# Enhancing Integrated History Learning through Inquiry Digital Storytelling for Historical Exploration in Virtual Museums

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***Abstract*—History provides insights into how societies, cultures, and civilizations have evolved. Learning history enables us to understand the events, decisions, and actions shaping our world today. However, many studies find that students fail to learn history because it is boring and irrelevant to their lives, leading to disengagement. Traditional methods of teaching history (e.g., lectures and textbook readings) may not capture students' interest, especially if they do not see how history connects to their personal experiences or the modern world. This study presents the Integrated History Learning through Inquiry Digital Storytelling (IHL-IDS) for Historical Exploration in Virtual Museum. We designed the architecture and developed an IHL-IDS in the virtual museums with Metaverse technology. This study was implemented with 30 students in Thailand using a one-group pre-posttest design. The research results show that the assessment of the suitability by three experts of the IHL-IDS had the highest overall suitability. In addition, it can promote students' learning achievement and positive attitude.**

***Keywords*—virtual museum, learning history, inquiry-based learning, digital storytelling, metaverse**

## I. Introduction

Thailand's education system has faced significant challenges recently, particularly in adapting to modern teaching approaches and technological advances. Over the past decade, standardized test scores have shown stagnation or decline in student performance, reflecting systemic issues in teaching methods, curriculum design, and access to quality education [1].

Introducing Metaverse technologies in education presents an opportunity to revolutionize learning by creating immersive, interactive environments that promote student engagement and deeper understanding. Studies indicate that Virtual Reality (VR) and Augmented Reality (AR) can enhance spatial learning, motivation, and collaboration, particularly in subjects that require abstract conceptualization [2]. Metaverse allows students to explore historical events through simulated experiences, fostering a more engaging and personalized approach to studying history [3]. Inquiry-Based Learning (IBL) is widely recognized as an effective educational approach that emphasizes critical thinking, problem-solving, and active learning. This approach allows students to explore historical accounts through questioning, research, and analysis rather than through rote memorization [4].

Some studies have shown that IBL enhances students' ability to construct historical interpretations, evaluate sources, and develop analytical skills, making it a valuable framework for studying history [5]. Meanwhile, digital storytelling is emerging as a powerful tool for transforming traditional learning into a lively and engaging experience. Digital storytelling integrates multimedia elements such as images, videos, and narration to create engaging historical stories, allowing students to make personal connections to past events and understand their significance [6]. This approach promotes intellectual and emotional engagement, making historical content more accessible and meaningful. Experiential learning complements digital methods by emphasizing learning through hands-on experience [7]. Experiential learning theory suggests that students retain knowledge more effectively when participating in learning processes such as role-playing, simulations, and hands-on historical performances. This is consistent with the theory of creative learning, which supports learning through action and reflection [8].

An important dimension of history education is the conceptual learning approach, which promotes historical thinking skills and develops historical imagination [9]. Conceptual learning encourages students to view historical events from multiple perspectives, helping them understand historical narratives' complex cause-and-effect relationships and broader socio-political implications. Integrating conceptual learning with the metaverse and digital storytelling allows learners to reconstruct historical contexts and critically discuss past events [10].

Therefore, integrating virtual reality learning technology, the Metaverse, and history teaching can produce engaging teaching media in history subjects. In other words, it can move history teaching away from traditional memorization, leading to teaching in a visual understanding format. Introducing inquiry-based learning into the teaching process will help students experience studying data and analyzing data, as well as the introduction of digital storytelling as a process for conveying integrated historical learning experiences in a conceptual dimension. It helps students tell or convey their experiences more effectively. It also changes the perspective on Thai history, which is difficult to access, into a medium suitable for people today, with online media that can be conveyed in an easy-to-understand way and accessible to people of all types. They can feel the same even if they cannot travel to the actual place.

Therefore, disseminating historical knowledge in this form makes history a source of knowledge close to everyone, attracting students' interest in historical knowledge. Therefore, the virtual museum for learning history by investigating and combining digital storytelling to create an integrated learning experience in the conceptual dimension is suitable for application to teaching and learning.

This study aims to answer the following research

questions:

1) What are experts' adjudgments about the development of the IHL-IDS?
2) To what extent does the integrated inquiry-based digital storytelling approach improve students' learning achievement compared to their prior performance?

## II. Literature Review

### A. Virtual Museum

A virtual museum is a collection of electronically stored artifacts and digital information that can be accessed online, including drawings, photographs, diagrams, graphs, recorded sounds, video segments, newspaper articles, interviews, numerical data, and other objects that can be archived in a museum's digital server [11]. Virtual museums are valuable digital resources that mirror traditional functions while expanding accessibility beyond physical constraints. According to [12], virtual museums employ 3D visualization techniques to present digital artifacts and environments, offering interactive experiences that compensate for the physical inability to handle objects. Users can explore exhibits freely, rotate objects, and zoom in for detailed inspection, which is often restricted in physical museum settings.

### B. Learning History

Learning history is to understand the past as a key to comprehending present conditions and making informed decisions for the future [13]. History education helps students analyze past events, recognize cause-and-effect relationships, and apply historical lessons to contemporary issues [9]. It argues that historical thinking is an unnatural cognitive process that requires learners to engage in sourcing, contextualization, and corroboration. Moreover, historical education fosters a sense of national identity and cultural continuity by deepening students' appreciation of their heritage and historical roots [10]. Furthermore, effective history teaching should emphasize critical analysis rather than rote memorization. By focusing on historical inquiry, students learn to evaluate evidence, interpret multiple perspectives, and construct reasoned arguments about past events [14]. To achieve this, teachers must guide students in recognizing history as a dynamic and interpretative discipline rather than a mere collection of dates and facts.

### C. Inquiry-Based Learning

Inquiry-Based Learning (IBL) is an instructional approach that encourages students to seek knowledge independently using scientific inquiry methods [15]. IBL is a pedagogical strategy where students generate questions, gather evidence, and construct explanations based on empirical findings. [16] highlights that IBL promotes curiosity, active engagement, and more profound comprehension by allowing students to explore concepts through direct investigation. The 5E Model of Inquiry-based Learning, proposed by [15], consists of five stages: Engagement – teachers introduce a phenomenon or problem that sparks student curiosity and connects to prior knowledge. Exploration – students conduct hands-on investigations to gather data and construct new understandings. Explanation – students articulate their findings, and teachers provide guidance to refine conceptual understanding. Elaboration – students apply their knowledge to new situations and extend their learning. Evaluation – students and teachers assess learning progress through reflection and formative assessments. Research supports the effectiveness of IBL in fostering critical thinking and problem-solving skills. Studies indicate that inquiry-based approaches enhance student motivation and academic achievement compared to traditional lecture-based methods [5].

Table 1. The synthesis of inquiry-based learning

| Inquiry-based learning process | [15] | [16] | [17] | [18] |
|---|---|---|---|---|
| 1. Engagement | √ | √ | √ | √ |
| 2. Exploration | √ | √ | √ | √ |
| 3. Explanation | √ | √ | √ | √ |
| 4. Elaboration | √ | √ | √ | √ |
| 5. Evaluation | √ | √ | √ | √ |

Table 1, the synthesis of inquiry-based learning, found that the inquiry-based learning process can be synthesized into five steps as follows: 1) Engagement: The teacher accesses the students' prior knowledge and helps students to be interested in new concepts with short activities that stimulate curiosity and examine prior knowledge. The activities should connect prior knowledge with new knowledge, show previous concepts, and organize thoughts about the learning outcomes of the activity. 2) Exploration: The teacher prepares activities for students to explore and search, which may be experiments that help students use prior knowledge to create new ideas, explore and search for doubts, and design methods to find answers. 3) Explanation: After creating interest and exploration, the explanation and conclusion stage focuses on the student's perspective by allowing students to demonstrate their understanding, process skills, or behaviors. In this stage, the teacher helps guide students and explains to them to gain a deeper understanding, which is an important part of this stage. 4) Elaboration: The teacher allows students to apply their understanding and skills to new situations with additional activities to gain a deeper understanding of the information and skills. 5) Evaluation: The evaluation stage is where students are evaluated for their understanding and abilities so that the teacher can know whether their progress and learning outcomes align with the learning objectives.

### D. Digital Storytelling

Digital storytelling integrates multimedia elements—text, images, audio, and video—to convey narratives engagingly and interactively [6]. Digital storytelling is a creative process that allows learners to express their ideas through digital media. Combining traditional storytelling with digital technology enhances comprehension, creativity, and communication skills [19]. The key components of digital storytelling include perspective development, which identifies the core message and the storyteller's unique viewpoint. Emotional Appeal – engaging audiences by evoking emotions through narratives. Multimedia Integration – using visual and auditory elements to enhance storytelling. Narrative Structure – organizing content logically with a clear beginning, middle, and end. Engagement and Interactivity – encouraging audience participation and feedback [20]. Many studies suggest that digital storytelling enhances historical understanding by making abstract historical concepts more relatable and memorable. It enables

students to personalize historical events, fostering deeper connections with historical figures and societal developments [21]. Table 2 summarizes the research on Digital Storytelling.

Table 2. Digital storytelling

| Digital storytelling process | [22] | [19] | [23] | [24] |
|---|---|---|---|---|
| 1. Start with an Idea /Selecting a topic | | √ | √ | √ |
| 2. Conducting Research and Learn | √ | √ | | √ |
| 3. Planning | √ | √ | √ | |
| 4. Writing Script | √ | √ | √ | √ |
| 5. Drawing Storyboard | | √ | √ | √ |
| 6. Gathering and Creating Images | √ | √ | √ | √ |
| 7. Revising | √ | | √ | |
| 8. Publishing | √ | √ | √ | √ |
| 9. Evaluation | | √ | | √ |

### E. Learning Experience

Experiential learning is a student-centered approach that emphasizes learning through direct experience. It defines experiential learning as a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation [7]. It bridges the gap between theory and practice, allowing learners to develop transferable skills applicable to real-world contexts [25]. Experiential learning is particularly effective in history education, where students can engage in historical reenactments, simulations, and project-based learning to enhance their understanding of historical events [8]. Some studies indicate that experiential learning fosters deeper engagement, critical reflection, and retention of historical knowledge [26].

### F. Conceptual Dimension

Conceptual learning involves developing overarching ideas that facilitate understanding across different subjects. According to [27], concepts are mental structures that enable individuals to organize knowledge and derive meaning from new information. Conceptual learning in history education focuses on broad themes such as power, revolution, and cultural exchange rather than isolated facts [28, 29], emphasizing that historical conceptualization requires learners to analyze multiple perspectives and question biases in historical narratives [9]. Educators can enhance students' ability to synthesize historical knowledge and draw meaningful connections across historical contexts by integrating conceptual learning with digital tools.

## III. METHODS

### A. Participants

This study introduced a specialized training course to 30 students enrolled in a history course at a college in central Thailand. The first-year students must register for this course because it is a core requirement, a basic subject in the curriculum. The pre-experimental research design used a one-group pre-posttest. This design allowed the study to focus on the training course's impact on the participants without using a control group, which is typical for the research design. The pre- experimental research design using a one-group pre-posttest design. This design allowed the study to focus on the training course's impact on the participants without using a control group, which is typical for the research design.

### B. Design of Integrated History Learning through Inquiry Digital Storytelling

We have designed integrated history learning through inquiry digital storytelling, which can be summarized as shown in Table 3.

Table 3. The design of IHL-IDS learning activity in virtual museum

| Inquiry-based Learning | Digital storytelling | Learning Activity |
|---|---|---|
| 1. Engagement | 1. Start with an Idea / Selecting a topic | 1. Engagement: Teacher stimulates students' interest with short activities that connect with prior knowledge and introduce new perspectives. Students brainstorm or select interesting story topics that serve as a foundation for further learning. |
| 2. Exploration | 2. Conducting Research and Learn | 2. Exploration: Students will have the opportunity to explore and find answers through experimentation and further research while also studying and gathering information necessary for storytelling, emphasizing evaluating the accuracy of information and organizing it systematically. |
| 3. Explanation | 3. Planning<br>4. Writing Script | 3. Explanation: Students demonstrate their understanding and findings, then move on to the storytelling planning stage, where they divide roles and responsibilities within the team and begin writing a script to prepare for the content presentation. |
| 4. Elaboration | 5. Drawing Storyboard<br>6. Gathering and Creating Images | 4. Elaboration: Teacher allows students to apply their knowledge to new situations by designing a storyboard to show the overall picture of the story and gathering the digital media needed to present the story effectively. |
| 5. Evaluation | 7. Revising<br>8. Publishing<br>9. Evaluation | 5. Evaluation: Students are assessed on their understanding and learning skills and then edit the created media to ensure the story engages the audience before publishing it to the platform.<br>6. Reflection and Feedback: Students receive feedback from peers, instructors, and audiences to enable them to reflect on their learning process and further develop their storytelling and communication skills. |

Table 3 shows the design of integrated history learning through inquiry digital storytelling (IHL-IDS) learning activity in a virtual Museum, including six steps:

1) Engagement: Teacher stimulates students' interest with short activities that connect with prior knowledge and introduce new perspectives. Students brainstorm or select interesting story topics that serve as a foundation for further learning.
2) Exploration: Students will have the opportunity to explore and find answers through experimentation and further research while also studying and gathering information necessary for storytelling, emphasizing evaluating the accuracy of information and organizing it systematically.

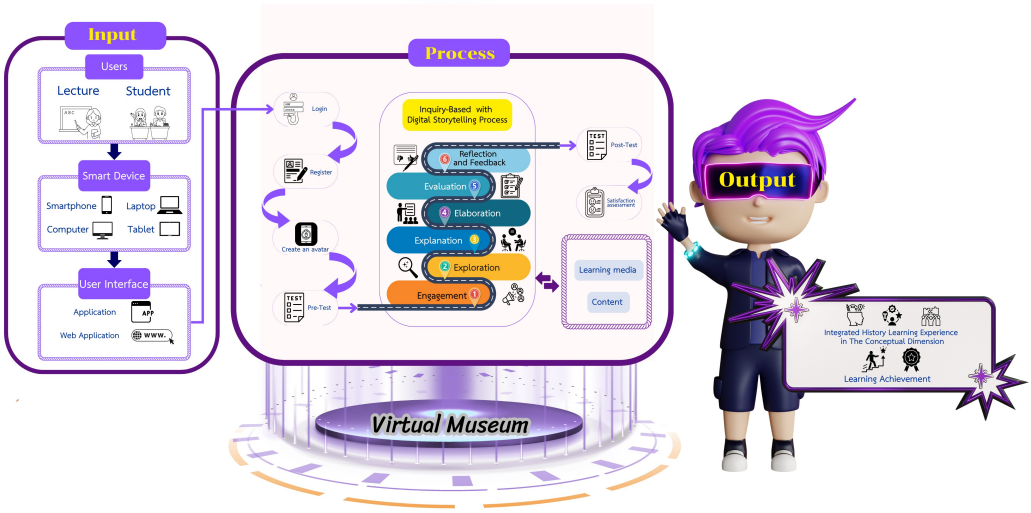


Fig. 1. The system architecture.

3) Explanation: Students demonstrate their understanding and explain their findings, then move on to the storytelling planning stage, where they divide roles and responsibilities within the team and begin writing a script to prepare for the content presentation.
4) Elaboration: The instructor allows students to apply their knowledge to new situations by designing a storyboard to show the overall picture of the story and gathering the digital media needed to present the story effectively.
5) Evaluation: Students are assessed on their understanding and learning skills, and then edit the created media to ensure the story engages the audience before publishing it to the platform.
6) Reflection and Feedback: students receive feedback from peers, instructors, and audiences to enable them to reflect on their learning process and further develop their storytelling and communication skills.

Fig. 1 shows the architectural design of IHL-IDS for historical exploration in the virtual museum architecture, which creates an integrated history learning experience in a conceptual dimension, as follows:

- Input

Primary access to virtual museums is through smart devices and a user-friendly interface. Users are divided into two main groups: teachers, who act as facilitators by organizing and guiding learning activities based on historical content, and students, who engage in learning history through inquiry and digital storytelling. This approach encourages questioning, exploration, and knowledge construction. Smartphones serve as essential tools for accessing virtual museums anytime and anywhere. They leverage internet connectivity and mobile technology to support digital learning, facilitating access via mobile applications and web-based platforms.

Computers and laptops provide high processing capacity and are suitable for interactive learning experiences on larger screens. Portable yet powerful laptops enable learners to engage in content creation and reflection beyond the classroom. Tablets, positioned between smartphones and laptops in size and functionality, offer larger touchscreens ideal for media-rich applications while maintaining portability.

The User Interface Application can be accessed via downloadable apps from the App Store or Google Play (Android), or through web applications accessible directly via browsers, eliminating installation.

- Process

Integrated history learning through inquiry-based digital storytelling involves virtual museums supporting historical exploration. A virtual museum is a digital environment replicating a physical museum's experience through technologies such as 3D modeling, Augmented Reality (AR), Virtual Reality (VR), and interactive multimedia. These tools allow learners to explore ancient sites, artifacts, and historical events in an immersive online setting. The platform, developed using Spatial.io, enables users to engage with historical content through inquiry and storytelling in a virtual space.

- Output

Students' learning achievement reflects the knowledge gained through an inquiry-based learning process integrated with digital storytelling, aiming to create a conceptual understanding of history. The integrated history learning experience and learner satisfaction also represent users' positive perceptions of virtual museum-based learning. These can be assessed through factors such as user experience, convenience, content quality, and learning effectiveness.

### C. *Virtual Museum*

D Developing a virtual museum platform for exploratory history learning, combined with digital storytelling, creates an integrated history learning experience in the conceptual dimension. It is a tool that supports and promotes historical learning that can be applied in practice. Learners can access content anywhere, anytime, without being limited by traditional locations or study times. It also supports a wide range of applications through digital platforms. This study focuses on design. A virtual learning environment that allows learners to explore historical stories through Inquiry-based learning and digital storytelling. Digital storytelling makes it possible to learn history more interestingly and engagingly by using virtual museum technology. We created through the Spatial.io platform, allowing learners to have a unique experience and immerse themselves in important historical events. To create an integrated history learning experience in the conceptual dimension, as shown in Figs. 2 and 3. In

addition, Fig. 4 shows the students using computers to learn in the virtual museum.

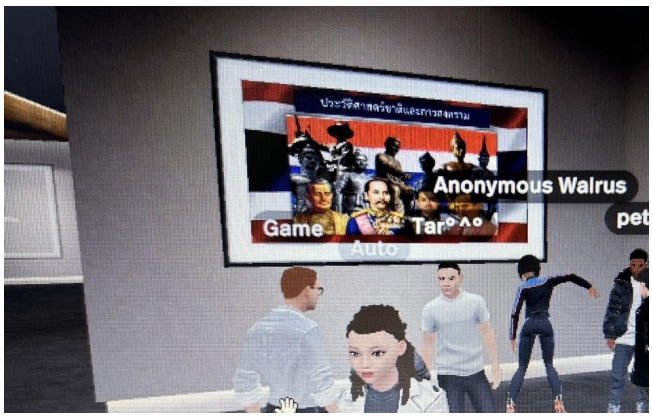


Fig. 2. The screenshot of learning activity in virtual museum.

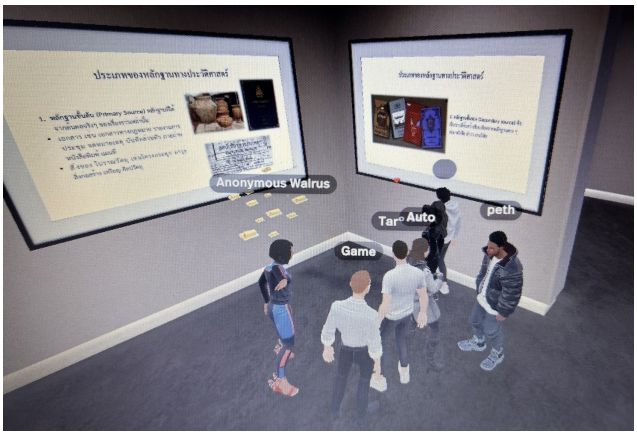


Fig. 3. The screenshot of learning activity in virtual museum.

Fig. 4. The students use computers to learn in virtual museum.

### D. Data Collection

This study's pre-experimental research methodology, a one-group pre-posttest research design, was conducted to examine the students' achievement in integrating history learning through inquiry digital storytelling for historical exploration in the virtual museum. The students attended the training course, and the experiment took 3 h. First, the student was given an introduction and overview, and they took a pre-test to measure their prior knowledge, which was completed in 30 min. Afterward, the teacher had an introduction to IHL-IDS for historical exploration in the virtual museum. After that, they performed the learning activities. After performing the learning activities, all the students took post-tests in 30 minutes.

## IV. Result and Discussion

In this study, we designed an integrated history learning model and a virtual museum to promote students' historical understanding through immersive, inquiry-based, and narrative-driven learning experiences. The model aims to enhance student engagement and participation by incorporating Metaverse environments and digital storytelling. The research results are presented under the following research questions:

RQ 1: What are experts' adjudgments about the development of the IHL-IDS?

After we have designed and developed the platform's architecture, it has been submitted to experts to evaluate the feasibility of the architecture, a virtual museum platform for inquiry-based history learning, combining digital storytelling to create an integrated history learning experience in the conceptual dimension. The results of the suitability assessment are shown in the Table with the following details:

Table 4. Results of the Suitability Assessment by Expert

| Assessment Details | Mean | S.D. | Result |
|---|---|---|---|
| 1. Principles and concepts used as a basis for architectural design Virtual Museums for learning history through inquiry integrating digital storytelling to create an integrated historical learning experience, in terms of conceptual dimension. | 4.86 | 0.35 | Very high |
| 2. Elements of a virtual museum architecture for inquiry-based historical learning integrated with digital storytelling. | 4.90 | 0.30 | Very high |
| 3. Steps and activities of virtual museum architecture for learning history through investigation and integration with digital storytelling to create an integrated history learning experience in the conceptual dimension. | 4.71 | 0.49 | Very high |
| 4. Virtual museum architecture for learning history, inquiry-infused Digital Storytelling. There is a possibility to develop into a Virtual Museum platform for learning history, inquiry-infused digital storytelling. | 5.00 | 0.00 | Very high |
| 5. Overview of virtual museum architecture for Learning inquiry-based history digital storytelling to create experiences, integrated history learning in conceptual dimension. | 4.86 | 0.38 | Very high |
| **Overall** | **4.88** | **0.33** | **Very high** |

Table 4 shows that the virtual museum architecture for learning history by investigating and integrating digital storytelling to create an integrated history learning experience in the conceptual dimension, in terms of the developed overall components, was most appropriate (mean = 4.88, *S.D.* = 0.33).

RQ 2: To what extent does the integrated inquiry-based digital storytelling approach improve students' learning achievement compared to their prior performance?

To answer the research question, we used the paired samples t-test to determine whether there was a significant difference in the students' understanding scores before and after the intervention. Table 5 shows the students' learning achievement of integrated history learning through inquiry digital storytelling for historical exploration in Virtual Museum with a pre-test score of 18.03 ($SD$ = 5.45) and a mean post-test score ($M$ = 25.43, $SD$ = 4.97, $t$ = 27.03, $p$ = 0.00).

Table 5. Results of paired samples t-test of students' learning achievement

| | Mean | S.D. | t | Sig. |
|---|---|---|---|---|
| Pre-test | 18.03 | 5.45 | 27.03 | 0.00** |
| Post-test | 25.43 | 4.97 | | |

** $p < 0.01$

The virtual museum architecture for integrated history learning combines inquiry-based learning with digital storytelling in a conceptual framework comprising three core components: inputs, processes, and outputs. The platform was developed using Spatial.io to create an immersive virtual environment where learners engage with historical narratives through inquiry and digital storytelling, fostering deeper interest and engagement. This approach enables learners to experience key historical events in a novel and meaningful way. The platform's quality evaluation, assessed across design, functionality, and usability, yielded results at the highest level. These findings align with previous research [30] that reported that virtual environments enhance student engagement and understanding of historical content. It demonstrated that digital storytelling improves critical thinking and learning engagement [31], and confirmed that integrating virtual technology with storytelling supports immersive learning and better conceptual understanding of history [32]. It is also consistent with research [33] that uses inquiry-based learning methods to engage students in taking responsibility for their learning by exploring topics, conducting research, and drawing conclusions, which makes learning more meaningful.

## V. Conclusion

This study presents an integrated history learning model through inquiry-based digital storytelling within a virtual museum environment. Designed as a digital-era teaching and learning management tool, the model aims to foster student engagement, critical thinking, and learning efficiency. Combining digital storytelling with inquiry-based learning in a virtual context offers a conceptual and experiential approach to history education. The virtual museum incorporates key elements of instructional system design, leveraging technology to create meaningful learning activities that enhance historical exploration and promote more profound understanding.

The findings indicate that developed architecture can be used as a guideline for developing a virtual museum platform for learning history by investigating and integrating digital storytelling to create an integrated history learning experience in the conceptual dimension by the experts' adjudgment. In addition, the integrated inquiry-based digital storytelling approach significantly improved students' learning achievement. Post-test scores were notably higher than pre-test scores, with a statistically significant difference at 0.05. This suggests that the approach effectively enhances students' understanding and conceptual learning in history.

Although this study demonstrates the potential of the Integrated History Learning through Inquiry Digital Storytelling (IHL-IDS) within a virtual museum setting using Metaverse technology to enhance students' historical understanding and engagement, several limitations should be acknowledged. First, the study employed a one-group pre-posttest design without a control group, which limits the ability to establish causal relationships or compare the effectiveness of IHL-IDS with traditional teaching methods. Second, the sample size was small, involving only 30 students from a single educational context in Thailand. This may affect the generalizability of the findings to broader populations with diverse cultural and educational backgrounds. Finally, the duration of the intervention was limited, potentially constraining the long-term observation of changes in historical understanding, critical thinking, or retention of knowledge. Finally, while expert evaluations indicated high suitability of the IHL-IDS model, student feedback and usability assessments were not deeply explored, which could provide valuable insights into user experience and engagement in future studies. Future research should consider larger and more diverse samples, include control groups for comparison, and investigate immersive digital storytelling's long-term impact and user experience in history education.

## Conflict of Interest

The authors declare no conflict of interest.

## Author Contributions

PN made contributions to the conceptualization and design of the study. CR was primarily responsible for collecting and analyzing the data to derive the findings. CR and SC jointly drafted the initial manuscript and undertook revisions. All authors reviewed, provided feedback on, and approved the final version of the paper.

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