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Map In Geography Teaching, Bibliographic Research Based On Scopus Data Source, Period 2015 – 2025

Phạm Thị Thuỳ Nhung, Nguyễn Thị Huyền
Thac Ba High School, Thac Ba Commune, Lao Cai Province;
Thai Nguyen University Of Education

Abstract:
This study aims to analyze the overall picture of the use of maps in Geography teaching, and identify key research trends, typical contributing countries and authors. The systematic evaluation method is applied according to the PRISMA process, using data collected from the Scopus database to screen and analyze relevant scientific publications. The results showed that 133 articles met the selection criteria and were included in the analysis. The number of publications has tended to increase significantly in recent times. In addition, the study noted the participation of many countries with different levels of interest, while highlighting key research directions and identifying trends in map research in Geography teaching. The conclusion shows that maps are increasingly used not merely as paper documents but as highly interactive and intuitive documents in the digital technology arena.
Keywords: *Bibliometric analysis; Geography education, Spatial Thinking, WebGIS, Digital Maps, GIS, Cartography*

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I. Introduction

In geography teaching, a map is a symbolic, schematic representation of the earth's surface or a portion of it, usually on a plane, that serves both as a model of territory and phenomena and as a key learning tool for developing geographic competence. According to Olson the map is a miniature model of the surface of the Earth (or the surface of another planet), and the miniature size is one of its most useful features because the Earth itself is too large to be easily visualized (Olson, 2015). With the study of M. Vasileva (Vasileva, 2019) gives a background definition and describes maps as "the second language of geography" and "the beginning and end of geography", emphasizing their importance for geographical literacy. Abdullah Balciogullari has asserted that maps are "symbolic representations that facilitate the understanding of the configuration of the space represented" and advance geographical knowledge while promoting spatial thinking (Balciogullari, 2017). According to von Schmettau et al., maps are an outstanding example of the combination of text, images and geometry, thereby supporting the spatialization of knowledge (von Schmettau et al., 2026).

Traditionally, maps are classified into general reference maps (which show many individual features), thematic maps (which show distribution), or between the two. Although this classification is inaccurate and the explosion of mapping using new tools and data sources has further complicated the system, these terms are still used. Currently, they are often used to distinguish different features on the map: Population maps have thematic data (population), but can also have reference data such as political boundaries (Olson, 2015).

Along with the development of society, knowledge and technology, cartography has developed from traditional methods of representation by strokes and symbols on the surface of the terrain into an advanced scientific field, integrating many modern data sources such as aviation images, satellite images, global positioning system (GPS), community data and data from social networks. However, the basic principles of cartography, including scale, projection, spatial relations, generalization, symbolization, and data modeling, still play a central role in the design, construction, and transmission of map information (Olson, 2015). However, the wave of technological advances has reshaped and further developed the maps, leading to changes in their use. Recently, the widespread availability of mobile phones, mobile data, Wi-Fi hotspots, and map-based applications has gradually replaced traditional maps and road atlases as the primary locator aids; however, this change has not made maps obsolete but has instead posed a challenge in terms of how individuals of all ages interact with them and, ultimately, how formal education can better prepare students for these changes. This is a fundamental challenge for geography, which in school makes the most important contribution to the introduction and development of mapping skills đồ (von Schmettau et al., 2026).

It can be seen that in recent years, the study of maps in geographical education has increased significantly such as research related to students' mapping skills, using WEBGIS, ArcGIS or comparing teaching materials that are maps in schools (Ababneh & Tawalbeh, 2026; Anthamatten et al., 2018; Giakoup, 2026; González González & Pisabarro, 2024; Wu et al., 2018). Although the number of studies on the application of maps in geography

teaching is increasing, current works mainly focus on evaluating the effectiveness of each specific technology or teaching method. Large-scale overview studies to analyze the development of the field, knowledge structures, cooperation networks and research trends are still relatively limited. Therefore, the comprehensive analysis of the research picture will contribute to identifying outstanding topics, research gaps and future development directions, and provide the scientific basis for the innovation of Geography teaching in the context of digital transformation.This study aims to perform bibliometric analysis for publications on maps in Geography teaching in the period 2015-2025 in order to:

1) How many publications related to the study were there in each year, from 2015 to 2025?
2) What are the prominent keywords related to the research problem?
3) Which countries have a lot of research on maps in teaching Geography?
4) Which journals publish more articles related to the field of research?

The research paper is structured into the following sections:
Part 1) giving the reasons for the study,
Part 2) Describing the method used in the study,
Part 3) Presenting the relevant research results and discussion, and finally the conclusion.

II. Materials And Methods

Data source and procedure

This study we used Scopus as the only database with unrestricted access because of its content coverage, convenience and practicality, as well as more reliable impact indicators, cannot be manipulated as easily as those provided by the Web of Science (Pranckutė, 2021). Scopus is a multidisciplinary and selective database, launched by Elsevier in November 2004, each year about 3 million new databases are added to Scopus, and it is also a selected database, which means that the content is selected to be included in the database through a rigorous process (Baas et al., 2020).

All searches were performed on the Scopus database by June 2026, and the data needed for bibliographic analysis was then collected. The search strategy includes identifying all materials that contain the terms “MAP,” “GEOGRAPHY,” and “EDUCATION.” To ensure updates, the search timeframe is limited from 2015 to 2025. In addition, the search parameters are limited to the English language, research in the form of articles, at the final stage of the publishing process, and open access data to ensure the wide applicability of the research content.

Analytical methods and software

To use the Scopus data source, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) process was used. This method helps us identify and screen papers, which is perfectly suited for systematic literature review (Page et al., 2021). For the screening process, it is clearly shown in Figure 1.

The first is the keyword search strategy using the keyword phrases “MAP” AND “GEOGRAPHY” AND “EDUCATION”, the results retrieved 1,363 documents.

After applying the initial filtering criteria on the database, including limiting the publication period from 2015–2025, selecting only scientific articles, English language articles and articles that have been officially published, a total of 934 documents were rejected. The remaining 429 articles were included in the screening stage according to the title and summary. In this step, 125 articles that did not meet the research objectives were rejected, while 304 articles were searched in full text. However, 171 papers were either not accessible or did not have full text, so the final 133 papers were selected and included in the review study.

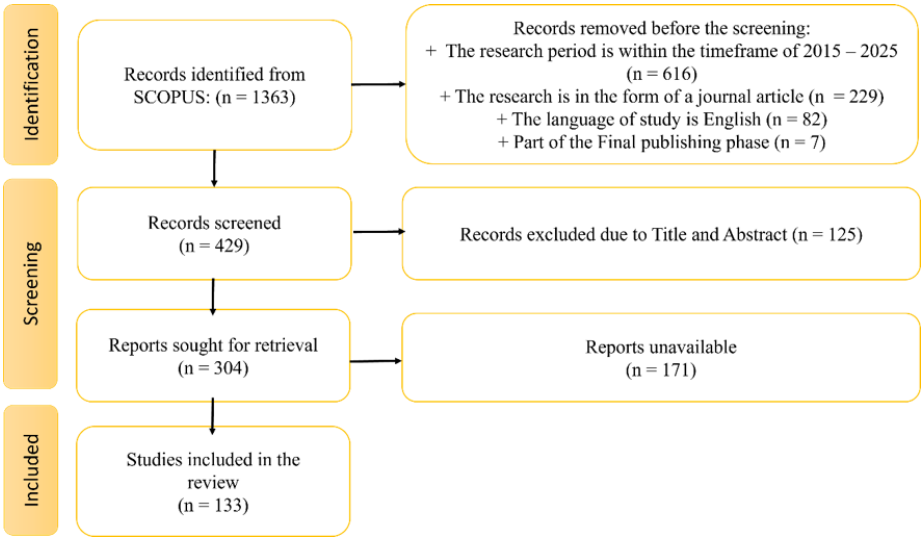

Figure 1. PRISMA 2020 flow diagram of the study selection process

At the same time, the analysis results are synthesized and interpreted through tables, charts and network diagrams generated from VOSviewer and Wordcloud software. These visualizations help clarify research trends, influential publications, and key thematic clusters on maps in geography education.

III. Results

***Summary Statistics*:** Data analysis from 133 publications (a total of 1,382 citations) demonstrates the growing academic interest in this research field. The dataset includes contributions from 339 authors affiliated with 245 organizations across 46 countries, and the studies were published in 70 scientific journals. A total of 813 authors and index keywords were identified, reflecting the multidisciplinary nature of the research domain. On average, each publication has received 10.39 citations. Among the selected publications, *Landscape interpretation with augmented reality and maps to improve spatial orientation skill skill* (Carbonell Carrera & Bermejo Asensio, 2017) is the most influential study, accumulating 87 citations.

How many publications related to the study were there in each year, from 2015 to 2025?

Figure 1 shows the number of publications published year over year during the study period. In general, the number of articles tends to increase over time, although there is some variation between the years, which shows that the study of maps in geographical education always retains a certain level of interest of researchers. In the first year of the research period, 9 publications were published, the next two years (2026, 2027) recorded a smaller number of publications, along with the number of 5. In 2018, there was an increase in research and together reached 9 publications the same as the first year in the research period. In the next 2 years, the number of publications increased continuously by 10, 19 publications, reflecting the increased interest of the scientific community in the research topic. Although the number of posts declined slightly between 2021-2023, the overall trend remained high. The next two years recorded a strong upward trend and reached 22 publications by the end of the research period, and this is also the highest number of publications of the whole research period, showing that this field continues to thrive and attract more and more research.

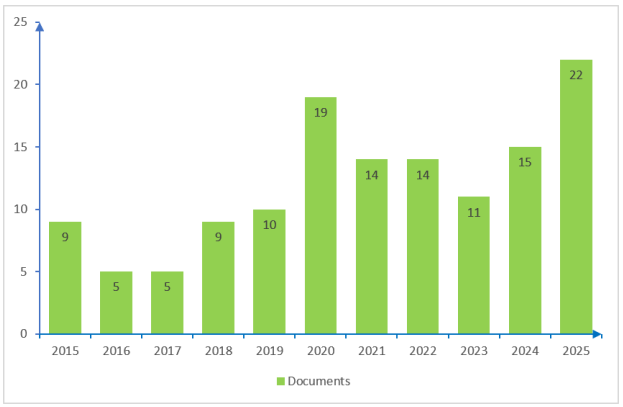

Figure 1. Total of studies by year

What are the prominent keywords related to the research problem?

Figure 2 presents the word cloud generated from the keywords of the selected studies. The size of each word reflects how often it occurs in the dataset. The results show that "education" is the most prominent keyword, reflecting that education is the central theme of the field of study. In addition, high-frequency keywords such as "geography", "maps", "learning" and "spatial" show that the majority of research focuses on integrating geographic knowledge, spatial thinking and maps in teaching activities. In addition, the emergence with significant frequency of the keywords "GIS", "digital", "Digital Literacy" and "geospatial" reflects the increasing trend in the application of digital technology and Geographic Information Systems (GIS) to geographic education.

At the same time, keywords such as "cartography", "skills", "teaching", "school" and "secondary" show that the studies not only focus on geographical content but also aim to develop map capacity, spatial thinking skills and innovate teaching methods, especially at the general education level.

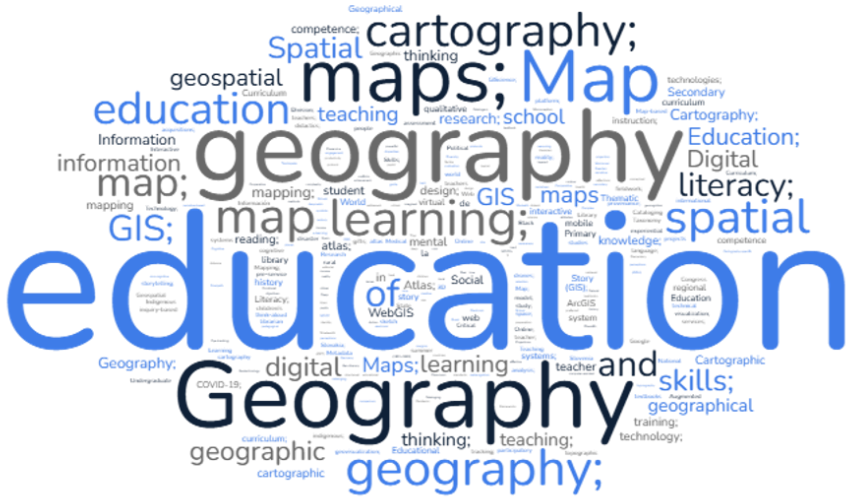

Figure 2. Visual representation of the frequency of occurrences of keywords in publications related to maps in Geography teaching (Source: Analysis results obtained using Wordcloud software)

In general, the keyword cloud shows the overall picture of the research field revolving around geographic education, in which prominent topics include map-based learning, spatial thinking development, cartography, GIS application and digital technology to improve the effectiveness of geography teaching.

In addition to keyword analysis of relevant studies to determine which research trends are prominent, the use of VOSviewer software is also used to verify and clarify research trends related to maps in geographic education. The analysis results show that the network is divided into three main topic clusters, reflecting the outstanding research directions in the field (figure 3). The red cluster focuses on the foundational themes of geography education, including education, geography, maps, cartography, and storymaps. In particular, geography serves as the central node of the cluster with many links to other keywords, showing that the studies mainly focus on the integration of maps, cartography and visual tools in geography teaching. The emergence of storymaps reflects the trend of using interactive map platforms to enhance the learning experience and the ability to visualize geographic information. The blue cluster represents the research group on GIS and geospatial technologies, including GIS and mapping keywords. Although the number of keywords in this phrase is not much, the links between GIS, geography and geography education show that the Geographic Information System serves as a bridge between geospatial technology and geographic education. This reflects a growing trend in the application of GIS to support learning, spatial analysis, and the development of geographic capacity for learners. The green cluster focuses on the topic of geography education, which is the largest node in the network, showing that this is the most prominent research direction. Relevant keywords include spatial thinking, map skills, and geography teaching, reflecting the research's interest in developing spatial thinking, mapping skills, and innovation in geography teaching methods. The close link between these keywords shows that current researches focus not only on imparting knowledge but also on developing geographical competence through modern teaching methods.

Notably, geography and geography education are the two central nodes connecting all three research clusters, showing that they play a bridging role between education, GIS technology and spatial capacity development. The network structure reflects the current research trend that is shifting from traditional geographical education to the integration of geospatial technology and the development of spatial thinking to improve the quality of geography teaching and learning.

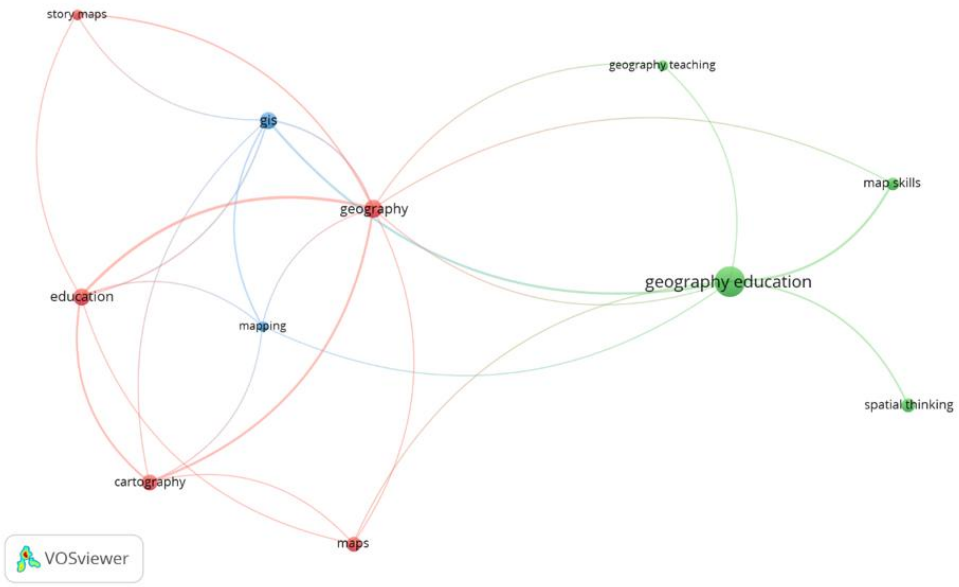

Figure 3. Visual representation of co-occurring network of keywords in publications related to maps in Geography teaching. Source: Analysis results obtained by VOSViewer software.

Which countries have a lot of research on maps in teaching Geography?

Figure 4 shows the spatial distribution of scientific publications by country. The level of lightness of the color reflects the number of publications, where the darker the color denotes the higher the research yield. The results show that research activities are unevenly distributed globally, mainly in North America and Europe. The United States is the country with the largest number of publications, followed by Germany and the Czech Republic; Turkey, Spain, China, and Slovakia also have significant contributions. Meanwhile, the majority of countries in Africa, South America and some parts of Asia have a limited number of publications. Overall, the map reflects the concentration of research capacity in developed countries, and shows the trend of expanding the participation of emerging economies in the field of geographical education.

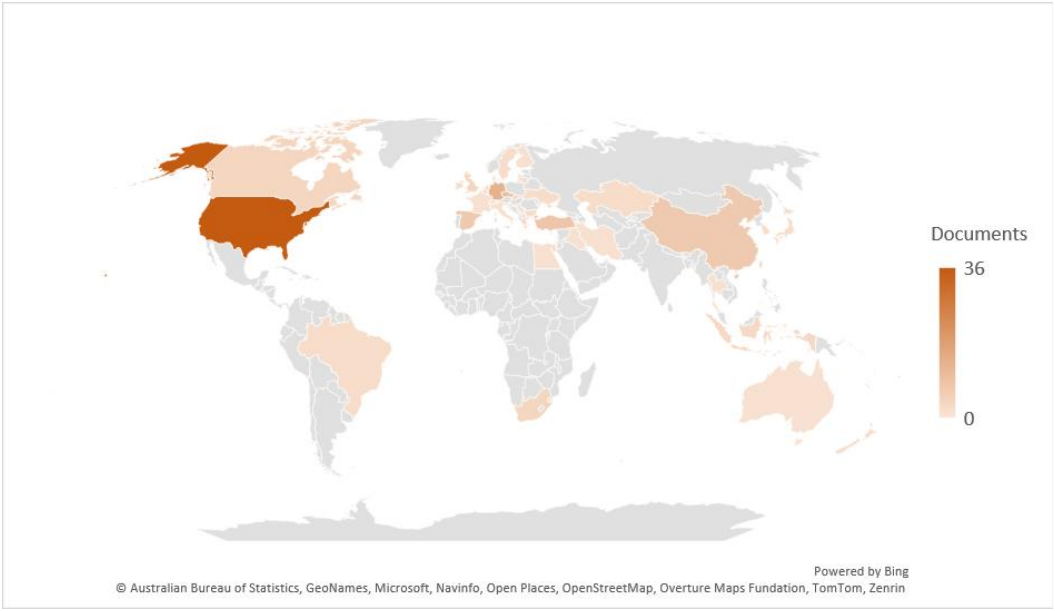

Figure 4. The countries involved the production of research papers on maps in teaching Geography

To further detail the level of contribution of countries, Table 1 below presents the distribution of the number of publications by country in the research dataset. The results show that the research activity is mainly concentrated in developed countries, of which the United States leads with 36 publications, far ahead of the rest. Germany ranked second with 13 publications, followed by the Czech Republic (10), Turkey (8), and Spain and

China (all 7). This group of countries plays an important role in promoting the development of the research field. In the next group, Slovakia recorded 6 publications, while the United Kingdom, Belgium and Canada all had 4 publications. Countries such as South Africa and Greece have 3 publications; Taiwan, Indonesia, Brazil, New Zealand, Sweden, Slovenia, Switzerland, Ukraine, Kazakhstan, Lithuania, Bulgaria, South Korea, Ireland and Japan all have 2-3 publications.Overall, the results show that the published productivity is unevenly distributed among countries, with the predominance of the United States and some European countries. Overall, the results show that the published productivity is unevenly distributed among countries, with the predominance of the United States and some European countries.

Table 1. List of countries with the highest number of publications related to research content in the period from 2015 to 2025

Country	United States	Germany	Czech Republic	Turkey	Spain	China	Slovakia	United Kingdom	Belgium	Canada
Documents	36	13	10	8	7	7	6	4	4	4
Country	South Africa	Greece	Taiwan	Indonesia	Brazil	New Zealand	Sweden	Slovenia	Switzerland	Ukraine
Documents	4	3	3	3	2	2	2	2	2	2
Country	Kazakhstan	Lithuania	Bulgaria	South Korea	Ireland	Japan	New Zealands	Ireland		
Documents	2	2	2	2	2	2	2	2		

In addition to considering which countries have many publications related to the research topic, the following figure 5 also presents a network of research cooperation between countries in the field of geographical education. The results show that the cooperation network is quite simple, consisting of only three countries, the United States, China and Germany, divided into two clusters of cooperation. In the network, the United States is the largest node country, reflecting the prominent role of research productivity as well as the level of influence in the field. The United States has a direct link with China, making it one of the most important international research cooperation partners. China acts as a bridging country, connecting the two research clusters through links with both the United States and Germany. China acts as a bridging country, connecting the two research clusters through links with both the United States and Germany. Germany, meanwhile, comes in with a smaller node size and only has direct links to China. This shows that Germany's level of international cooperation in the dataset is limited and is mainly done through cooperation with China instead of forming a multilateral network.

Figure 5. Visual representation of the network of cooperation between countries in publications related to maps in Geography teaching. Source: Analysis results obtained by VOSViewer software

Overall, the network of cooperation between countries has a low density, reflecting that international cooperation in this field has not really expanded. The research relationships mainly focus on some countries with high publication productivity, while the participation of other countries is relatively limited. This result shows that there is still a lot of potential to expand the network of international cooperation to enhance academic exchange and promote the development of the field of geographical education.

Which journals publish more articles related to the field of research?

Figure 6 shows that studies on maps in geography teaching are published in various journals, reflecting the interdisciplinary nature of the field, including geography education, cartography, geographic information systems (GIS), and educational technology. However, the number of publications is mainly concentrated in a

number of specialized journals. The Journal of Geography in Higher Education is the most prominent publication source with 13 articles, accounting for the highest proportion of the total number of studies. This shows that this journal plays a central role in disseminating research related to teaching method innovation, geographic capacity development and application of mapping technology in higher education. The second place is the Journal of Geography with 10 articles, followed by the Review of International Geographical Education Online (7 articles) and ISPRS International Journal of Geo-Information (6 articles). The presence of ISPRS International Journal of Geo-Information shows the growing trend in integrating geospatial technologies, GIS and digital data into Geography teaching research.

Other journals such as the European Journal of Geography (8 articles) and Cartographic Journal (5 articles) also have a significant number of publications, reflecting interest in both geographical education and cartographic science. Meanwhile, International Research in Geographical and Environmental Education, KN – Journal of Cartography and Geographic Information and J-Reading have 4, 3 and 3 articles, respectively. In addition, many other journals only record 2-3 articles, showing that the research is scattered across many different academic forums instead of focusing on a few journals.

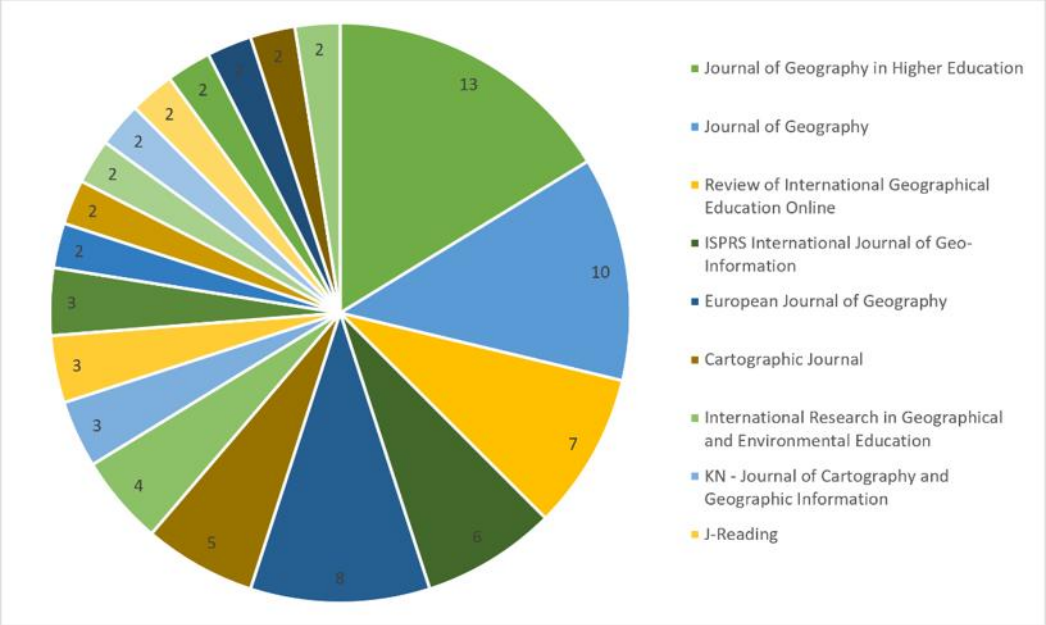

Figure 6. Journals that publish many articles related to research content

In general, this result shows that the field of map research in Geography teaching has a relatively high level of publication source dispersion, but still forms a group of nuclear journals specializing in geography education and geospatial technology. This reflects the development trend of the field in the direction of interdisciplinarity, the connection between educational science, cartography and GIS technology. At the same time, the appearance of geospatial journals such as ISPRS International Journal of Geo-Information in the top publishing source group also shows that recent studies not only focus on the use of maps as a visual medium but also aim to exploit digital map technologies, WebGIS, Story Maps and geospatial data to improve the effectiveness of Geography teaching.

What are the most cited articles on maps in teaching Geography?

Table 2 presents the 10 papers with the highest number of citations related to the research topic. Citation counts ranged from 39 to 87, reflecting the varying degree of influence the works had on the development of the field.

Table 2. Top 10 most cited articles related to the research topic

Stt	Tên bài báo	Số trích dẫn	Năm xuất bản
1	Landscape interpretation with augmented reality and maps to improve spatial orientation skill (Carbonell Carrera & Bermejo Asensio, 2017)	87	2017
2	The Impact of Paper Versus Digital Map Technology on Students' Spatial Thinking Skill Acquisition (Collins, 2018)	79	2018
3	Map learning with a 3D printed interactive small-scale model: Improvement of space and text memorization in visually impaired students (Giraud et al., 2017)	72	2017

4	WebGIS for geography education: Towards a GeoCapabilities approach (Fargher, 2018)	56	2018
5	Sorting of suitable areas for disposal of construction and demolition waste using GIS and ELECTRE TRI (Biluca et al., 2020)	55	2020
6	Maps and the geospatial revolution: teaching a massive open online course (MOOC) in geography (Robinson et al., 2015)	52	2015
7	Education in cartography: What is the status of young people's map-reading skills? (Ooms et al., 2016)	50	2016
8	WebGIS Implementation and Effectiveness in Secondary Education Using the Digital Atlas for Schools (De Miguel González & De Lázaro Torres, 2020)	47	2020
9	Web GIS for Sustainable Education: Towards Natural Disaster Education for High School Students (Li et al., 2022)	43	2022
10	Including Students' Geographies in Geography Education: Spatial Narratives, Citizen Mapping, and Social Justice (Schlemper et al., 2018)	39	2018

The most cited article was "Landscape interpretation with augmented reality and maps to improve spatial orientation skill" with 87 citations, published in 2017. This study focuses on the application of Augmented Reality (AR) combined with maps to develop spatial orientation capacity, showing that immersive technology is becoming a highly influential research direction in geography education. Second is "The Impact of Paper Versus Digital Map Technology on Students' Spatial Thinking Skill Acquisition" with 79 citations (2018) . This work compares the effectiveness of paper and digital maps in developing students' spatial thinking, reflecting a growing interest in the transition from traditional to digital learning materials. In third place was "Map learning with a 3D printed interactive small-scale model" with 72 citations (2017). The study exploits interactive 3D printing models to support spatial and textual memory for the visually impaired, expanding the application of educational technology to inclusive education.

The group of articles with 50–56 citations mainly focuses on WebGIS, GIS and geographic education. Typical are the study "WebGIS for geography education: Towards a GeoCapabilities approach" (56 citations), "Sorting of suitable areas for disposal of construction and demolition waste using GIS and ELECTRE TRI" (55 citations) and "Maps and the geospatial revolution: teaching a massive open online course (MOOC) in geography" (52 citations). These works show the strong development of geographic information systems, online maps and digital learning platforms in geography teaching. The remaining articles were cited 39–50 times, including studies on map reading skills, WebGIS implementation in high schools, WebGIS for sustainable development education and Citizen Mapping. Although the number of citations is lower, these studies reflect the sector's expansion towards aligning digital mapping technology with civic education, disaster education, and social justice.

In terms of publication time, articles are published in the period 2015–2022, of which the period 2017–2018 dominates with 5/10 articles. This shows that this is the period when research on geospatial technology in education begins to attract strong interest from the scientific community and create many high-impact works. Post-2020 studies, although having a lower number of citations, still appear in the group of 10 prominent articles, reflecting new research trends such as sustainability education, disaster education and WebGIS in general education.

Overall, the 10 most cited papers focus on four main research directions: 1) Application of digital technology in geography teaching (AR, WebGIS, GIS, digital maps, MOOC); 2) Development of spatial thinking and spatial orientation; 3) Innovating learning materials and teaching methods (3D models, interactive maps, online learning); 4) Expand the application of geospatial technology to social issues and sustainable development, such as disaster education, civic education, and social justice.

These results show that the outstanding research trend of the field is not only about digitizing maps but also towards exploiting geospatial technology to improve the geographical capacity of learners, and at the same time linking with modern educational goals such as sustainable education, inclusive education and digital transformation in education.

IV. Discussions

The results of the bibliographic analysis show that the study of maps in geographical education has expanded significantly over the past decade. This development reflects the rapid digital transformation in education and the increasing availability of geospatial technologies, including GIS, WebGIS, remote sensing, and Story Maps.

These technologies have changed the role of maps from static teaching materials to interactive learning environments, promoting spatial thinking and inquiry-based learning. Besides, the development of keywords shows the transition from traditional map teaching methods to learner-centered and technology-supported methods. Recent emerging topics, including Story Maps, WebGIS, and digital learning, show a growing emphasis on interactive, inquiry-based, and experiential learning environments.

The study also found that the leading contribution of the United States and several European countries can be attributed to their long-term investment in GIS education, educational technology, and geography curricula.

Strong international cooperation among these countries has further promoted the dissemination of knowledge. In addition, the dominance of the Journal of Geography shows that the study of educational maps is still mainly in the field of geographical education, not just cartography. This suggests that recent studies are increasingly emphasizing innovation in teaching methods, competency-based education, and spatial literacy rather than focusing solely on purely technical problems of cartography.

At the same time, the top 10 articles with the highest citations also show that the trend of maps in geography teaching associated with digital platforms, strengthening the formation of spatial science cognitive capacity for students will be the advantages that interactive maps can bring. These findings are consistent with previous review studies reporting the rapid integration of geospatial technology into geographic education. However, unlike previous review studies that focused solely on GIS education, the current study provides a more general view that includes both traditional and digital mapping research. These findings provide useful evidence for geographical educators seeking to integrate digital map technology into teaching practice. They also give policymakers and curriculum developers a comprehensive overview of emerging research trends that could guide future education reforms.

Although the study has provided an overview of the trends in map research in Geography teaching, there are still some limitations that need to be considered. Firstly, data is only collected from the Scopus database. Although this is one of the academic databases with great reliability and coverage, not incorporating other sources such as Web of Science, ERIC or Google Scholar may lead to the omission of some related publications. Second, the study only looked at papers published in the period 2015-2025. This period reflects well the modern research trends and the development of digital map technology, but does not fully reflect the development process of the field in previous periods. Third, the results of the analysis depend on the search strategy, including keywords and material selection criteria. Due to terminological diversity in the field (such as digital maps, interactive maps, Story Maps or GIS education), some relevant research may not yet be included in the dataset. Finally, bibliographic analysis mainly reflects publication trends, collaborative networks, and research topic structures, but does not directly assess the methodological quality or pedagogical effectiveness of each study. Therefore, further studies should combine bibliographic analysis with systematic review or meta-analysis to provide further evidence on the effectiveness of map application in Geography teaching.

V. Conclusions

This study has provided an overview of the development of the field of maps in Geography teaching through a bibliographic analysis of 133 articles indexed in Scopus in the period 2015-2025. The results show that the number of publications tends to increase, reflecting the increasing interest in the application of maps and geospatial technology in education. The research focuses mainly on specialized journals on geographic education and GIS, and shows the shift from traditional maps to digital map technologies such as GIS, WebGIS and Story Maps to develop spatial thinking and geographic capacity. The research contributes to clarifying the knowledge structure, key publishing sources and prominent research trends of the field, thereby providing a reference basis for researchers, teachers and policy makers in orienting research and promoting the application of geospatial technology to geography teaching.

In the future, studies should expand the scope of data to multiple academic databases and focus on emerging topics such as artificial intelligence, virtual/augmented reality (VR/AR), and smart geospatial learning environments to improve teaching efficiency and develop geographic competencies for learners.

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