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Applying and evaluating digital humanities tools in teaching Chinese history and culture to a diverse university-level student population

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Abstract

Digital humanities (DH) is one of the fastest-growing interdisciplinary fields, driven by rapid technological advancements. However, the majority of DH tools, databases, and methodologies have been developed primarily for research purposes, with comparatively few designed explicitly for teaching and learning. This study adopts an experimental approach, referring to the Technological Pedagogical Content Knowledge (TPACK) framework, to examine the implementation of a DH module in university-level history education. The aim is to enhance students' awareness of digital humanities and improve their digital competencies through structured exposure to selected DH categories and tools. The study was conducted at The Hong Kong Polytechnic University from 2023 to 2024, covering four semesters, eight courses, and involving approximately 500 students from both history and non-history majors. Findings suggest that the DH module represents a cost-effective and practical strategy for integrating digital tools into existing curricula with minimal structural adjustments. Survey data and classroom observations demonstrate that the module effectively increased students' awareness of digital humanities, regardless of academic background. The study also underscores the need for a tiered framework to categorize DH tools and approaches by complexity and learner readiness, particularly in light of generally low DH awareness among Hong Kong students. Additionally, broadly applicable tools such as StoryMaps and Generative AI were more favorably received than domain-specific tools like CBDB and MARKUS, offering insight into future tool selection in historical education. A small-scale competition aligned with the DH module also demonstrated significant potential for enhancing student engagement and motivating the practical application of digital tools.

Keywords Digital humanities (DH), Digital pedagogy, Digital storytelling, Story maps, Historical education, Chinese history, Technological Pedagogical Content Knowledge (TPACK)

1 Introduction

Digital humanities (DH), also known as 'humanities computing,' is an interdisciplinary field that employs digital technologies and quantitative methodologies to support humanities research [1]. Digital humanities is considered the first 'next big thing' within

the DH community [2]. The number of digital humanities centers, programs, and departments established at prestigious universities in China, the United Kingdom, Germany, North America, and globally has grown significantly since the 2010s, notably including the establishment of the Department of Digital Humanities at King's College London [3].

Despite significant advancements in digital technology during the twenty-first century, DH applications in research contexts have notably outpaced their integration into pedagogical settings. This notable gap between DH in research and its use in teaching has been highlighted by Brett D. Hirsch and Stephen Brier. Brett D. Hirsch, in his analysis of *Blackwell Companion to Digital Humanities* and *Companion to Digital Literary Studies* using, found that the word 'research' appears 504 times out of 297,399 words, compared to only 66 instances of 'teaching' and 8 instances of 'pedagogy' [4].Similarly, Stephen Brier highlighted the marginalization of DH pedagogy, noting that while the words 'research' and related terms are frequently used in all the abstracts of NEH Digital Humanities Start-Up Grants (2007–2010), terms such as 'teaching,' 'learning,' 'classroom,' and 'pedagogy' are absent [5].

Given that DH tools have been predominantly developed for research purposes, it is increasingly important to consider how these tools can be adapted and applied in teaching contexts. Gaining practical experience in this area can facilitate the transfer of research tools into pedagogical settings, thereby making the field more dynamic and impactful. As Curtis Fletcher notes, it is essential to "think more about these kinds of cross-purposes—teaching and learning, on the one hand, and research and scholarship, on the other," emphasizing the need to bridge the divide between DH research and instruction [6].

And more importantly, Jessica DeSpain and Jennifer Travis, in their work *Teaching with Digital Humanities: Tools and Methods for Nineteenth-Century American Literature*, raised concerns about shifting the focus of DH from broad, generalized discussions to how specific DH method and practices operate at a field-specific level [7]. This highlights the importance of examining the application of DH in history education through detailed and in-depth studies. Such studies should explore how various types of DH tools can be applied to develop specific skills in historical education, particularly when addressing the diverse backgrounds and levels of students. Tona Hangen initiated the concept of "Historical Digital Literacy," which integrates historical thinking with digital skills in response to the explosion of digital sources, tools, and resources [8]. This concept also highlights the urgent need for historical education to develop and adapt in response to the challenges and opportunities of the digital age.

2 Literature review—digital humanities and Chinese history—research and education

One of the earliest initiatives in applying digital methods to the study of Chinese humanities was the computerization of Chinese characters, particularly in the field of linguistics. Notably, in the 1960s, Professor William Shiyuan Wang initiated the project "*A Chinese Dialect Dictionary on Computer (DOC)*," marking a foundational effort in the digital processing of Chinese language data.

The application of digital humanities to Chinese historical studies began in 1984, when the Institute of History and Philology at Academia Sinica collaborated with the Computing Centre to digitize essential research documents in traditional Sinology. This initiative

led to the development of *Scripta Sinica*, one of the largest Chinese full-text databases, reflecting the research-oriented focus of early DH applications in Chinese historical studies. Notable scholars such as Qian Zhongshu (1910–1998) and D.C. Lau (1921–2010)—from the Institute of Literature at the Chinese Academy of Social Sciences and the Institute of Chinese Studies at The Chinese University of Hong Kong, respectively—also played important roles in the digitization of ancient texts, contributing to the creation of databases such as the *Complete Tang Poetry* and the *CHANT Database* [9]. The establishment of electronic full-text databases has since become a defining feature of digital humanities work in Chinese historical research.

Concurrently, Geographic Information Systems (GIS) have been extensively utilized in Chinese historical research contexts, as demonstrated by the influential projects from Taiwan's Academia Sinica, such as "Chinese Civilization in Time and Space" (CCTS, http://ccts.sinica.edu.tw/) and "Taiwan History and Culture in Time and Space" (THCTS, http://thcts.sinica.edu.tw/) projects, and also Fudan University and Harvard University launched the China Historical Geographic Information System(CHGIS, https://sites.fas.harvard.edu/~chgis/) in 2001 [10].

A major milestone in digital humanities was the launch of the China Biographical Database (CBDB), jointly developed by Harvard University, Academia Sinica, and Peking University since 2005. Originating from Robert M. Hartwell's prosopographical dataset, the data was migrated from dBase to FoxPro, and later to Microsoft Access. Under the direction of an international committee led by Peter K. Bol, the project continues to expand. CBDB aims to systematically compile significant biographical data from China's historical record and make it freely accessible for academic research (https://projects.iq.harvard.edu/cbdb) [10].

The year 2009 marked a significant milestone when Wang Xiaoguang advocated for embracing digital humanities as a transformative approach in Chinese humanities research, capable of driving transformative change in humanities and social science research paradigms. In the same year, National Taiwan University hosted its first Digital Archives and Digital Humanities (DADH) conference, the first in Taiwan with digital humanities as its central theme [10].

In 2011, the first Digital Humanities Research Center in mainland China was established at Wuhan University, marking a significant milestone in the field's development. Since 2016, digital humanities in China have entered an institutionalized phase of accelerated growth. Peking University has hosted a Digital Humanities Forum for three consecutive years since 2016, and similar seminars have been organized by Tsinghua University. During this period, the Digital Humanities Committee of the Chinese Information Society of Social Sciences and the Digital Humanities Committee of the China Society of Indexers were also established, together forming the Chinese Alliance of Digital Humanities Organizations (CADHO). By 2020, a total of 425 articles on digital humanities had been published—eight times more than in 2016. The majority of these works focused on libraries, archives, museums, and information science, with 20% receiving support from the National Social Science Fund. Currently, six leading digital humanities centers—based at Peking University, Tsinghua University, Renmin University of China, Nanjing University, Wuhan University, and National Taiwan University—are at the forefront of digital humanities development in Chinese history. These institutions support major platforms such as the DocuSky Collaboration Platform and

Digital Humanities in China (DHCN), which integrate a wide range of relevant tools and resources. They have also contributed to the establishment of key academic journals, including the *Journal of Digital Humanities* and *Digital Humanities Research* [11].

The field has also seen the emergence of technical subfields with distinct methodological features, such as text mining, network analysis, visualization, and geographic information systems (GIS). These are supported by specialized tools and platforms including CBDB, MARKUS, CText (Chinese Text Project), and CBETA (Chinese Buddhist Electronic Text Association). This development is one of the main reasons why the project incorporated these tools into the categorization used in the DH module.

Despite the rapid growth of DH within Chinese academia, China remains relatively behind in formally integrating DH into pedagogical practices. The field is not formally recognized as either a first- or second-order discipline within the national academic system. As a result, informal teaching, often led by individual faculty members based on their academic interests, continues to be the primary mode of DH instruction. This partly explains why DH courses are still rare and largely limited to a few universities, where they are typically offered within traditional disciplinary frameworks rather than through dedicated DH programs [12].

Wang Tao reflected on his experience with digital humanities in undergraduate education, highlighting several challenges: the limited participation of students with science and technology backgrounds, which hindered interdisciplinary dialogue with humanities students; difficulties in managing the scope and depth of course content; and the use of general approaches that often did not meet individual learning needs. He also identified the lack of digital infrastructure as a persistent constraint in course delivery [13].

Tsui and Li experimented with integrating digital tools such as Hypothesis, CText, and "Gushiwen duanju" (古詩文斷句) into history major courses during the COVID-19 pandemic. Their findings showed that students using these tools achieved an accurate rate of nearly 90% when marking up ancient texts—significantly higher than the 70% average typically seen among arts students. Tsui also noted that collaborative platforms like Hypothesis encouraged students to share their insights while working on the same texts, fostering a more interactive learning environment [14, 15].

Currently, several universities in Hong Kong offer digital humanities courses tailored for history majors. These include *HIST 4027 Topic Studies in Asian History: Introduction to Spatial History* at Hong Kong Baptist University (HKBU), *HIST4702 Digital History* at The Chinese University of Hong Kong (CUHK), and *CHC407P Digital Humanities and Chinese Studies* at The Hong Kong Polytechnic University (PolyU). In addition, bachelor's and master's programmes in digital humanities are offered at the University of Hong Kong (HKU) and Lingnan University, respectively [16, 17].

In addition, HKBU developed the Historical GIS interactive map, "The Battle of Hong Kong 1941: A Spatial History Project", aimed at supporting public, secondary, and university education [18]. At City University of Hong Kong (CityU), the course GE1108 The Silk Road: A Pathway of Interactive Culture from the Ancient to the Modern World was created as part of the Teaching Development Grant (TDG) project "GIS for Teaching Chinese Civilization: Integrating Google Maps, Wikipedia, and Video on Demand" in 2010–2011 [19].

It is worthwhile to explore how DH can be extended to the study of Chinese history and culture among non-humanities students, as well as to further investigate the

pedagogical approaches used in university-level education for implementing DH in this context.

3 Research questions

Considering the notable imbalance between the rapid development of DH tools and methodologies in research and the relatively slow pace of their adoption in education, as well as the institutional constraints in implementing DH in university teaching—particularly due to its non-recognized disciplinary status in mainland China—this study seeks to explore the following questions:

1. Feasibility: Can a DH module—integrating selected digital tools and methodologies without significant curriculum modifications—be effectively implemented in university education to: (i) promote awareness and perception of digital humanities and improve students' digital competency, and (ii) improve learning effectiveness in Chinese history and culture through DH-based approaches?
2. Tool suitability: What types of digital humanities tools are most effective, suitable, and responsive to student needs when used in university-level Chinese history and culture courses with a diverse student population?
3. Evaluation of impact: How can the overall efficacy of digital tools in the teaching and learning of Chinese history and culture be improved?

4 Method

This study is based on the Learning and Teaching (L&T) project titled "*Applying and Evaluating Digital Humanities Tools in Teaching Chinese History & Culture to a Diverse Student Population*," conducted at The Hong Kong Polytechnic University between 2023 and 2024. The project spanned four semesters and was implemented across eight courses, including both history-major subjects and general education courses focused on Chinese history. Approximately 500 undergraduate students participated, comprising both history and non-history majors.

4.1 Study design

This study employs an experimental approach informed by the Technological Pedagogical Content Knowledge (TPACK) framework to evaluate how effectively a DH module can integrate content, pedagogy, and technology in the context of teaching Chinese history and culture. In particular, the study aims to identify which digital tools may be most effective for historical education. As the TPACK framework suggests, effective learning results from the emergent and dynamic interplay among content knowledge, pedagogical understanding, and technological proficiency [20]. While the TPACK framework involves utilizing technology as an interactive learning tool, it also supports in-depth historical understanding and helps increase student engagement and motivation [21].

However, the TPACK framework remains neutral concerning broader educational goals, offering no specific prescriptions concerning content selection or instructional methodologies. The framework encourages educators to look beyond existing methodologies and develop new techniques and approaches that address the pragmatic, applied, and creative goals of teaching with technology, especially given the rapid pace of technological change [20].

Although the TPACK framework has been applied in history education, particularly in the preparation of pre-service history teachers. Research shows that the TPACK-oriented approach enhances content knowledge and strengthens the integration of technology and pedagogy, equipping future teachers to effectively utilize primary sources and digital tools in curriculum design and instruction [22]. TPACK-based training supports history teachers in strategically selecting student-centered activities and technologies that foster intellectual engagement. This promotes a more deliberate and thoughtful integration of technology into the history curriculum, rather than its incidental or superficial use [23].

In practice, TPACK has been applied through the integration of classroom technologies (e.g., iPad carts) into social studies instruction, particularly benefiting students from lower socioeconomic backgrounds who may lack access to technology at home. This classroom implementation encourages a student-centered pedagogy, with built-in checkpoints that enable teachers to monitor and support student learning and technology use effectively [24].

However, research has also noted that the integration of digital technology in Swedish history teaching has had limited impact on actual teaching practices and the development of students' historical competencies. These findings underscore the need for a deeper understanding of how teaching interacts with technology and highlight the importance of adapting the TPACK model to better suit the specific demands of history education [25], It also needs to better account for disciplinary specifics, calling for further development of TPACK to include all facets of history teaching [22].

This study aims to apply the TPACK framework through an experimental approach to assess the development of a DH module that enhances the integration of content knowledge, pedagogical understanding, and technological proficiency—with particular emphasis on critically examining the technological dimension through the use of DH tools and approaches in the context of Chinese history education for a diverse university student population. The design of the Digital Humanities (DH) module explicitly followed the TPACK framework. The four major categories and tools of digital humanities—such as ArcGIS StoryMaps, CBDB, and MARKUS—together with digital storytelling, GIS, and data visualization, were incorporated as the Technology component. The module was primarily implemented in Chinese history and culture courses, as indicated in the Object section, which provided the Content component. Finally, a "learning by doing" approach was adopted as the Pedagogical element.

4.1.1 Design of DH module

The selection of the four categories in the DH module was informed by three key references.

(1) According to a Library Journal survey, the three most commonly utilized DH tools in U.S. universities are GIS/mapping (45%), data visualization (35%), and text and data mining with markup/encoding (25–33%), with 62% of these tools being used in history departments [26].(2) The *World Humanities Report*, in its section *Digital Humanities in China, 1980–2020*, also identifies text mining, network analysis, visualization, and GIS as defining features of the technical subfields in digital humanities studies [11]. (3) Brandon T. Locke effectively integrated digital components into numerous History and Anthropology courses at Michigan State University over a 2-year period. The framework

he initiated provided not only domain-specific content, but also essential skills in information retrieval, data analysis, media literacy, and digital communication. It proved effective in engaging individuals who were new to digital research, as well as those skeptical of its value. Additionally, it served as a strong foundation for fostering collaboration among faculty, librarians, graduate students, educational technology specialists, and others. Moreover, these digital components of the framework serve as extensions of the longstanding skills, literacies, and knowledge that the humanities and social sciences have traditionally contributed to liberal arts education [27].

Consequently, this study aimed to design a DH module integrating prominent DH categories and tools relevant to the Chinese history and culture context, in order to further examine the effectiveness and potential of adapting major research-oriented DH tools for educational use.

CBDB was chosen as one of the most prominent digital projects in the field. It has generated numerous research outputs, especially in data visualization and social network analysis, making it a strong example of a feasible tool with ample existing case studies and publications for students to reference [28]. CHGIS was included as a prominent digital project, as mentioned earlier. For text encoding, tools like MARKUS and auto-annotation platforms were selected based on the teaching experiences of Li and Tsui, who demonstrated their effectiveness in previous undergraduate courses.

In geography education, StoryMaps has been shown to significantly increase student engagement and enhance understanding of course content, particularly in relation to its real-world applications. Students also expressed strong appreciation for the opportunity to work with this geospatial technology through an online mapping platform [29]. StoryMaps has also proven particularly effective in preparing students for fieldwork in geography education. The application introduces students to field sites and related assignments in an engaging and accessible format. Reflection notes reveal that students found the StoryMap application useful for fieldwork preparation, as it allowed them to access information from multiple sources in a single interactive visual platform. Students appreciated the flexibility to choose what and how to learn, as well as when and in what sequence. Moreover, complex physical geography and geomorphological concepts became more concrete through StoryMaps, which presented content from multiple perspectives using pictures, videos, animations, tasks, and graphs [30].

And StoryMaps was successfully implemented in twelve history major courses at the University of Minnesota over three semesters (Fall 2018 to Fall 2019), involving approximately 150 students. The tool transformed how students analyzed primary sources, constructed historical interpretations, and presented their findings. The spatial perspective introduced through the mapping process prompted students to rethink their approach to historical research and writing [31].

It has also been proven applicable to the Hong Kong and Chinese history context. Notably, one example was inspired by an entry for the Esri Young Scholars Award 2022—"*Coastal Defense and Taxation: Qing Military and Check Posts in Hong Kong During the 19th Century*"—which originated as a course assignment in the Department of History at Hong Kong Baptist University [32].

Dora Wong, as an instructor, conducted the research project "*Digital Story Making with the Community*" between 2012 and 2015, exploring the application of digital storytelling in teaching and learning. The study found the approach to be both fruitful and

encouraging, as reflected in positive student feedback. A supporting survey of 1130 first-year undergraduates at the University of Hong Kong revealed that only 54% used computers monthly to create or edit audio and video content, while 28% had no experience using such technologies. These findings suggest that digital storytelling can play a significant role in enhancing students' digital competency for learning [33, 34].

Based on the popular digital humanities categories identified in the survey, the notable features of technical subfields developed in Chinese digital humanities, and practical teaching experiences from Hong Kong's tertiary education, the DH module has been designed around the following four categories and their corresponding tools (Table 1).

In the DH module, each of the four categories is introduced in lecture with one representative tool, allotted approximately 15–30 min per tool. The module is intentionally designed to minimize disruption to the original course curriculum and structure, ensuring its feasibility and adaptability across a variety of courses.

In courses where the module is implemented, students are encouraged to complete their assignments using the digital tools introduced. The approach follows the principle of "learning by doing," which has been shown to be an effective pedagogy in digital humanities. This hands-on method not only helps students feel more confident but also enables them to initiate their own projects and continue learning independently through digital means [35].

4.1.2 Object

Since 2022, Chinese History and Culture has been included as a component of the Cluster-Area Requirements (CAR) at The Hong Kong Polytechnic University, underscoring its importance in promoting a well-rounded general education. As a result, all undergraduate students, regardless of their major, are required to complete at least one semester of a Chinese History and Culture course and attain a pass grade in order to fulfill their graduation requirements. This policy reflects a growing demand for teaching Chinese history and culture to a large and academically diverse undergraduate population.

According to university statistics from the 2022/2023 academic year, PolyU had 15,778 undergraduate students across a wide range of disciplines, including the Faculty of Business, Faculty of Construction and Environment, Faculty of Engineering, Faculty of Health and Social Sciences, Faculty of Science, School of Design, School of Fashion and Textiles, and the School of Hotel and Tourism Management [36].

The project was implemented in the courses from September 2023 to December 2024, spanning 4 semesters and covering a total of 8 courses (5 CAR(M) courses and 3 BACHC courses), involving a total of around 500 students. This included 419 non-history majors and 81 history majors (Tables 2, 3):

Table 1 Categories of digital humanities tools for the trial DH module

Categories:	Related Digital Tools that particular in Chinese History and Culture learning
(i)GIS/mapping	Harvard—China Historical Geographic Information System (CHGIS), ArcGIS Storymaps
(ii)Data visualization	Harvard—China Biographical Database Project (CBDB), Gephi
(iii)Text encoding	MARKUS, a semi-automatic markup platform; Gushiwen duanju (古詩文斷句系統)
(iv)Digital storytelling	ArcGIS StoryMaps

Table 2 Courses involved in DH module implementation

	Course:	Enrollment (remarks)
1	CHC306P Politics and Military Affairs in Imperial China (Autumn Semester 2023)	10 (major)
2	CHC308P Discovering Chinese Culture in Hong Kong (Autumn Semester 2023)	35 (major)
3	CHC1M38P Introductory History of China (Section 1) (Spring Semester 2024)	111
4	CHC1M38P Introductory History of China (Section 2) (Spring Semester 2024)	40
5	CHC1M43P Discovering Chinese History in Hong Kong (Summer Semester 2024)	96
6	CHC308P Discovering Chinese Culture in Hong Kong (Autumn Semester 2024)	36 (major)
7	CHC1M43P Discovering Chinese History in Hong Kong (Autumn Semester 2024)	110
8	CHC2M42P Practical Dreamers in Chinese History (Autumn Semester 2024)	60

Table 3 Implementation timeline of the DH module

Stage 1: Pilot implementation	
Coverage:	10 major and minor students in the History programme
Period:	Semester 1, 2023–2024 (September to November 2023)
Module Content and Focus:	The trial DH module introduced the following tools across three categories: (1) GIS with digital storytelling—ArcGIS StoryMaps (2) Data Visualization—China Biographical Database (CBDB) (3) Text Encoding—MARKUS, a semi-automatic markup platform, and Gushiwen Duanju These tools were introduced and explained in detail, particularly focusing on how they work with ancient Chinese texts
Stage 2: Expansion to non-humanities majors	
Coverage:	Approximately 150 non-humanities students enrolled in Cluster Area Requirement courses (CAR) in Chinese History and Culture
Period:	Semester 2, 2023–2024 (January to April 2024)
Module Content and Focus:	Based on the experience from Stage 1—and considering that the majority of students in this stage came from non-humanities backgrounds—the DH module was implemented with adjusted emphasis. The focus shifted toward lecture-prepared teaching materials using ArcGIS StoryMaps, covering four specific topics: (1) Confucius and the Intellectuals (770–476 BCE)—Mapping Confucius's life, travels, and intellectual exchanges(2) Han Dynasty Expansion—Visualizing military and economic development(3) Northern Song Officials' Social Network—Representing official relationships and interactions(4) Late Qing Revolutionary Activities—Mapping key events and locations of revolutionary movements
Stage 3: Application-oriented instruction	
Coverage:	36 history major/minor students and 266 non-humanities students enrolled in Cluster Area Requirement courses (CAR)
Period:	Summer Term to Semester 1, 2024–2025 (May to December 2024)
Module Content and Focus:	The approach was further refined. Interactive maps continued to serve as teaching tools to promote student engagement. (i) Importantly, PolyU Digital Humanities Historian Awards 2024 was introduced, offering certificates and prizes to encourage student participation. Students were invited to submit assignments developed using DH tools (ii) The competition's website hosted tutorial videos on ArcGIS StoryMaps, Gephi, and Experience Builder—all contextualized within Chinese history and culture. These resources enabled students to explore and practice DH tools independently, at their own pace

4.1.3 Date collection

Data collection in this study includes the following components: (i) pre-and post-surveys conducted during the trial stage to measure the effectiveness of the DH module and to inform further refinement. Similar surveys were also distributed in related courses in 2023 to assess changes over time, particularly in response to the emergence of generative AI. (ii) Evaluation of entries and participants in the PolyU Digital Humanities Historian Awards 2024, which served as a means to assess student engagement and motivation in applying DH tools introduced through the module. Supplemented by observation and reflective analysis of the module's implementation over the study period, this study aimed to better understand the applicability and impact of the DH module across different teaching contexts.

4.1.3.1 Survey To evaluate the impact of the DH module in Chinese history and culture courses, this study adopted a pretest–posttest survey design using a quasi-experimental method. Parallel surveys were administered at the beginning of the semester (7 September 2023, Week 1) and after the final class (30 November 2023, Week 13). The pre-survey was used to establish students' backgrounds and baseline digital competencies, while the post-survey assessed changes in skills and perceptions following exposure to DH tools throughout the course.

Pre-survey design

The pre-survey contained three sections:

1. Disciplinary background—two yes/no items asked whether students had taken Chinese history courses in junior (F1–F3) and senior (F4–F6) secondary school. These questions were intended to gauge prior exposure and to see if earlier study influenced receptivity to DH tools.
2. Current academic profile—two questions recorded respondents' year of study and which Chinese history or culture courses they had already completed at university.
3. Digital competency and perceptions—Students were asked to list the digital tools they had used in the field, including augmented/virtual reality platforms, search engines, online databases, geographic information systems (e.g., CHGIS, ArcGIS), and the China Biographical Database. These tools align with the project's key categories: GIS & spatial data, data visualization, text encoding, and digital storytelling, and were used to assess students' digital competency and perceptions. They then rated the helpfulness of each tool on a four-point scale (4 = very helpful, 3 = positively helpful, 2 = partially helpful, 1 = effect not obvious).

Pre-survey respondents and baseline findings

Out of eight majors and two minors enrolled, 70% completed the pre-survey. The data showed that senior Chinese-studies students had limited prior experience with DH tools; the most commonly used resources were search engines (44%) and databases (38%), that implying their limited experience with these categories of digital tools and approaches, suggesting a substantial opportunity for the module to broaden their digital skill set.

Post-survey design

The post-survey comprised eight items evaluating perceived learning gains and course design. Students were asked:

1. How effectively the module helped them understand and apply DH tools within Chinese history and culture.
2. Whether the tools introduced met their learning needs.
3. Which specific DH tools they used during the course.
4. Whether the integration of DH tools into course content was appropriate.
5. Whether the module's digital content should be expanded in future.
6. To rate the module's overall effectiveness using the same four-point scale (very helpful, positively helpful, partially helpful, not obvious).

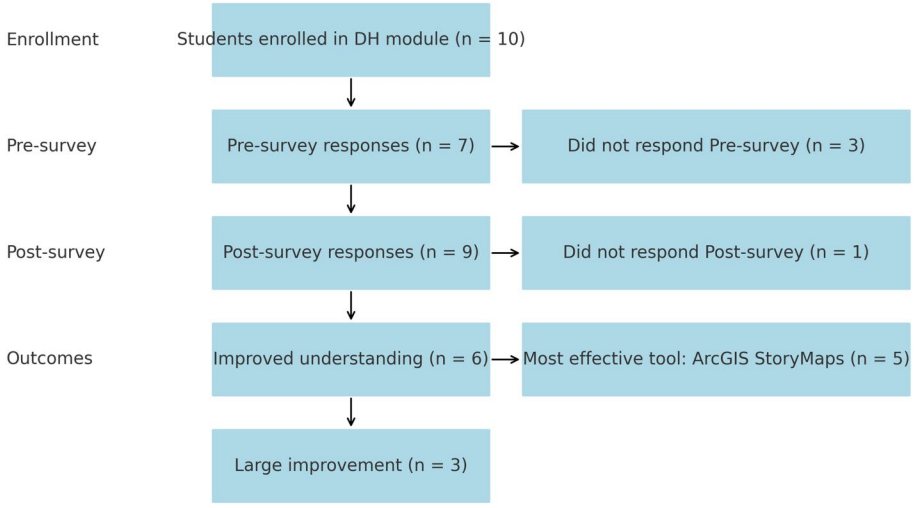
Two additional questions solicited feedback on teaching arrangements.

Post-survey response and outcomes

The post-survey achieved a 90% response rate, with students reporting substantial learning gains. Among respondents, 67% indicated that their understanding of digital

humanities (DH) tools improved very significantly, while 33% reported improvement to a large extent. These results suggest that the DH module—covering all four categories of digital tools—significantly enhanced students' perceptions of digital humanities and had a positive impact on promoting digital literacy.

When asked to identify the most effective tool, 56% of students selected ArcGIS StoryMaps, highlighting its value as an accessible and effective introductory tool that combines GIS and digital storytelling within the module.



The survey was conducted in a separate course in 2024 with a similar student background to ensure the validity of the results and to observe changes over time. It involved 29 major and 7 minor students from the Chinese History and Culture programme, with a 47% response rate (17 out of 36). Among respondents, 94% agreed that the digital humanities (DH) tools introduced were effective in helping them understand and apply DH concepts, reaffirming the module's value in promoting digital literacy. While 40% of students identified Generative AI as the most effective learning tool and 16% selected ArcGIS StoryMaps, the latter remained the highest-rated tool across all DH categories introduced in the course.

4.1.3.2 PolyU digital humanities historian awards 2024 Beyond surveys, the project also launched a year-round initiative—the PolyU digital humanities Historian Awards 2024—to promote digital awareness among the broader student body. Starting from Stage 3 in June 2024, the competition was incorporated into the DH module's implementation. Open to all PolyU undergraduate students, the competition invited submissions by December 2024 that demonstrated: (i) the use of digital humanities (DH) for creative purposes, (ii) data visualization, (iii) exploration of DH concepts, (iv) application of DH tools or suites, (v) the use of AI, or (vi) the development or use of language models for learning or research. Prizes ranged from HKD $500 to $1,500 for the top three entries (https://events.polyu.edu.hk/polyudhha/home).

The competition received 12 entries—3 from Accounting and Linguistics majors, and 9 from History majors. Notably, 11 out of 12 submissions utilized ArcGIS StoryMaps, with only one entry coming from a student outside the module-covered courses. These outcomes closely reflect the 2023 and 2024 survey findings, confirming that the DH

module effectively raised awareness of digital tools, with ArcGIS StoryMaps consistently identified as the most impactful and accessible platform among students.

5 Analysis

5.1 Findings

Survey results from the implementation of the DH module, which targeted senior history major students, reveal several key insights when analyzed through the lens of the TPACK framework:

5.1.1 Technological knowledge (TK 1): students' low digital awareness

Pre-module survey findings indicated minimal prior student exposure to digital humanities tools, reflecting a broader gap in DH awareness and integration within Hong Kong's undergraduate curriculum. The data showed that while many students had experience using general search engines (44%) and online databases (38%), their familiarity with specialized DH tools, such as GIS platforms or CBDB, was minimal. According to the TPACK framework, this baseline reflects a limited TK foundation, underscoring the need for structured instructional efforts to build students' digital competencies in the DH context.

5.1.2 Technological knowledge (TK 2): the DH module as an effective approach

Post-survey findings indicated considerable advancement in students' TK. A majority of students (67%) reported substantial improvement in their ability to use DH tools, while the remaining 33% indicated notable gains. Importantly, 56% of students in 2023 and 40% in 2024 identified specific tools—ArcGIS StoryMaps and Generative AI, respectively—as the most effective in enhancing their learning experience. These findings suggest that the DH module served as an effective means of developing students' digital competencies,

5.1.3 Pedagogical knowledge (PK): the DH module as a reference for curriculum design in digital humanities integration

The post-survey invited students to reflect on the structure and delivery of the DH module. A consistent majority agreed that the integration of digital humanities tools into the course content was both appropriate and effective. Notably, 94% of respondents in 2024 confirmed that the digital tools used in the module supported their understanding of DH concepts. These responses indicate a positive perception of the module's pedagogical design, particularly regarding the tools and instructional approaches introduced. The findings suggest that the DH module can serve as a valuable reference for curriculum design, illustrating how digital tools can be meaningfully and effectively integrated into humanities education.

Further observations from the survey provide additional insights into how students perceived the specific DH categories and tools selected for the module:

1. Limited interest in core DH tool categories: Even among senior history major students, interest in the four core categories of digital humanities tools introduced in the module—GIS, data visualization, text encoding, and digital storytelling—was uneven. This stands in contrast to their prominence and rapid development as

technical subfields in current digital humanities scholarship, particularly in mainland China.

2. Low engagement with field-specific tools: Digital tools developed specifically for Chinese historical research, such as CBDB, MARKUS, and CHGIS, did not attract strong interest from students. Despite their scholarly relevance, these tools were perceived as too complex or less engaging for undergraduate use without additional scaffolding. Contributing factors may also include institutional resistance — for example, limited access to resources and the rigidity of traditional teaching programs — which can constrain broader adoption of such digital humanities tools.
3. Stronger preference for general-purpose tools: Students showed a clear preference for tools like ArcGIS StoryMaps and Generative AI. Although not originally designed for Chinese history and culture education, these tools were favored for their accessibility, flexibility, and broader applicability across various content areas.
4. Effective adoption of universal tools in historical contexts: General digital tools—particularly ArcGIS StoryMaps and Generative AI—proved to be effective when adapted to the context of Chinese history and culture education. Their versatility enabled meaningful integration into both major-specific and general education courses.

   In addition to the survey results, the following findings were drawn from classroom observations, reflections on the implementation experience, and analysis of student submissions to the PolyU Digital Humanities Historian Awards 2024:
5. Module relevance beyond humanities majors: The DH module was also effective for non-humanities majors enrolled in Cluster Area Requirement courses on Chinese history and culture. Several students from these courses completed assignments using ArcGIS StoryMaps, demonstrating the module's cross-disciplinary adaptability.
6. Competition as a practical incentive for tool usage: The PolyU Digital Humanities Historian Awards 2024 served as a motivating factor by encouraging students to use the digital tools introduced in the module. Eleven out of twelve entries were based on course assignments from students in module-covered courses, showing a direct link between classroom learning and participation in the competition.
7. Competition as an extension of learning resources: Beyond motivation, the competition also acted as an extended learning platform. Tutorial videos and supporting materials provided on the competition website allowed students to continue exploring DH tools at their own pace and outside the classroom.

6 Discussion

6.1 The DH module as a practical, low-cost solution for integrating digital humanities

The DH module developed for this study sought to raise student awareness of digital humanities and to improve the effectiveness of learning in Chinese history and culture, while also developing digital competencies. Importantly, it was implemented without major revisions to existing curricula. Instead of modifying course content, structure, or assessment methods, the module introduced selected DH tools through in-class tutorials and sample teaching materials, offering a low-disruption, practical approach to DH integration. This design proved to be both effective and efficient in introducing digital humanities to diverse student populations, including those in general education and non-humanities contexts. It also demonstrated itself to be a cost-effective and highly

adaptable approach to integrating DH into university teaching, aligning with the idea of scalable DH instruction models that avoid overhauling existing curricula [37].

Importantly, this model offers a viable pathway for institutions operating within rigid curriculum structures or facing resource constraints, particularly in contexts such as Mainland China, where digital humanities remain unrecognized as a formal academic discipline and where opportunities for comprehensive, course-length DH instruction are still limited.

6.2 Learning by doing: active use of DH tools enhances engagement and outcomes

In the second stage of the module, teaching materials were developed using ArcGIS StoryMaps to deliver content more interactively. However, student feedback indicated little difference in engagement compared to more traditional instructional methods. This suggests that simply presenting digital humanities (DH) tools through instructor-created materials may not be sufficient to foster deep learning or enthusiasm.

Conversely, when students were given opportunities to actively engage with DH tools—such as creating data visualizations, developing digital storytelling projects based on historical social networks, or building their own StoryMaps—both history and non-history majors demonstrated heightened enthusiasm and motivation to learn. The quality of their projects further indicates that workshops and structured, hands-on instructional strategies are significantly more effective in promoting meaningful engagement with DH and in developing students' digital competencies, compared to passive or purely conceptual exposure.

6.3 Rethinking categories & tools: aligning DH tool complexity with student needs

Survey results from this study indicate that not all categories of DH tools—even those highlighted in recent reports for their rapid technological development—are equally suitable for student needs. In particular, tools such as ArcGIS StoryMaps, which integrate spatial data with digital storytelling, have proven to be significantly more manageable and accessible. These tools are not only user-friendly for history majors, but also well-suited for non-humanities majors with limited background in the discipline, highlighting their versatility and ease of use.

This observation highlights a critical point: DH tools and approaches vary in complexity, and not all tools align with the capabilities or learning needs of a diverse student population. To address this, the study identifies a need to develop a tiered framework that categorizes DH tools and skills into three levels—beginner, intermediate, and advanced.

A tiered framework offers several advantages. First, it enhances accessibility by making beginner-level tools more approachable, encouraging participation from students with minimal prior experience. Second, it provides a clear sense of learning progression: a structured path supports the gradual development of skills and confidence, allowing students to advance toward more complex applications over time. Third, it improves curricular adaptability. By categorizing tools according to their level of complexity, instructors can better tailor instruction to the digital readiness and academic backgrounds of their students.

By applying this tiered approach, the inclusion of DH elements in history and humanities education can be further supported, contributing to the enhancement of both teaching effectiveness and students' digital competencies. As a result, DH education becomes

more inclusive, adaptable, and impactful, offering meaningful engagement opportunities for students across disciplines and levels of experience.

6.4 StoryMaps as effective and foundational tools in the DH module

Findings from the implementation experience, student surveys, and competition submissions consistently indicate that ArcGIS StoryMaps was the most favored tool introduced in the Digital Humanities (DH) module. In comparison to tools specifically designed for Chinese history and culture research—such as CBDB, CHGIS, and MARKUS—StoryMaps received more positive feedback from both history and non-humanities majors in the context of learning Chinese history and culture.

StoryMaps proved particularly effective for teaching topics such as historical events, urban development, and the geographical transformation of communities. Its capacity to convey complex historical processes through dynamic, visual narratives offers students a more engaging and intuitive way to explore the past.

Moreover, this preference highlights that the generality and flexibility of digital tools may be a key factor in their successful application in historical education. Unlike domain-specific tools, StoryMaps integrates spatial data, GIS functionality, and digital storytelling, making it broadly accessible and adaptable across varied disciplines and learner backgrounds.

6.5 Sparking motivation through small-scale competitions

Learning new skills can be challenging—particularly in Cluster Area courses, where students from diverse academic disciplines, especially those within the project-covered courses, may perceive DH tools as unrelated to their fields, professional training, or future career paths.

To address this, the *PolyU Digital Humanities Historian Awards 2024* was launched as a small-scale, year-round competition to encourage engagement and participation.

The competition was integrated into most courses where the DH module was implemented during the project period. It offered modest incentives in the form of gift cards for top entries and certificates of participation for all students who submitted work. The outcomes were promising: several students from CAR courses enthusiastically adopted ArcGIS StoryMaps to complete their assignments, with many choosing to submit their projects for the competition.

This initiative illustrates that small-scale competitions, when paired with meaningful incentives and recognition, can effectively motivate students to explore DH tools, experiment with unfamiliar methodologies, and showcase their work with confidence. Moreover, the provision of certificates and prizes offered tangible acknowledgment of students' efforts and achievements—validating their digital competencies and potentially supporting their academic portfolios or career development.

7 Limitations

This study is among the few research efforts focused on the application of DH in university-level historical education in Hong Kong. Although several limitations are present, it is hoped that the findings and discussion can still offer meaningful insights for future DH pedagogy and curriculum development [38].

The study was conducted as part of a L&T project, which aimed to propose an add-on DH module to integrate digital tools into the learning of Chinese history and culture. The project sought to enhance both teaching effectiveness and students' digital competence. To minimize disruption to existing course delivery, the study was intentionally designed without altering the original curriculum, including course content, structure, and assignment formats. This constraint, while practical, also limited the scope of possible innovations in pedagogy and assessment.

Several specific limitations should be noted:

- The survey was not extended to non-humanities courses, limiting the evaluation of the module's effectiveness among students from other disciplines.
- The study did not incorporate in-depth qualitative interviews, which could have offered deeper insights into student perceptions and experiences.
- There was no dedicated survey or questionnaire to evaluate the advantages and disadvantages of each DH tool or tool category introduced in the module.
- Precisely evaluating the module's impact on teaching effectiveness remains challenging due to the varied academic backgrounds of students involved.
- This study primarily focused on enhancing digital competence and awareness, with limited observation on the module's direct impact on historical learning outcomes.
- During the implementation, students found CBDB too difficult to use, while the limited functionality of the free version of ArcGIS StoryMaps posed challenges to completing their projects. These experiences suggest that future module design should also take into account tool accessibility and usability to ensure more effective and inclusive student engagement.

8 Conclusion

This study demonstrates that a carefully designed DH module, integrating targeted workshops and teaching materials utilizing DH tools—can serve as an effective, cost-efficient strategy for integrating digital humanities into existing curricula and course structures without major alterations. Survey results, along with analysis of competition participants and their submitted works, confirm that this approach can effectively enhance students' awareness of digital humanities, regardless of whether they come from a history or non-humanities background. The study also reveals the importance of categorizing DH tools and approaches by difficulty level when applying them in student learning. Many tools were originally developed for research purposes and thus require a certain level of disciplinary knowledge, technical background, and time investment to use effectively. To improve the effectiveness of the DH module, tools and methods should be selected based on students' backgrounds and learning needs. This finding indicates the importance of further developing a framework for DH tools and approaches in order to more effectively promote digital humanities in education.

Among the various digital tools implemented within the module, ArcGIS StoryMaps emerged as particularly effective in supporting student learning. StoryMaps is a web-based story authoring application that enables users to combine maps with narrative text and multimedia content [39], making it an elementary DH tool that integrates spatial data with digital storytelling. The results indicate that StoryMaps is a suitable digital tool for learning Chinese history and culture, regardless of whether students are history majors or from non-humanities disciplines. It is especially effective in supporting

"learning by doing" approaches, allowing students to actively apply what they learn through their assignments and projects. Compared to CBDB, CHGIS, and MARKUS—tools specifically designed for the Chinese historical context—ArcGIS StoryMaps and generative AI, as widely applicable digital tools, were more favored by students, regardless of whether they were history or non-humanities majors. This may be attributed to the cross-disciplinary applicability of digital humanities tools, which students can recognize as beneficial for their personal and professional development. For instance, the second runner-up entry in the competition was produced by accounting students, who applied their skills to the history of Hong Kong in the context of module-covered courses.This finding is noteworthy and should be carefully considered in the future adoption of digital humanities tools in historical education, as the use of versatile, broadly applicable tools may offer a more effective approach to engaging diverse student populations, rather than developing specific tools.

Notably, survey results indicate low digital humanities awareness among Hong Kong students, which aligns with findings from studies in language education [40]. This reveals a notable phenomenon that warrants attention in efforts to advance digital humanities education within Hong Kong's education sector.

Small-scale competition, which offered awards and certificates and was aligned with the module's implementation period, served as an effective incentive to encourage students to adopt and engage with digital tools.

This study offers practical experience, reflections, and findings on developing Technological Knowledge (TK) through the application of digital humanities tools in the context of Chinese history and culture education at a Hong Kong university. These insights can serve as a reference for strengthening Technological Pedagogical Knowledge (TPK), and may further support the integration of TPK with Pedagogical Knowledge (PK) and Content Knowledge (CK) to advance the application of the TPACK framework in this field.

However, this study serves only as a starting point in investigating the application of digital humanities in the learning of Chinese history and culture within the context of Hong Kong university students. The project was primarily designed to raise digital awareness and promote the use of DH tools among students, with limited focus or observation on its direct impact on teaching effectiveness. Further research is needed to explore this aspect in greater depth and to assess the broader educational outcomes of integrating DH into the curriculum.

Author contributions

Ka Fai Kwok conceived the research idea, designed and conducted the study, analyzed the data, and wrote the manuscript. No other individuals contributed to the research or writing. Ka Fai Kwok is solely responsible for all aspects of the work.

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Data availability

The author confirms that all data generated or analysed during this study are included in this published article.

Declarations

Ethics approval and consent to participate

The survey and methodology for this study were approved by the Institutional Review Board of The Hong Kong Polytechnic University (Ethics Approval Number: HSEARS20250516002) and were conducted in accordance with the guidelines and regulations set by the Board. All participants in this study provided their informed consent to participate.

Competing interests
The authors declare no competing interests.

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