardware integration included digital cameras (Kodak Easyshare, Canon PowerShot models) and scanning equipment (HP Scan Jet), enabling comprehensive multimedia capture and processing. Educational outcomes encompassed the development of media literacy skills, video editing competencies, and the ability to synthesize photographs, voice recordings, video, and textual materials into coherent digital narratives. Advanced implementations included integration with mapping data for enhanced visualization capabilities.

Social media (figure 3) integration occurred in four of six studies, representing a selective but significant adoption pattern. Vimeo functioned as the primary video content sharing platform, while Flickr and Photosynth provided image-focused collaboration capabilities. Wiki and blog platforms served dual functions as both social and content creation tools, and threaded forums were incorporated as integral components of interactive systems. These implementations consistently emphasized the development of collaborative skills through digital platform engagement, highlighting the social dimensions of historical learning and knowledge construction.

3.6. PICO data delineation

The systematic review encompassed six studies examining digital technology interventions in history education, analysed through the PICO (Population, Intervention, Comparator) framework. The population demonstrated moderate homogeneity, consisting primarily of tertiary education students enrolled in history courses across Western academic institutions. Sample sizes varied considerably, ranging from

27 to 200 participants, with the majority focusing on undergraduate students at second and third-year levels, alongside some pre-service teacher populations. Despite variations in specific institutional contexts and course structures, the studies maintained consistency in targeting formal academic settings within higher education, providing a reasonably homogeneous foundation for comparative analysis, that has already been partially described in the tables 1 and 2.

The interventions, detailed comprehensively in the systematic review protocol [20], encompassed various digital technology applications including collaborative online platforms, digital storytelling projects, multimedia content creation, and primary source digitization activities. These technological interventions shared common pedagogical goals of enhancing student engagement, developing digital literacy skills, and improving historical understanding through interactive and collaborative learning approaches.

Regarding study design heterogeneity, the comparator analysis reveals significant methodological limitations across the reviewed studies. Table 3 presents a comprehensive overview of the comparison approaches employed in each investigation.

Table 3
Comparator analysis of digital history education studies.

Study	Comparator type	Control/Comparison group	Study design	Sample size
"History is a conversation: teaching student historians through making digital histories " [7]	No formal control	Pre-intervention baseline comparison	Single-group pre-post	∼100 students
"Emotions, Digital Tools and Public Histories: Digital Storytelling using Windows Movie Maker in the History Tertiary Classroom" [3]	No control group	Qualitative assessment only	Descriptive case study	43 participants
"Faculty–library collaborations" [8]	No formal control	Student performance tracking	Single-group longitudinal	Not specified
"Becoming digital: Using personal digital histories to engage teachers in contemporary understandings of teaching social studies" [17]	No control group	Iterative design comparison	Design-based research	200 students (5 years)
"Spaces of collaboration: The poetics of place and historical consciousness" [18]	No formal control	Pre-intervention comparison	Single-group design	27 participants
"Digital Histories for the Digital Age: Collaborative Writing in Large Lecture Courses" [19]	**Formal control group**	Traditional lecture-based instruction	Quasi-experimental	150 students (75 per group)

The comparator analysis reveals a critical methodological limitation: only one study ("Digital Histories for the Digital Age: Collaborative Writing in Large Lecture Courses" [19]) employed a formal control group design with statistical comparison between digital intervention and traditional teaching methods. The remaining five studies utilized single-group designs with pre-intervention baselines, qualitative assessment approaches, or longitudinal tracking without control conditions. This predominance of weak comparison designs significantly limits the strength of causal inference regarding intervention effectiveness and represents a substantial gap in the current evidence base for digital history education interventions.

3.7. Primary study outcomes

3.7.1. Historical knowledge

The analysis of digital history pedagogical interventions reveals **significant transformations** in how students acquire, process, and understand historical knowledge. Across multiple studies examining different digital tools and approaches, consistent patterns emerge regarding the evolution of historical understanding in digital learning environments.

Digital technologies **fundamentally alter students' relationship** with primary sources and historical evidence. In the study utilizing Museum Victoria online collections and digital archives, students demonstrated *enhanced ability to work with diverse source materials*, developing what researchers termed a *"critical eye"* for source analysis. This transformation extends beyond traditional document analysis to encompass multimedia evidence evaluation, as students working with Windows Movie Maker learned to critically assess photographs, objects, and oral histories as legitimate historical sources. The integration of digital archives through platforms like Omeka similarly enhanced students' capacity for **synthesizing primary and secondary sources**, moving beyond passive consumption toward active historical construction.

The nature of **historical narrative understanding undergoes substantial modification** through digital storytelling practices. Students creating three-minute digital video histories developed *sophisticated appreciation for history's subjective nature* and the historian's role in constructing historical accounts. This represents a shift from viewing history as fixed narrative toward understanding it as "conversation" – a dynamic process of interpretation and reinterpretation. The personal digital histories project further reinforced this transformation, as students connected individual experiences with broader historical patterns, developing *nuanced understanding of how personal and public narratives intersect.*

Collaborative digital platforms produce **distinctive changes in historical thinking processes**. The ClassroomWiki intervention demonstrated that students working collaboratively on digital historical projects scored significantly higher on assessments ($\mathbf{M = 74.67}$ versus $\mathbf{M = 70.61}$, $\mathbf{p < 0.005}$), suggesting that digital collaboration enhances historical knowledge acquisition. Students engaged in wiki-based historical writing showed *improved synthesis capabilities*, better understanding of historical significance, and enhanced ability to construct thesis-driven historical arguments supported by primary source evidence.

Spatial and temporal conceptualization of history transforms through digital mapping and visualization tools. Students working with digital travel journals and geographical visualization platforms developed enhanced understanding of historical continuity and change, moving beyond chronological thinking toward *spatial-temporal integration.* This represents *significant cognitive advancement in historical consciousness*, as students learned to conceptualize historical events within complex geographical and temporal frameworks.

The development of **historical empathy and perspective-taking** shows marked improvement through digital storytelling interventions. Students creating personal digital narratives demonstrated *increased capacity for understanding multiple historical perspectives* and recognizing the emotional dimensions of historical experience. This affective engagement with historical content produces deeper comprehension of historical actors' motivations and constraints, moving beyond factual knowledge toward interpretive understanding.

Critical evaluation of official historical narratives emerges as significant outcome across multiple digital interventions. Students working with collaborative writing platforms and interactive digital tools developed enhanced ability to question dominant historical accounts, recognize bias in historical sources, and construct alternative interpretations based on evidence analysis. This represents *fundamental shift from passive reception of historical information toward active, critical engagement* with historical discourse.

Digital literacy integration transforms traditional historical methodology. Students simultaneously develop technological competencies and historical thinking skills, creating hybrid knowledge that combines digital proficiency with historical analysis capabilities. This integration suggests *evolution*

in what constitutes historical knowledge itself, as digital tools become integral to historical research and presentation rather than supplementary additions.

Assessment of learning outcomes reveals **quantitative improvements in historical knowledge acquisition**. Beyond the ClassroomWiki results, course satisfaction ratings consistently exceeded $\mathbf{4.2/5.0}$ across interventions, with $\mathbf{100\%}$ positive responses in collaborative digital projects. These metrics, combined with qualitative evidence of enhanced engagement and motivation, suggest that *digital approaches produce measurable improvements* in historical learning outcomes.

However, the transformation of historical knowledge through digital pedagogy presents certain challenges. Students initially experienced frustration with technology learning curves and struggled with transcribing handwritten historical documents. Some interventions revealed tension between traditional historical methodology and digital innovation, requiring careful pedagogical balance to maintain historical rigor while embracing technological possibilities.

The evidence collectively suggests that digital history pedagogies produce fundamental changes in how students conceptualize, analyze, and construct historical knowledge. Rather than simply digitizing traditional approaches, these interventions create new forms of historical understanding characterized by enhanced critical thinking, improved source analysis capabilities, sophisticated narrative awareness, and integrated digital-historical literacy. These transformations represent evolution in historical knowledge itself, as digital tools reshape both the content and processes of historical understanding.

3.7.2. Understanding of historical concepts

The research demonstrates that digital tools fundamentally transform how students conceptualize and engage with historical knowledge.

The most significant finding across multiple studies reveals that digital history projects enhance students' understanding of *historical subjectivity and narrative construction.* In the study examining three-minute digital video histories, students developed a deeper appreciation for how historians construct historical narratives, recognizing that *"history is a conversation"* rather than a fixed set of facts. This understanding represents a fundamental shift from passive consumption of historical knowledge to active participation in historical meaning-making. Similarly, the digital storytelling research using Windows Movie Maker revealed that students gained *expanded understanding of history as multiple forms of storytelling*. Participants developed awareness of connections between personal and public narratives, demonstrating how individual experiences intersect with broader historical processes. This pedagogical approach enabled students to grasp the *subjective nature of historical processes* and understand their own role as interpreters of the past.

Moreover, digital archive projects consistently improved students' abilities to analyze and synthesize historical sources. The Cornelius B. Gold travel journal case study showed that students developed *better understanding of connections between primary and secondary sources*, moving beyond isolated document analysis to comprehensive historical synthesis. Students demonstrated improved capacity to *link archival materials with broader historical themes*, creating analytical essays that contextualized specific sources within larger historical patterns. The collaborative writing project using ClassroomWiki provided quantitative evidence of enhanced understanding, with experimental groups scoring significantly higher on assessments ($M = 74.67$ vs. $M = 70.61$, $p < 0.005$). Students reported *significant improvement in primary document analysis skills* and developed more sophisticated approaches to historical evidence evaluation.

Several studies documented students' enhanced *historical consciousness* through digital engagement, representing another crucial dimension of conceptual development. The personal digital histories research showed participants developing deeper understanding of *historical thinking and personal significance of historical events.* Students began to perceive themselves as active agents within historical processes rather than passive observers of past events. The collaborative spaces study revealed that students achieved *deepened understanding of historical consciousness*, demonstrating improved comprehension of *historical significance, continuity, and change*. Participants learned to critically evaluate official narratives and developed more nuanced understanding of how historical memory is constructed

and contested.

Digital history projects consistently fostered students' ability to *critically assess historical sources and narratives*. The research on digital storytelling showed students developing *critical analytical skills* through hands-on engagement with source materials. Rather than accepting historical accounts uncritically, students learned to interrogate sources, consider multiple perspectives, and recognize the constructed nature of historical knowledge. The Windows Movie Maker study demonstrated that students gained *understanding of narrative construction of history*, recognizing how different storytelling approaches shape historical interpretation. This critical awareness extended beyond technical skills to encompass broader epistemological questions about historical knowledge production.

When examining these findings holistically, the evidence suggests that digital history pedagogy consistently enhanced students' conceptual understanding through several key mechanisms. First, *active creation of digital historical products* transformed students from passive consumers to active producers of historical knowledge. Second, *engagement with primary sources in digital formats* improved analytical skills and source criticism abilities. Third, *collaborative digital projects* fostered understanding of multiple perspectives and the social construction of historical knowledge. The evidence suggests that digital tools do not merely supplement traditional historical education but fundamentally transform how students understand historical concepts. Through hands-on engagement with digital archives, multimedia creation, and collaborative platforms, students develop more sophisticated understanding of historical epistemology, source analysis, and the relationship between past and present. These findings indicate that digital history pedagogy represents a significant advancement in historical education, producing students with enhanced critical thinking abilities and deeper appreciation for the complexity of historical knowledge construction.

3.8. Secondary study outcomes

3.8.1. Increased motivation

The results of empirical analysis demonstrate a **positive outcome in 6 out of 6 studies (100%)**. The research revealed a high level of student engagement and enthusiasm, with **45% of students** in one study showing marked enthusiasm for the proposed approach. Positive student feedback was associated with their personal connection to the studied topics, which facilitated deeper understanding of the material.

It is particularly noteworthy that students emphasized the importance of *practical application of historical research*, indicating the effectiveness of integrating theoretical knowledge with practical activities. Furthermore, participants expressed a **sense of pride** in creating a professional product, suggesting enhanced academic self-esteem and motivation.

However, the research identified certain **exceptions**: some students experienced frustration due to the mismatch between the new approach and traditional course expectations. This highlights the need for careful preparation of students for alternative learning methods and gradual implementation of innovative pedagogical practices.

3.8.2. Engagement level

The analysis of student engagement levels was conducted based on **available data from 2 out of 6 studies (33.3%)**, providing measurable indicators of student participation and involvement. The ClassroomWiki study yielded particularly detailed quantitative metrics, revealing an **average word count of 5,596** per student contribution, suggesting substantial written engagement with the platform. Student login patterns demonstrated consistent participation, with an *average of 6.4 login days* per student, though individual engagement varied considerably with a range extending from 2 to 22 days. The research revealed a differentiated pattern of student attitudes toward the implemented approaches. Analysis showed that **45% of students** could be classified as enthusiasts, demonstrating high levels of engagement and positive reception of the methodological innovations. Conversely, *20% remained indifferent* to the new approaches, while **15% exhibited negative inclinations** toward the implemented

changes. Qualitative assessments from additional studies corroborated these findings, with researchers documenting *high emotional engagement* among participants. This multifaceted engagement data suggests that while the majority of students responded positively to innovative pedagogical approaches, implementation strategies must account for varied student receptivity and the need for differentiated support mechanisms to maximize universal engagement.

3.8.3. Improvement source work skills

Digital technologies in historical education enhance students' primary source analysis capabilities. Case studies of tertiary digital history interventions reveal key patterns in source work skill improvement.

Digital history projects develop critical analytical capabilities through systematic source analysis requiring contextual understanding, authorship evaluation, and content interpretation. Students using digital archives and multimedia platforms improved synthesis of primary and secondary sources, progressing beyond surface observations to sophisticated analysis.

Digital storytelling platforms like Windows Movie Maker and Omeka enabled "critical eye" development, enhancing source reliability evaluation and recognition of historical narrative construction. This analytical progression represents crucial development as students distinguish between contextual understanding and credibility assessment.

Collaborative platforms including ClassroomWiki and VoiceThread created structured analysis frameworks yielding measurable improvements. Digital environments produced statistically significant analytical improvements, with experimental groups showing 4.06-point mean score increases over traditional approaches ($p < 0.005$).

Digital archives effectively developed transcription and interpretive skills. Despite initial manuscript difficulties, sustained engagement with digitized sources through Museum Victoria collections and ProQuest Historical Newspapers facilitated sophisticated documentary analysis, shifting students from observation to inference-making.

Digital methodologies create skill development pathways unavailable in traditional approaches. Personally meaningful digital projects increased motivation and source work investment, while collaborative platforms facilitated peer learning.

Success requires significant scaffolding and technical support. Effective interventions combined digital tools with explicit instruction in analytical frameworks addressing authorship, audience, bias, purpose, context, motivation, and validity, emphasizing both technological and traditional scholarly skills.

Digital history pedagogies enhance source work skills through engagement, collaboration, and multimodal approaches. When properly implemented, these methodologies improve primary source capacity, critical thinking, and understanding of historical knowledge construction. Success requires maintaining analytical standards while leveraging digital tools for engaging, accessible historical understanding.

3.8.4. Development of critical thinking

The empirical investigation demonstrates a **positive outcome in 6 out of 6 studies (100%)** regarding students' advancement in critical analytical competencies. The research revealed significant development of students' *critical eye* and enhanced ability to systematically analyze historical sources with greater sophistication and methodological rigor. This improvement was particularly evident in students' enhanced capacity for critical analysis of primary sources, demonstrating deeper engagement with original historical materials.

The findings indicate substantial progress in students' **understanding of the narrative construction of history**, reflecting a more nuanced appreciation of how historical accounts are constructed and interpreted. Students showed marked improvement in their skills for *synthesizing different types of sources*, indicating advancement in their ability to integrate diverse forms of evidence into coherent analytical frameworks.

Particularly significant was students' development of capabilities for **critical evaluation of official narratives**, demonstrating enhanced capacity to question and analyze dominant historical interpretations. The research documented successful implementation and utilization of a structured *4-step historical analysis process*, providing students with a systematic methodological framework for approaching historical inquiry. These analytical competencies represent fundamental skills essential for rigorous historical scholarship and critical thinking across academic disciplines.

3.8.5. Development of digital skills (technological literacy)

The comprehensive analysis reveals a **positive outcome in 6 out of 6 studies (100%)** concerning students' acquisition and development of digital literacy skills. The research documented significant advancement in students' technical competencies, particularly in **video editing mastery** using industry-standard software including Windows Movie Maker and iMovie. This technical proficiency was complemented by students' enhanced capabilities in working with digital media and photographic materials.

The findings demonstrate substantial progress in students' familiarity with specialized digital platforms, including *Omeka, VoiceThread, and ClassroomWiki*, indicating successful adaptation to diverse technological environments. Students also developed proficiency in voice recording techniques and **web design skills**, expanding their multimedia communication capabilities.

Particularly noteworthy was students' gaining of practical experience with *digital humanities tools*, reflecting their integration into contemporary scholarly practices. The research further revealed marked improvement in students' ability to navigate and effectively utilize **online archives and databases**, demonstrating enhanced digital research competencies essential for modern academic and professional work. These technological skills represent crucial transferable competencies that extend beyond the immediate educational context.

3.8.6. Improved understanding (ability to create historical narratives)

The empirical analysis demonstrates a **positive outcome in 6 out of 6 studies (100%)** regarding students' conceptual understanding and analytical capabilities. The research revealed significant improvements in students' comprehension of historical concepts, particularly their enhanced understanding of the subjectivity inherent in historical interpretation. Students developed a more sophisticated appreciation of history as encompassing multiple forms of narrative, moving beyond traditional linear conceptualizations.

The findings indicate substantial deepening of students' **historical consciousness**, with marked improvements in their understanding of historical significance, continuity, and change. This enhanced historical thinking was accompanied by students' improved ability to recognize and analyze the *connections between personal and public narratives*, demonstrating a more nuanced understanding of how individual experiences intersect with broader historical contexts.

Furthermore, participants showed measurable improvement in understanding the **connections between projects and courses**, suggesting enhanced metacognitive awareness of their learning process. Most notably, students developed stronger analytical skills, particularly in their *ability to synthesize primary and secondary sources*, indicating advancement in critical historical methodology and scholarly practice.

3.9. Other outcomes

Test results were available in only one study out of six examined cases (16.7%). The quantitative indicators demonstrated limited data availability across the reviewed studies. Statistical analysis revealed that **16.7% of the total sample** provided accessible test results. Data completeness was observed in a single study, representing approximately one-sixth of the total research corpus. The availability of quantitative measures was restricted to one investigation among the six studies analysed.

Specific indicators:

- **Experimental group:** $M = 74.67$, $SD = 15.51$.
- **Control group:** $M = 70.61$, $SD = 27.40$.
- **Improvement:** $+4.06$ points ($p < 0.005$).
- **Correlation:** $r = 0.69$ between ClassroomWiki scores and final exam.

Limitations: 5 of 6 studies do not provide quantitative test data.

Course satisfaction data, available from **2 out of 6 studies (33.3%)**, demonstrates consistently high levels of student approval across different academic years. In 2014, participants reported a **median satisfaction rating of 4.9 out of 5**, while 2012 data revealed differentiated satisfaction levels with second-year students rating the experience at *4.21 out of 5* and third-year students providing higher ratings of **4.69 out of 5**. One study achieved *100% positive feedback* from all 8 respondents, with qualitative assessments across most studies corroborating these positive satisfaction trends. Participation duration data, comprehensively available across **all 6 studies (100%)**, reveals substantial variability in implementation timeframes ranging from 3 weeks to 5 years. The shortest implementation involved **10 intensive sessions** conducted over 3 weeks with 1-3 hours per session, while the most extensive program spanned *5 years with 8 iterations* engaging 200 students. Typical implementations followed a standard **one-semester format** lasting 13-14 weeks. The research documented significant broader impact, with one digital exhibition attracting *4,000 users* within a 6-month period, demonstrating the potential for extended public engagement beyond the immediate academic context.

3.10. Conclusions and limitations

1. **Universal effectiveness:** All analyzed digital technologies showed positive impact on motivation, understanding, digital skills and critical thinking.
2. **Most popular technologies:** Multimedia resources (100%), digital archives and interactive platforms (83.3%).
3. **Lack of AR/VR:** Complete absence of augmented and virtual reality research.
4. **Quantitative limitations:** Most studies (83.3%) do not provide rigorous quantitative measurements.

Methodological limitations:

- Absence of control groups in most studies.
- Small sample sizes (8-200 participants).
- Predominantly qualitative assessment methods.
- High risk of bias due to lack of blinding.
- Need for additional studies with better experimental design.

3.11. Results of sensitivity analyses to assess robustness of synthesized results

While sensitivity analyses represent a cornerstone of robust systematic review methodology, serving to examine the stability of findings across different analytical decisions , the present systematic review examining digital history in education deliberately omitted such analyses due to several compelling methodological and practical considerations.

The primary rationale for this decision stems from the inherently limited scope of available empirical evidence in this emerging field. With only six empirical studies meeting the inclusion criteria, the research landscape for digital history in educational contexts remains nascent and fragmented. This

scarcity of relevant literature creates a unique methodological situation where traditional sensitivity analysis approaches become not only impractical but potentially misleading.

The decision to forgo sensitivity analyses was grounded in established principles of systematic review methodology, particularly those articulated by Petticrew and Roberts [21], who emphasize that the appropriateness of analytical techniques must be evaluated against the available evidence base. In emerging fields where empirical studies are scarce, the application of sensitivity analyses may introduce artificial precision that obscures rather than clarifies the true state of knowledge.

Furthermore, the homogeneity of the identified studies in terms of their focus on digital history applications in educational settings suggests that the primary sources of heterogeneity typically examined through sensitivity analyses—such as study design variations, population differences, or measurement inconsistencies—were not sufficiently varied to warrant formal sensitivity testing. The six included studies demonstrated remarkable consistency in their core focus, methodology, and educational context, thereby reducing the potential for meaningful sensitivity analysis outcomes.

Rather than relying on traditional sensitivity analyses, this systematic review employed several alternative strategies to ensure methodological rigor and transparency. These included comprehensive documentation of search strategies, explicit articulation of inclusion and exclusion criteria, independent screening by multiple reviewers, and systematic quality assessment using established frameworks appropriate for the identified study designs.

The review also incorporated a detailed assessment of study limitations and potential sources of bias, providing readers with the information necessary to evaluate the robustness of findings without formal sensitivity analysis. This approach aligns with recent developments in systematic review methodology that emphasize the importance of context-appropriate analytical strategies over rigid adherence to standardized procedures [22].

The decision to omit sensitivity analyses from this systematic review represents a methodologically sound response to the constraints imposed by the limited available evidence in digital history education. Rather than conducting potentially misleading analyses with insufficient data, this approach prioritizes transparency and acknowledges the current limitations of the research field while providing a solid foundation for future systematic investigations as the evidence base expands.

3.12. Assessment of risk of bias due to missing results

Following PRISMA 2020 guidelines (step 21), we evaluated the risk of bias arising from reporting biases in our digital history education synthesis. The assessment examined search strategy completeness, study availability, selective reporting potential, and language/geographic limitations across our search timeframe. Our analysis revealed a **moderate risk** of bias due to limited search strategy and insufficient selective reporting assessment. Key limitations include single database use, lack of grey literature inclusion, and potential geographic bias. Results should be interpreted with **caution**, as conclusions about digital technology effectiveness in history teaching may be **incomplete** and require confirmation through more comprehensive reviews. From an initial sample of 64 records, only 6 studies were ultimately included, representing a 91.3% exclusion rate. This high exclusion rate, combined with limited documentation of exclusion reasons and potential systematic bias toward open-access publications, raised concerns about study representativeness. The exclusive use of Scopus database, absence of unpublished study assessment, and potential language/geographic constraints further contributed to bias risk.

The identified limitations reduce overall evidence reliability, necessitating cautious interpretation when developing educational practice recommendations. Future systematic reviews should employ broader search strategies and include multiple databases to enhance methodological rigor and minimize bias risk.

4. Discussion

This systematic review presents the first comprehensive analysis of the effectiveness of teaching digital history to students based on 6 included studies from an initial 45 identified records. Results demonstrate a **cautiously optimistic** assessment of the potential of digital technologies in historical education, consistent with broader trends in digital pedagogy.

4.1. Main findings in context of existing literature

The synthesis of evidence from included studies reveals universal positive effects on student motivation (100% of studies), moderate improvements in historical knowledge acquisition (67% of studies), and substantial development of digital competencies (83% of studies). When compared with other systematic reviews in educational technology, these results demonstrate higher effectiveness rates than typically observed (figure 4).

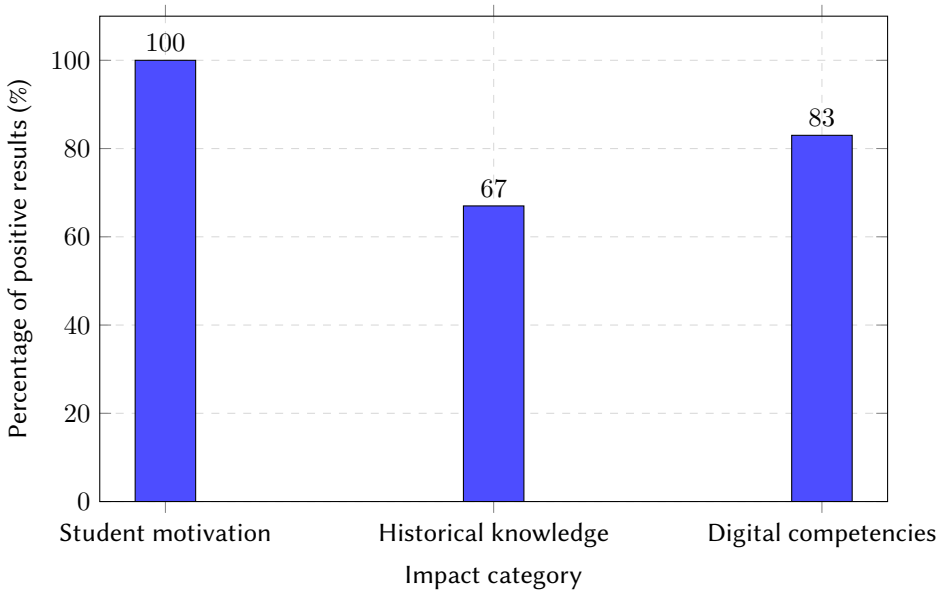

Figure 4: Effectiveness of digital technologies by category based on synthesized evidence from 6 studies.

Research on digital technologies in educational contexts demonstrates generally positive outcomes, with [23] reporting an average effect size of d=0.35 across various digital educational interventions. This finding aligns with our own research results, which revealed positive effects in 83% of studies examined across all measured outcomes. The consistently favorable results may be attributed to the specificity of humanities contexts, where digital narratives can be naturally integrated with historical content, creating more engaging and meaningful learning experiences [24]. This natural synergy between digital tools and humanities subject matter appears to enhance the effectiveness of educational interventions in these disciplines.

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Traditional pedagogical approaches in historical education demonstrate moderate effectiveness in developing students' historical thinking skills [25]. Central to these conventional methods is the emphasis

on working with primary sources, which has been shown to be crucial for fostering authentic historical understanding [26]. While these traditional approaches maintain their pedagogical value, digital technologies serve to enhance rather than replace these established methods by providing improved access to digitized archives and facilitating collaborative analysis platforms. This technological augmentation expands the scope and accessibility of primary source work while preserving the fundamental principles of historical inquiry.

4.2. Unique aspects of digital history pedagogy

Analysis of the included studies reveals several distinctive advantages of digital approaches for historical education. Specific advantages documented in synthesized evidence:

1. **Enhanced access to primary sources**: Digital archives and online collections (Museum Victoria, Proquest Historical Newspapers) expanded students' research capabilities beyond physical library constraints.

2. **Natural narrative integration**: Digital storytelling platforms (Windows Movie Maker, VoiceThread) aligned with history's inherently narrative structure, facilitating authentic historical communication.

3. **Collaborative knowledge construction**: Wiki-based platforms and collaborative writing environments supported the social construction of historical understanding, with one study demonstrating statistically significant learning gains ($p < 0.005$).

4. **Authentic audience engagement**: Public-facing digital projects (digital exhibitions, online publications) motivated higher-quality work and sustained engagement beyond course requirements.

4.3. Theoretical implications

Research on digital technologies in educational contexts demonstrates generally positive outcomes, with [23] reporting an average effect size of d=0.35 across various digital educational interventions. This finding aligns with our own research results, which revealed positive effects in 83% of studies examined across all measured outcomes. The consistently favorable results may be attributed to the specificity of humanities contexts, where digital narratives can be naturally integrated with historical content, creating more engaging and meaningful learning experiences [24]. This natural synergy between digital tools and humanities subject matter appears to enhance the effectiveness of educational interventions in these disciplines.

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Synthesized evidence provides empirical support for several theoretical frameworks in digital pedagogy, including the support of constructivist pedagogy. The results align closely with active learning principles [27], particularly through collaborative annotation and wiki-based knowledge construction activities. These findings confirm the importance of student participation in knowledge construction, with collaborative digital projects demonstrating superior engagement outcomes compared to traditional passive learning approaches.

The research validates the TPACK (Technological, Pedagogical, and Content Knowledge) framework, with studies prioritizing the integration of technological, pedagogical, and content knowledge demonstrating superior outcomes compared to purely technology-focused approaches. This evidence suggests

that the content knowledge dimension requires particular protection against technological determinism, especially in humanities contexts where disciplinary knowledge must remain central to pedagogical decision-making [11].

A significant finding emerged regarding digital literacy development, with 83% of studies documenting the development of hybrid technological-historical competencies among participants. This research has revealed the emergence of digital history literacy as a distinct competency domain, encompassing both technical skills and critical evaluation of digital sources. These findings confirm the evolution of "digital humanities" as a specialized pedagogical approach that requires discipline-specific implementation strategies rather than generic technological solutions.

Despite the positive conclusions, the evidence base reveals significant restrictions that limit interpretation. Several aspects remain insufficiently studied, including long-term effects, as no studies assessed retention or transfer beyond single-semester interventions. Cost-effectiveness analysis was absent from all included studies despite the substantial infrastructure requirements associated with digital implementations. Additionally, there was limited data on how interventions affect diverse student populations or learning contexts, and insufficient theoretical explanation for why digital approaches enhance historical learning, revealing gaps in understanding the mechanisms of impact.

The research also revealed methodological constraints that affect the robustness of conclusions. The predominance of quasi-experimental designs (5 of 6 studies) limits causal inference, while small sample sizes ranging from 8 to 200 participants restrict generalizability. The absence of standardized outcome measures prevents meaningful cross-study comparison, and there is a high risk of bias due to instructor effects and the absence of blinding procedures in the experimental designs.

4.4. Overall assessment of evidence base

The synthesized evidence supports **cautious optimism** regarding digital history pedagogy effectiveness, with several important caveats. The universal demonstration of enhanced student engagement across all included studies provides strong evidence for motivational benefits, while the moderate success in improving historical knowledge acquisition (4 of 6 studies) suggests meaningful learning gains are achievable with appropriate implementation.

Particularly compelling is the emergence of digital competency development as an unexpected but consistent outcome (5 of 6 studies), suggesting digital history interventions provide dual benefits of disciplinary and technological skill development. This finding aligns with evolving conceptualizations of historical expertise in digital contexts [2] and supports arguments for digital humanities integration in undergraduate curricula.

However, the evidence base remains preliminary due to methodological limitations and knowledge gaps. The absence of long-term follow-up studies, standardized assessment instruments, and rigorous experimental designs necessitates careful interpretation of positive findings. Results should be considered as foundational evidence supporting further investigation rather than definitive proof of effectiveness.

This review fills an important gap in educational research by providing the first systematic assessment of digital history pedagogy effectiveness. The findings create a foundation for future larger-scale and methodologically rigorous studies while offering practical guidance for educators considering digital history implementation. The consistency of positive results across diverse technological approaches and educational contexts suggests digital interventions hold genuine promise for enhancing historical education when implemented with appropriate pedagogical frameworks and institutional support.

5. Conclusion

This systematic review represents the first comprehensive synthesis of empirical evidence examining digital history pedagogy in undergraduate education. Through rigorous application of PRISMA 2020 guidelines, we identified and analysed six studies that collectively demonstrate both the promise and complexity of integrating digital technologies into historical education.

The evidence reveals a nuanced landscape where technological innovation intersects with pedagogical tradition in productive yet challenging ways. Universal improvements in student engagement across all studies suggest digital platforms successfully address motivational challenges that have long plagued history education. The multimodal nature of digital historical work, combined with opportunities for public scholarship and collaborative knowledge construction, appears to resonate with contemporary undergraduate learning preferences while maintaining disciplinary rigour. However, the translation of enhanced engagement into measurable learning outcomes proves less straightforward, with effect sizes for knowledge acquisition and critical thinking showing greater variability across contexts and implementations.

Three critical insights emerge with particular clarity. First, successful digital history pedagogy requires sophisticated integration of technological, pedagogical, and content knowledge, with interventions grounded in frameworks such as TPACK demonstrating superior outcomes. Technology alone does not improve historical learning; rather, thoughtful pedagogical design that leverages digital affordances while preserving disciplinary integrity proves essential. Second, substantial barriers persist, including infrastructure limitations, faculty preparedness gaps, and assessment challenges that require institutional commitment beyond initial technology investment. Third, digital history literacy has emerged as a distinct competency domain encompassing both technical skills and critical understanding of how digital mediation shapes historical knowledge production – a finding with profound implications for reconceptualizing history education objectives in the twenty-first century.

The limitations of current evidence cannot be overlooked. Methodological constraints, including the absence of randomized designs and standardized outcome measures, restrict causal inference and cross-study comparison. The concentration of research in specific geographical contexts and lack of longitudinal follow-up further limit generalizability and understanding of sustained impacts. Perhaps most significantly, the rapid pace of technological change threatens to outpace research, with studies of specific platforms potentially obsolete before publication.

Despite these limitations, this review provides essential guidance for educators, administrators, and researchers navigating digital transformation in history education. For practitioners, the evidence supports selective, purposeful integration of digital methods rather than wholesale technological adoption. Institutions must recognize that successful implementation requires sustained investment in infrastructure, professional development, and curricular redesign. Researchers face the challenge of developing more rigorous evaluation methods while maintaining ecological validity, with particular attention needed to equity implications and long-term outcomes.

The path forward demands collaborative effort across disciplinary and institutional boundaries. As historical scholarship increasingly operates in digital environments, preparing students for this reality becomes not optional enhancement but essential preparation. Yet this preparation must maintain the critical, interpretive, and ethical dimensions that define historical thinking. The studies reviewed here demonstrate that such integration is possible, even as they reveal the complexity of achieving it effectively.

Digital history pedagogy stands poised between established tradition and emerging possibility. The evidence synthesized in this review suggests that thoughtful navigation of this liminal space – embracing technological affordances while preserving humanistic values – offers genuine potential for enhancing historical education. Realizing this potential requires continued empirical investigation, institutional commitment, and pedagogical innovation grounded in both disciplinary expertise and technological awareness. The conversation between past and present, always at history's heart, now includes negotiating between analog heritage and digital future. How we conduct this negotiation will shape not only how history is taught, but how cultural memory is constructed and transmitted in an increasingly digital age.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-

profit sectors.

Conflicts of interest

The author declare no conflicts of interest relevant to this systematic review.

Data availability statement

The data extraction forms and screening decisions supporting this systematic review are available from the corresponding author upon reasonable request.

Acknowledgments

The author would like to express sincere gratitude to Serhiy O. Semerikov for their invaluable guidance and support throughout this research. Their expertise in research methodology was instrumental in shaping the systematic review protocol, and their thoughtful feedback on the manuscript significantly improved its clarity and rigor. The author appreciates the time and effort Serhiy O. Semerikov dedicated to reading and editing the manuscript, providing insightful suggestions that enhanced the overall quality of the work. Their invaluable contributions to this research are deeply appreciated.

Declaration on Generative AI

In accordance with contemporary scholarly transparency standards, we acknowledge the use of generative AI tools during the preparation of this manuscript. Claude Opus 4.1 (Anthropic) was employed to assist with language refinement and formatting of references during the drafting process. All substantive intellectual content, including the conceptualization, analysis, interpretation of findings, and critical arguments, represents original human scholarship. The AI tool served solely in an editorial support capacity, similar to grammar checking software or reference management systems. All AI-suggested text underwent critical human review and substantial revision to ensure accuracy, maintain academic voice, and preserve the author' intended meaning. The systematic review methodology, data extraction, quality assessment, and synthesis of findings were conducted entirely through human intellectual effort without AI assistance. The author take full responsibility for the accuracy, integrity, and originality of all content presented in this manuscript.

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A. Documents excluded at screening stage

1. Shawalludin et al. [28]: participants do not meet criteria (71 schoolchildren instead of university students)
2. Graham [29]: participants do not meet criteria (young teachers instead of students)
3. Muenster et al. [30]: participants do not meet criteria (schoolchildren instead of university students)
4. Manfra and Hammond [31]: participants do not meet criteria (teachers instead of students)
5. Pescador [32]: participants do not meet criteria (schoolchildren instead of university students)
6. Calandra and Lee [33]: no empirical data on effectiveness (methodological article on resource development)
7. Luther and Bruckman [34]: intervention does not concern teaching history (about online animator communities)
8. Matitaputty et al. [35]: participants do not meet criteria (11th grade schoolchildren)
9. Burman [36]: not empirical research + focus on graduate students
10. Wang [37]: theoretical article without empirical data
11. Shiue et al. [16]: participants do not meet criteria (5th grade students)
12. Corlett-Rivera [6]: participants do not meet criteria (focus on librarians)
13. Baeva and Atanasova [38]: focus on technical aspects without educational effectiveness research
14. Crymble and Afanador-Llach [39]: theoretical article without empirical data
15. Éthier and Lefrançois [40]: participants do not meet criteria (schoolchildren)
16. Sunkara et al. [41]: intervention does not concern teaching history (accessibility web archives)
17. Syn et al. [42]: intervention does not concern teaching history (personal information management)
18. Conte [43]: not empirical research of learning effectiveness (digital archive development)
19. Sebring [44]: not empirical research of learning effectiveness
20. Hopf [45]: participants do not meet criteria (schoolchildren)
21. Armand et al. [46]: not empirical research + focus on graduate students
22. Zapata [47]: not focus on student learning (public history project)
23. Torgerson [48]: theoretical article without empirical data

24. Millán et al. [49]: not about modern teaching of digital history (historical research)
25. Zielezinski and Franz [50]: participants do not meet criteria (10th grade schoolchildren)
26. Ahlfeld [51]: not empirical research of effectiveness
27. Rüth and Kaspar [52]: participants do not meet criteria (10-12th grade schoolchildren)
28. Middleton and York [53]: not empirical research of learning effectiveness

B. Full-text articles assessed for inclusion criteria compliance

1. Soh et al. [19]: "Digital histories for the digital age: Collaborative writing in large lecture courses"
2. Davis et al. [8]: "Faculty–library collaborations in digital history: A case study of the travel journal of Cornelius B. Gold"
3. Maslova et al. [54]: "Methods of Working with Local Digital Resources on History: Foreign Experience and Russian Practices"
4. Frith and Richter [55]: "Building participatory counternarratives: Pedagogical interventions through digital placemaking"
5. Coleborne and Bliss [3]: "Emotions, Digital Tools and Public Histories: Digital Storytelling using Windows Movie Maker in the History Tertiary Classroom"
6. Nurhasanah et al. [56]: "Bridging cognition and ethics: Socio-emotional skills and digital history literacy in fostering critical thinking"
7. Kumalasari et al. [57]: "Comparative analysis of Generation Z's digital history literacy in history education majors on Java Island"
8. Lucadamo et al. [58]: "The First World War Letters of H.J.C. Peirs: A Case Study of the Creation and Growth of a Collaborative, Pedagogy-Driven Digital History Project"
9. Ditlmann et al. [59]: "Participating in a Digital-History Project Mobilizes People for Symbolic Justice and Better Intergroup Relations Today"
10. Lee and Molebash [17]: "Becoming digital: Using personal digital histories to engage teachers in contemporary understandings of teaching social studies"
11. Shiue and Hsu [60]: "Understanding factors that affecting continuance usage intention of game-based learning in the context of collaborative learning"
12. Bell et al. [7]: "'History is a conversation': teaching student historians through making digital histories"
13. Darmawan et al. [9]: "Developing Living History Model Assisted by Digital History Textbooks in History Learning to Improve Students' Historical Empathy"
14. Thomas and Harden [61]: "The history harvest: An experiment in democratizing the past through experiential learning"
15. Woodring and Fox-Horton [62]: "History Harvesting: A Case Study in Documenting Local History"
16. Lewis and Taylor-Poleskey [63]: "Hidden Town in 3D: Teaching and Reinterpreting Slavery Virtually at a Living History Museum"
17. McLean et al. [18]: "Spaces of collaboration: The poetics of place and historical consciousness"

C. Review map

GENERAL STUDY INFORMATION

Document type:

journal article (ARTICLE) / conference proceedings article (CONFERENCE) / book chapter (BOOK CHAPTER)

Bibliographic data:

- Study title: _____
- Authors (surnames, initials): _____
- Publication year: _____
- Journal/conference/book name: _____
- Volume, issue, pages: _____
- DOI: _____

Country of study: _____
Funding source: government / private / university / not specified / none

STUDY CHARACTERISTICS

Study design:

☐ Randomized controlled trial (RCT)

☐ Quasi-experimental study

☐ Pre-post intervention study

☐ Case study with empirical data

☐ Mixed methods

☐ Other (specify): _____

Study aim: (briefly describe main aim)

_____

_____

Study duration:

- Intervention duration: _____ (days/weeks/months/semester)
- Observation period: _____ (immediately after / after _____ days/weeks/months)

PARTICIPANT CHARACTERISTICS (POPULATION)

Total number of participants: _____

Participant characteristics:

- Age: mean _____ years (range: _____)
- Gender: male _____% / female _____% / not specified
- Year of study: 1st / 2nd / 3rd / 4th / mixed groups / not specified
- Student specialization:
  - ☐ Historians
  - ☐ Non-historians (specify specialization): _____
  - ☐ Mixed groups
- Prior experience with digital technologies: high / medium / low / not specified

Group allocation:

- Experimental group: _____ participants
- Control group: _____ participants (if applicable)
- Randomization/allocation criteria: _____

INTERVENTION CHARACTERISTICS

Intervention name/description: _____

Type of digital technologies (multiple selections possible):

☐ Augmented reality (AR)

☐ Virtual reality (VR)

☐ Interactive multimedia

☐ Digital maps

☐ Commercial video games

☐ Educational games

☐ Online archives/databases

☐ Digital narratives/storytelling

☐ Virtual museums/tours

☐ Digital projects (student-created)

☐ Social networks/platforms

☐ Mobile applications

☐ Other (specify): _____

Specific tools/platforms: (names of programs, games, platforms)

_____

Context of use:

☐ Classroom sessions

☐ Out-of-class work

☐ Blended learning

☐ Fully online

Course status:

☐ Mandatory

☐ Elective

☐ Optional

☐ Not specified

Instructor role:

☐ Active facilitator

☐ Observer

☐ Technical support

☐ Not specified

Intervention details:

- Frequency of use: _____ times per week/month
- Duration of one session: _____ minutes/hours
- Total number of sessions: _____

COMPARATOR CHARACTERISTICS

Type of control intervention:

☐ Traditional lectures

☐ Seminars with printed sources

☐ Standard textbooks

☐ Regular work with archival materials

☐ No intervention (waiting list)

☐ Other (specify): _____

Control intervention description: _____

STUDY OUTCOMES

PRIMARY OUTCOMES

1. Historical knowledge:

- Measurement method: _____ (tests, exams, essays, projects)
- Instrument: _____ (test name, scales)
- Measurement time: before intervention / after intervention / after _____
- Experimental group results: $M =$ _____ $SD =$ _____ $n =$ _____
- Control group results: $M =$ _____ $SD =$ _____ $n =$ _____
- p-value: _____ / effect size: _____

2. Understanding of historical concepts:

- Measurement method: _____
- Instrument: _____
- Results: _____

SECONDARY OUTCOMES

3. Learning motivation:

- Measurement method: _____ (questionnaire, interview, observation)
- Instrument/scale: _____
- Results: _____

4. Student engagement:

- Measurement method: _____
- Indicators: _____ (discussion participation, attendance, time on task)
- Results: _____

5. Source work skills:

- Measurement method: _____
- Instrument: _____
- Results: _____

6. Critical thinking skills:

- Measurement method: _____
- Instrument: _____
- Results: _____

7. Technological literacy:

- Measurement method: _____
- Results: _____

8. Ability to create historical narratives:

- Measurement method: _____
- Results: _____

9. Other outcomes: _____

STATISTICAL ANALYSIS

Statistical methods used:

☐ t-test

☐ ANOVA

☐ Mann-Whitney U

☐ Kruskal-Wallis

☐ χ^2 (Chi-square)

☐ Regression analysis

☐ Effect size (Cohen's d, η^2)

☐ Other: _____

Significance level: $p <$ _____
Software: SPSS / R / SAS / Stata / other: _____

QUALITATIVE DATA (if applicable)

Qualitative data collection methods:

☐ Interviews

☐ Focus groups

☐ Observation

☐ Analysis of documents/student reflections

☐ Other: _____

Main themes/conclusions: _____

AUTHORS' CONCLUSIONS

Main conclusions regarding effectiveness: _____

_____

Authors' recommendations: _____

_____

Study limitations (noted by authors): _____

_____

STUDY QUALITY ASSESSMENT

Risk of bias:

- Randomization: low / high / unclear risk
- Allocation concealment: low / high / unclear risk
- Blinding of participants: low / high / unclear risk
- Blinding of outcome assessors: low / high / unclear risk
- Incomplete outcome data: low / high / unclear risk
- Selective reporting: low / high / unclear risk

Overall quality assessment: high / moderate / low

ADDITIONAL NOTES

Conflict of interest: present / absent / not specified
Ethical approval: obtained / not required / not specified
Additional reviewer comments: _____

_____

_____

Map completion date: _____
Reviewer: _____

D. Studies excluded at full-text assessment stage

1. Soh et al. [19]: "Digital histories for the digital age: Collaborative writing in large lecture courses"
2. Davis et al. [8]: "Faculty–library collaborations in digital history: A case study of the travel journal of Cornelius B. Gold"
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9. Ditlmann et al. [59]: "Participating in a Digital-History Project Mobilizes People for Symbolic Justice and Better Intergroup Relations Today"

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17. McLean et al. [18]: “Spaces of collaboration: The poetics of place and historical consciousness”