TEACHING METHODOLOGY OF HISTORICAL GEOGRAPHY THROUGH GEOSPATIAL AND IMMERSIVE TECHNOLOGIES COMPLETED WITH BIBLIOMETRIC ANALYSIS

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Abstract

This paper examines how geospatial and immersive technologies improve teaching historical geography. A mixed design compared a control class taught traditionally with an experimental class using mapping software, virtual field experiences, and collaborative platforms; surveys, pre- and post-tests, and performance tasks were analysed. To complete this study, a bibliometric analysis was added. Technology-enhanced engagement, retention, critical thinking, and practical spatial skills compared with traditional instruction. These gains arise because interactive visualization supports spatial reasoning, multimodal inputs reduce extraneous load, and inquiry tasks elicit deeper analysis of historical patterns in place. The study shows that integrating geospatial analysis, virtual simulations, and blended delivery modernizes the curriculum, equips learners with transferable digital literacy, and guides instructors on sequencing activities, assessing spatial thinking, and scaffolding data interpretation for historical geography. The approach is adaptable across levels, supports inclusive participation, and aligns with current educational priorities for active learning and constructive integration of technology in schools.

Keywords: Blended learning, Geospatial technologies, Historical geography, Spatial thinking, Virtual reality.

1. Introduction

The study of historical geography offers a vital perspective on how spatial factors influence the progression of historical events and vice versa [1]. As a discipline that bridges geography and history, it cultivates students' abilities to think critically, analyze spatial relationships, and understand complex historical patterns. However, traditional methods of teaching (such as textbook readings and passive lectures) often fail to engage students actively or foster deep spatial awareness. These methods lack the interactivity and dynamism needed to represent the temporal and geographical dimensions of historical events in meaningful ways.

Recent advances in science and educational technology have introduced tools like Geographic Information Systems (GIS), virtual reality (VR), interactive simulations, and online collaborative platforms, which have shown promise in transforming the learning experience. This technology is important to increase knowledge [2].

According to constructivist theory, students learn more effectively when they actively construct their own understanding through engagement with materials and environments. These digital tools allow students to explore historical spaces, simulate historical changes over time, and visualize historical processes in 3D, supporting the development of spatial intelligence and experiential learning. Furthermore, connectivism [3] suggests that learning through digital networks enhances access to distributed knowledge, while cognitive load theory [4] indicates that well-structured digital materials can optimize mental effort by reducing extraneous load during complex learning tasks.

Despite the availability of these technological resources, there remains a lack of empirical studies focused specifically on the implementation of such tools in historical geography classrooms. This study addresses that gap by examining the pedagogical impact of integrating modern technologies into historical geography instruction. The goal is to propose a science- and technology-driven framework for enhancing spatial thinking, student engagement, and critical analysis through blended learning. The novelty of this work lies in its comparative evaluation of traditional and digital methods using real student performance data. Its broader impact is to support curriculum modernization and provide an adaptable model for integrating digital literacy and geospatial reasoning into the humanities classroom.

2. Literature Review

The relevance of integrating modern pedagogical technologies into historical geography lies in the increasing demand for interdisciplinary competencies among students. Many reports regarding geography have been well-documented [5, 6].

As educational goals shift toward developing critical thinking, digital literacy, and problem-solving abilities, historical geography emerges as a platform that naturally combines temporal and spatial reasoning. Through digital tools, such as 3D maps, interactive timelines, and virtual reconstructions of historical sites, learners are able to contextualize historical narratives within physical landscapes, thereby deepening their understanding.

The theoretical foundation of this integration is rooted in several educational paradigms. Constructivism emphasizes that students actively construct knowledge

through exploration and interaction rather than passive reception. In historical geography, constructivist strategies are realized through GIS, simulations, and map-based inquiries, where learners reconstruct historical events by navigating through geographic data. This method aligns with experiential learning, which posits that hands-on experience facilitates deeper learning outcomes. Technologies such as VR and digital simulations allow students to "experience" history in spatial context, engaging both cognitive and sensory dimensions.

Another important concept is spatial intelligence, part of the theory of multiple intelligences, which refers to the ability to visualize and manipulate spatial relationships. Tools like GIS and virtual modeling enhance this intelligence by enabling learners to explore geographical influences on historical developments. In parallel, connectivism highlights the role of digital networks in distributing knowledge [7]. Platforms such as Google Earth, Padlet, or historical GIS databases exemplify this theory by linking spatial data with narrative, chronology, and archival resources.

Moreover, cognitive load theory provides insight into how these tools optimize learning [8]. When digital interfaces present layered, interactive content in manageable segments, they reduce extraneous cognitive load and allow students to focus on essential spatial-historical connections. Lastly, the blended learning model supports differentiated instruction and personalized pacing by combining face-to-face guidance with digital resources, making historical geography more accessible and engaging for diverse learners [9, 10].

In summary, the integration of technology in historical geography education is not a trend but a theoretically grounded shift. These frameworks justify the use of geospatial tools and immersive platforms as effective mediators between historical content and learner engagement, aligning with the competencies required in the 21st century.

3. Method

This study employed a mixed-methods research design that combined both quantitative and qualitative approaches to evaluate the effectiveness of integrating modern pedagogical technologies into the teaching of historical geography. Detailed information regarding this method is explained elsewhere [11]. The central aim was to compare the outcomes between traditional teaching methods and those that incorporate geospatial and immersive tools, using multiple indicators of student performance.

The research sample consisted of two groups of students from comparable academic backgrounds. The control group received instruction through conventional means, including textbook readings, teacher-led lectures, and static map interpretation. In contrast, the experimental group was taught using a blend of digital tools, such as GIS, VR experiences, interactive whiteboards, digital textbooks, and online platforms like Google Earth and Padlet. Both groups covered the same historical geography content but engaged with it through different pedagogical modes.

Data collection included pre-tests and post-tests to measure knowledge retention and learning gains, as well as surveys and feedback questionnaires to assess student engagement, perceived usefulness, and ease of technology use.

Additional data on practical skill development (such as GIS navigation and historical map analysis) were collected through direct performance assessments. Qualitative insights were also gathered from student reflections and instructor observations to understand learner experiences in depth.

For the analysis, statistical tools were used to compare performance metrics across the two groups. These included descriptive statistics for quantitative data and thematic coding for qualitative responses. The effectiveness of the technology-enhanced instruction was evaluated using key performance indicators such as student engagement, retention of knowledge, development of spatial and critical thinking skills, and the acquisition of practical digital competencies.

This methodological framework ensured that the comparative analysis not only focused on academic outcomes but also accounted for the learner's interaction with educational technologies. The dual emphasis on performance data and learner feedback strengthens the validity of the findings and highlights the multifaceted impact of integrating science and technology tools into the humanities curriculum.

4. Results and Discussion

4.1. Bibliometric analysis

This has been confirmed by the bibliometric analysis (see Fig. 1). Bibliometric analysis plays a crucial role in identifying research trends, evaluating knowledge growth, and justifying the academic relevance of a study. In the context of geography education, bibliometric data reveal a significant increase in scholarly attention, particularly in the past two decades, driven by advancements in geospatial technologies and interdisciplinary integration. Many studies regarding the use of bibliometrics have been well reported [12-17].
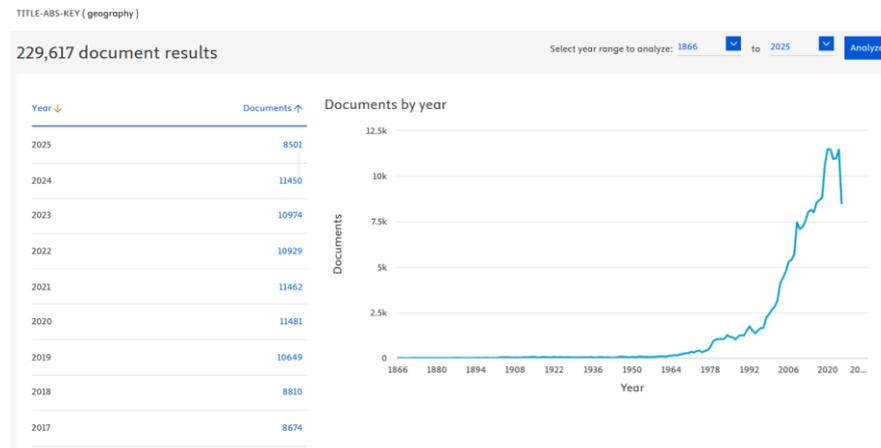

Fig. 1. Bibliometric analysis using keyword geography taken from Scopus database in October 2025. Detailed information on how to use bibliometric is explained elsewhere [18].

In the case of geography, over 229,000 documents have been indexed in global scientific databases, with annual publications peaking above 11,000 articles between 2020 and 2022. This upward trend underscores a growing global interest

in spatial analysis, digital mapping, and educational innovations in geography. By using bibliometric evidence, researchers can validate the significance of their topic within the broader academic landscape, align their work with global research directions, and demonstrate its potential contribution to educational policy and classroom practice.

4.2. Student engagement

Figure 2 and Table 1 are referenced to demonstrate the increase in student engagement when modern pedagogical technologies are applied. The experimental group, which used tools such as VR and GIS, exhibited active participation in class discussions, interactive simulations, and online forums. This was significantly higher compared to the control group, where engagement was mainly passive and lecture-driven.
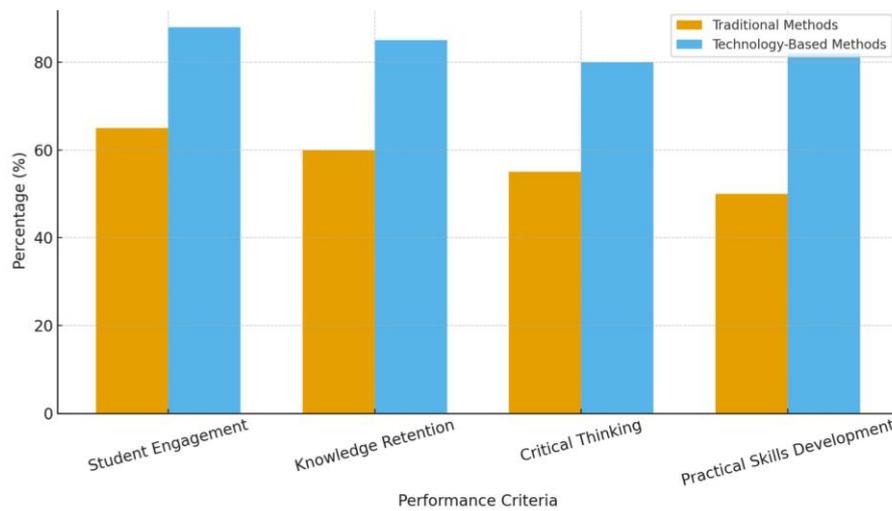

Fig. 2. Comparative results of student performance by criteria.

**Table 1. Comparison of student performance
(traditional vs. technology-based methods).**

Criteria	Traditional Methods	Technology-Based Methods
Student Engagement (%)	65%	88%
Knowledge Retention (%)	60%	85%
Critical Thinking Improvement (%)	55%	80%
Practical Skills Development (%)	50%	82%

Student interaction with immersive environments allowed them to virtually experience historical locations and geographic changes, promoting a sense of presence and emotional connection. As a result, learners were more motivated to explore content beyond the classroom. These findings align with studies that show virtual reality, and interactive media can enhance affective engagement and motivation in geography learning [19].

4.3. Knowledge retention

The post-test data showed a marked improvement in knowledge retention in the technology-based group. Students who engaged with layered, interactive content retained historical information more effectively than those exposed to static textbook materials. Digital maps and time-based overlays enabled learners to visualize cause-and-effect relationships across geographic space and historical timelines.

Cognitive Load Theory supports this result, as multimedia elements reduce extraneous load and allow for better schema construction [20]. Learners in the experimental group could control the pace of content delivery and revisit historical simulations, reinforcing long-term memory through repetition and context-rich representation.

4.4. Critical thinking improvement

The integration of GIS and interactive tasks significantly improved students' critical thinking abilities. They were tasked with analysing historical migration patterns, evaluating terrain influences on empire expansion, and mapping economic trade routes using real geospatial data. These activities encouraged learners to go beyond recall and engage in interpretation, synthesis, and hypothesis-making.

This outcome is supported by constructivist and experiential learning theories, which argue that knowledge construction is strengthened when students engage with problems requiring inquiry, decision-making, and spatial reasoning. Technology enabled learners to test their assumptions by manipulating variables within simulations, thereby deepening their analytical competence.

4.5. Practical skills development

Perhaps the most significant gain observed was in the area of practical skills development. Students trained using GIS software were able to interpret thematic layers, create time-series maps, and apply spatial analysis to historical questions. These are skills that mirror real-world applications in urban planning, archaeology, and heritage conservation.

The use of VR tools also enabled learners to perform simulated historical explorations (such as traversing ancient cities or analysing battlefield geographies), which would otherwise be inaccessible. These technologies bridge the gap between theoretical learning and applied skill-building, fulfilling a core aim of competency-based education models.

5. Conclusions

The findings confirm that integrating modern pedagogical technologies (such as GIS, virtual reality, and interactive platforms) significantly enhances student engagement, knowledge retention, critical thinking, and practical skills in historical geography education. These improvements occur because immersive and geospatial tools support active learning, optimize cognitive processing, and develop real-world competencies. The study reinforces the value of technology-based instruction in aligning historical geography with 21st-century learning goals. Future research should expand the application of these methods across subjects and assess their long-term educational impacts in diverse learning environments.

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