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A Bibliometric Analysis of Inquiry Learning in Science

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Abstract

Inquiry-Based Learning (IBL) has become a central approach in science education reform, especially following the adoption of standards like the Next Generation Science Standards (NGSS), which emphasize exploration and problem-solving. This study aims to identify publication trends related to IBL in science education from 2019 to 2024 and to determine the most influential journals and researchers in the field. Using bibliometric methods, 700 articles were retrieved from the Scopus database and analyzed using VOSViewer and the Biblioshiny package in R. The analysis reveals a significant rise in publication volume, with major contributions from Beijing Normal University and countries such as the United States. Germany and China demonstrate a balanced integration of national and international collaboration, reflecting openness to cross-border partnerships and contributing to the advancement of global science education research. Influential documents by authors like Vorholzer and Furtak underscore the global and local impact of IBL research. A thematic shift is observed from "scientific inquiry" to broader terms such as "scientific literacy," "science education," and "nature of science." These findings suggest the need for enhanced international collaboration, deeper integration of technology into instructional strategies, and increased visibility of key institutions and authors to drive globally relevant innovations in science education.

Keywords: Bibliometric Analysis, Inquiry Learning, Learning Model, R Studio (Biblioshiny), Science Education, Vosviewer.

Introduction

Inquiry-Based Learning (IBL) is rooted in constructivism and situational cognition theories that emphasize active and contextual learning, yet it presents distinctive characteristics that differentiate it from related pedagogical approaches. Its uniqueness lies in the explicit focus on inquiry, which involves asking questions, conducting investigations, and drawing conclusions based on evidence as the central element of the learning process (1). While other constructivist approaches may emphasize experience, collaboration, or social context without positioning inquiry at the core, IBL consistently establishes inquiry as the foundation of knowledge construction. Although it shares similarities with active learning and problem-based learning, IBL is more structured because it guides students through systematic stages of evidence-based investigation (2).

Inquiry learning is one of the important components in the constructivist approach that has a long history in educational innovation or renewal. Inquiry learning is a learning approach that emphasizes the process of investigation, data collection, and inference by learners, so that they can build understanding independently (3). This explains that inquiry learning is a learning approach that emphasizes an active process where learners are involved in observation, investigation, and problem-solving independently. Therefore, in inquiry learning, learners are encouraged to formulate questions, develop hypotheses, and conduct experiments to find answers to the questions or problems given.

Inquiry-based learning (IBL) has become an important part of science education reform, especially after the implementation of standards such as the Next Generation Science Standards (NGSS) that encourage exploration-based learning and problem solving (4). These proposed standards are in line with inquiry strategies, where the approach is more structured and oriented towards scientific practices. This is also conveyed by Furtak in his research that has been a reform of

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science learning where there is a shift that involves students in the science learning experience. In his research, Furtak involved teachers, administrators, district and state Science curriculum supervisors, and discussions with the public (5). The results of this study are in line with the Framework for K-12 Science Education published by the National Research Council. The shift in science learning occurs because it has an emphasis on science learning that focuses on student participation, where students not only receive information but also actively build their understanding through exploration, investigation and data analysis. In the context of science education, this shift is in line with inquiry learning as it reflects the methods used by scientists in developing new knowledge.

Although the understanding of inquiry-based learning in science education has advanced, in practice, many science teaching methods remain unchanged. Corrigan said, there is much evidence that people who are the result of the education system today, tend not to realize how scientific research, both past and current, is relevant to their personal lives (6). This suggests that science education has not succeeded in instilling curiosity, relevance or a deep understanding of the importance of science in everyday life. This results in many adults showing apathy towards scientific issues, despite scientific research and findings having a major impact on society in general. The results of this study indicate that further research is still needed to minimize the gaps and challenges in implementing inquiry-based learning strategies in science education. In this digital era, technology allows for simulation, virtual experiments, and online collaboration in science learning. One of the innovations in science education is the use of virtual laboratories within blended-learning approaches that integrate inquiry-based learning with digital technology. Inquiry learning in virtual laboratories is a learning process that requires students to actively seek solutions to the problems they face, through practicum/observation using interactive simulations in searching/examining information/data through virtual proof to draw a generalization (7). Therefore, with the changing learning trends in this digital era, there are still many opportunities to develop Science learning with inquiry strategies.

To advance science education through inquiry-based strategies, research involving academic collaboration networks and the exploration of new topics is needed to optimize the implementation of inquiry approaches in today's modern era. In conducting research involving academic collaboration networks, it is important to identify the countries, institutions, and key researchers that contribute to the development of inquiry-based learning theories and practices. In this case, bibliometric analysis is an effective method in assessing the development of research in a field by utilizing data from scientific publications. This method enables the identification of research patterns through quantitative analysis of publication counts, citation rates, author collaborations, and conceptual relationships within the academic literature (8).

Therefore, this study employed bibliometric analysis to map the evolution of research on inquiry-based learning in science education from 2019 to 2024. The specific objectives of this research are to identify publication trends related to inquiry learning in science education by tracking the number and distribution of publications on inquiry learning in science education from 2019 to 2024. Determine influential journals and researchers by searching for journals and authors that have had a major impact on the development of inquiry learning research. Analyzed researcher and institutional collaboration by identifying relationships between academics and institutions active in this research. And mapping the evolution of keywords and research topics by analyzing how concepts in inquiry learning have evolved over time. This method will be implemented using software tools such as R Bibliometric and VOS Viewer to visualize data through network maps and research evolution diagrams. It is hoped that with this approach, this research can provide a comprehensive picture of inquiry learning and its development direction.

Methodology

The research conducted using the bibliometric analysis method is by identifying relevant research in science learning with inquiry strategy. Bibliometric analysis can analyze scientific developments in various fields through publications, citations, keywords, authors, journals, countries, sources and others using mathematical and statistical methods so as to make it easier for researchers to analyze large amounts of research results (9).

The measurement of collaboration strengths in bibliometric analyses of inquiry-based science learning integrates co-authorship networks, institutional and national affiliations, and citation patterns to capture the intensity and influence of cooperative research (10). Co-authorship mapping reveals the degree of author collaboration, while affiliation analysis highlights the interconnectedness of institutions and countries in producing joint publications. Citation and co-citation analyses further identify the impact of collaborative works on shaping research directions. Tools such as VOSViewer and R Studio enhance the visualization of these relationships, providing systematic insights into collaborative dynamics.

The bibliometric analysis method in the research includes defining words as initial search keywords, initial search results, refinement of the search results, compiling statistics on the initial data, and data analysis (11, 12).

Data Collection

In defining search keywords, researchers refer to previous literature to identify commonly used terminology in the field of inquiry-based strategies in science education. Based on the reviewed literature, the search was also conducted using a variety of synonyms and related terms to broaden the scope by identifying frequently occurring technical terminology (13). In this study, the keyword data search stage can be seen in Table 1.

The data analyzed is based on Scopus data, by applying categorization in accordance with the research objectives. Although the exclusive use of Scopus as the sole database in this bibliometric analysis may introduce certain biases due to its limited coverage compared to other databases, its strengths make it a highly suitable choice for this study. Scopus was chosen because it has the largest database and citations for scientific journals, conference proceedings, and books with broad global and regional coverage. The data retrieved from is also of high quality as it goes through a rigorous content selection process. In addition to complete metadata records of scholarly articles, Scopus also offers comprehensive author and institution profiles, derived from advanced profiling algorithms and manual curation, thus ensuring a high degree of precision and completeness. The reliability of Scopus supports data analysis with bibliometrics for large-scale analysis in research (14). The data will be exported in CSV (Comma-Separated Values) format for further processing using R studio and VOSViewer program.

At this initial search result stage, articles will be obtained that include publication title, author name, publication year, citation. This stage provides an overview of the number and scope of relevant documents (9).

The search in the Scopus database used several keywords which can be seen in Table 1. The search period was set from 2019 to 2024, with the language restriction used being English. The search results showed that there were 700 documents found, all of which were articles without limiting the type of article (such as journal articles, conferences, or others).

Table 1: Instructions From the Scopus Database

Time Range	Search	Results	Download	Access Time
2019 - 2024	TITLE-ABS-KEY(("Inquiry") OR ("Inquiry based instruction") OR ("guided inquiry learning") OR ("open inquiry learning") OR ("problem-based inquiry") OR ("Inquiry-based science education") OR ("inquiry-based laboratory learning") AND ("Science education"))	700	March 20, 2025	15.36

Data Analysis and Presentation

At the data analysis stage, software such as VOSViewer and or Bibliometric in the R program is used. The analysis includes two main approaches, namely Performance Analysis and Science Mapping (15). Performance analysis is by measuring the productivity of authors, institutions, countries, number of citations, and other indices. Science Mapping explores thematic relationships, collaboration networks between researchers, and keyword clustering. Tools such as VOSViewer are used to visualize networks and clusters based on bibliometric data, while Bibliometric helps generate statistical analysis and graphical mapping. VOSViewer is used because of its ability to produce mapping images in three types including network visualization, density visualization, and overlay visualization so that researchers can find research variables that are still little researched to variables that have been researched (16). The use of R Studio to open Biblioshiny is to visualize the knowledge network in this field by using bibliographic images that show the relationship between documents based on the similarity of references cited (17).

Table 2: Key Information

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2019:2024
Sources (Journals, Books, etc.)	234
Documents	700
Annual Growth Rate %	8.03
Document Average Age	3.35
Average citations per doc	8.069
References	35797
DOCUMENT CONTENTS	
Keywords Plus (ID)	377
Author's Keywords (DE)	1937
AUTHORS	
Authors	1982
Authors of single-authored docs	101
AUTHORS COLLABORATION	
Single-authored docs	107
Co-Authors per Doc	3.34
International co-authorships %	18
DOCUMENT TYPES	
article	700

Results

Overview

Based on data obtained from Scopus data analyzed with R (Bibliometric package) and VOSViewer, information is obtained regarding the publication trend of inquiry learning (2019-2024), In the 2019–2024-time span, there were 700 documents with an average of 8.069 citations per document. There were 21763 authors who contributed to this research topic, with 2224 single authors. From the Scopus article database processing, 377 keywords were used in this research, and 1937 author's keywords were relevant to the topic of inquiry learning in Science learning.

Table 2 shows the main information of the analyzed Scopus files such as: document types, document content, authors, and author collaboration.

Most Relevant Sources

The results of the bibliometric analysis on inquiry learning in science education for the period 2019-2024 show 10 main sources that are relevant in this field. The first rank is occupied by the International Journal of Science Education with 42 publications, which shows its role as a leading source that contributes greatly to the development of inquiry learning in Science education. Both the International Journal of Science Education and Research in Science Education contribute as sources of information on inquiry-based learning in science education. The next source is Research in Science and Technological Education, which produced 27 publications, giving attention to inquiry and technology strategies in science learning. The fourth rank is occupied by Education Sciences with 26 publications highlighting aspects of education, including inquiry-based learning. In 5th position, the Journal of Science Education and Technology with 21 publications shows its contribution in linking science education with technology. These five sources are the main references that reflect the development and direction of research related to inquiry strategies in science education. To get information on the 10 journals included in the most relevant sources can be seen in Table 3.

Table 3 presents the ten most productive journals, all of which consistently publish work related to inquiry-based science education within a relatively broad scope. This indicates that research on inquiry-based approaches in science education remains a central topic in various scholarly publications. Nevertheless, discussions on this approach are still conducted in a broader context, highlighting opportunities for further research, particularly in the integration and utilization of technology as part of the learning process.

Table 3: Top 10 Most Relevant Sources 2019-2024

Rank	Sources	Articles
1	International Journal of Science Education	42
2	Research in Science Education	32
3	Research in Science and Technological Education	27
4	Education Sciences	26
5	Journal of Science Education and Technology	21
6	Eurasia Journal of Mathematics, Science and Technology Education	19
7	Science and Education	19
8	Cultural Studies of Science Education	18
9	Journal of Research in Science Teaching	18
10	Science Education	15

Based on Figure 1, the Three Field Plot illustrates the reinforcing relationship between authors' countries of origin, the dominant research themes, and the journals that serve as publication outlets. The visualization indicates that the USA emerges as the most dominant contributor to research on inquiry-based science education, while science education appears as the most frequently investigated thematic focus. At the same time, the International Journal of Science Education is identified as the most productive outlet in this domain, thereby affirming its central role in advancing scholarship on inquiry-based science education.

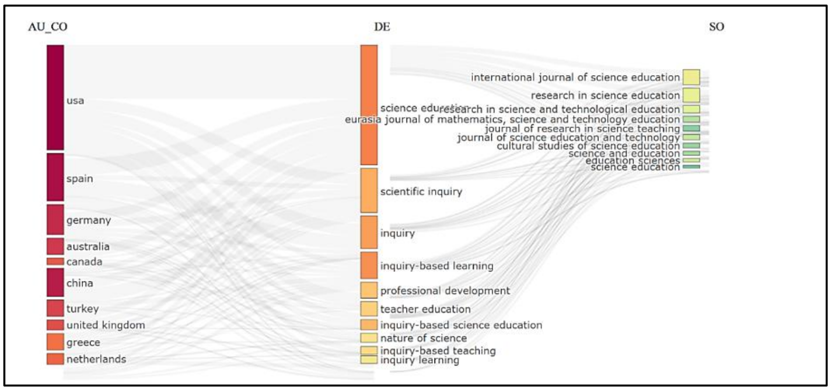

Figure 1: Three Field Plot (County-Keyword-Source journal)

Annual Scientific Production

Figure 2 shows the annual production growth (2019-2024) of research on the implementation of inquiry learning in science education. This research has increased significantly from year to year. In 2019, there were 104 studies, which continued to increase to 110 studies in 2020, and so on until it reached 122 studies in 2021. This shows the growing enthusiasm and attention to this topic. However, in 2022, there was a decline with a total of 107 studies and continued in 2023 with 104 studies. However, in 2022 and 2023, there was a decline in the number of studies conducted. This trend warrants further investigation to identify the underlying factors contributing to this decrease. In 2024, there was a sharp increase with 153 studies, reflecting a major resurgence in interest in inquiry learning, which could be attributed to new needs or innovative directions in science education. This pattern illustrates the dynamics of research that keep pace with the evolving needs and challenges in modern educational contexts, as shown in Figure 2.

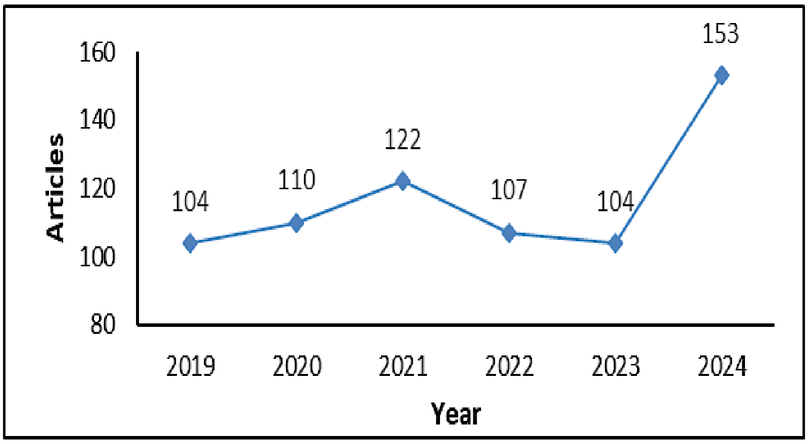

Figure 2: Annual Scientific Production (2019 - 2024)

Authors' Local Impact (H-Index)

Table 4 shows the impact that authors have had on related research. Authors' Local Impact (H-Index) analysis shows that, Bogner Fx is the author with the highest local impact based on the H-Index indicator. Bibliometric analysis of Bogner Fx shows metrics that explain his academic contributions since 2019. An h-index value of 5 indicates that there are at least 5 publications that have each been cited at least 5 times, reflecting significant research impact albeit on a limited scale.

Table 4: Top 10 Authors' Local Impact Based On H-Index

Rank	Author	H-index	g_index	m_index	TC	NP	PY_start
1	Bogner Fx	5	6	0.714	169	6	2019
2	Scheiter K	5	5	1.25	90	5	2022
3	Aksela M	4	4	0.571	153	4	2019
4	Blonder R	4	4	0.571	87	4	2019
5	García-Carmona A	4	5	0.571	75	5	2019
6	Liu C	4	5	0.571	127	5	2019
7	Bartels S	3	4	0.429	85	4	2019
8	Chen J	3	3	0.5	35	3	2020
9	Cirkony C	3	3	0.5	15	4	2020
10	Emden M	3	4	0.429	34	4	2019

Note: TC (Total Citations), NP (Number of Publications), and PY (Publication Year Start)

Additionally, a g-index of 6 indicates that the cumulative number of citations of the top 6 publications is greater than the sum of the squared publications, indicating a high concentration of citations on a few works. The m-index value of 0.714 shows an average increase in h-index per year since its first publication, indicating consistency in research contribution. The total citations (TC) of 169 explain that Bogner Fx's research is recognized by the academic community so that it is widely cited by other researchers. The number of publications (NP) of 6 indicates that Bogner Fx has produced a total of 6 scientific papers since 2019. This relatively limited number reflects that the research focus has relevance to inquiry strategies in science education, allowing for more in-depth exploration and significant contributions. This data reflects the productivity and relevance of Bogner Fx's work in supporting research developments since 2019.

Bibliometric analysis of Scheiter K shows that his academic productivity began in 2022 with h-index and g-index values of 5 each, reflecting consistency in the number of high-impact publications and cumulative citations of the top five publications. The m-index value of 1.25 indicates relatively rapid growth of the h-index each year compared to Bogner Fx, who has a lower m-index value of 0.714, despite starting publication in 2019. With a total of 90 citations (TC) and 5 publications (NP), Scheiter K has made significant contributions within a relatively short period. This indicates an accelerated impact in terms of both index and quality. In contrast, Bogner Fx demonstrates long-term consistency in academic contributions.

What is interesting from Table 4 is the Bibliometric analysis of Liu C, which shows his academic contribution with h-index 4 and g-index 5 since 2019. This shows a significant impact from his 5 publications with a total of 127 citations (TC). The m-index value of 0.571 shows slower growth than Bogner Fx with an m-index of 0.714, and much lower than Scheiter K with an m-index of 1.25. Based on Table 4, Liu C has a relatively high number of citations at 127, which explains that Liu C's research is recognized by the academic community so that it is often cited by other researchers.

Leading Institutions

As shown in Table 5, the Most Relevant Affiliation analysis indicates that Beijing Normal University ranks first in contributing to research on inquiry-based science learning, with a total of 25 published articles. This number of publications reflects the university's significant role in producing relevant and impactful research in the field of science education. This top position confirms the institution's commitment to developing educational innovation and supporting inquiry-based scientific studies. Beijing Normal University's dominance in the number of articles also demonstrates its strong academic and research capacity, while strengthening its position as one of the global centers of excellence in research-based science education. This contribution has a major impact on the development of inquiry learning strategies at the international level. Therefore, Beijing Normal University can be used as an institution that deserves to be used as a reference and partner in further research development.

Table 5: Most Relevant Affiliations

Rank	Affiliation	Articles
1	Beijing Normal University	25
2	National Taiwan Normal University	23
3	The University of Auckland	20
4	Universidad De Sevilla	19
5	University Of Helsinki	17

Figure 3 shows an increase in the number of publications from universities researching the field of inquiry learning in science education from 2019 to 2024. Based on the Most Relevant Affiliations analysis, Beijing Normal University ranked first in academic contributions with a consistent increase in the number of articles from 2019 to 2024. In 2019, the university produced 5 articles, and there was a slight increase to 6 articles in 2020. This shows a steady initial growth. Significant increases occurred in subsequent years, with 10 articles published in 2021 and 17 articles in 2022. The number of publications continued to grow until it reached 20 articles in 2023 and peaked in 2024 with 25 articles. This upward trend demonstrates Beijing Normal University's role in supporting the development of scientific literature, especially in the field of science education, while also showing its capacity as an institution that actively contributes to the development of inquiry-based research at the global level.

In addition to Beijing Normal University, there are also contributions from several institutions that show mixed trends in the number of articles produced from 2019 to 2024. National Taiwan Normal University showed steady growth, starting with 1 article in 2019, then increasing sharply to 10 articles in 2020, reaching 16 articles in 2021, and remaining consistent with 18 articles in 2022 and 2023, until finally reaching 23 articles in 2024. Universidad de Sevilla also showed a steady trend, starting with 3 articles in 2019, increasing to 8 articles in 2020, and peaking in 2024 with a total of 19 articles. The University of Helsinki's contribution follows a gradual pattern, from 7 articles in 2019 to reach 17 articles in 2024. The University of Auckland showed a unique pattern with no contributions from 2019 to 2023 but suddenly produced 20 articles in 2024. This phenomenon reflects a significant surge in academic activity over the past year, highlighting the institution's growing commitment to advancing research, particularly in inquiry-based strategies within science education. A visual explanation of this can be seen in Figure 3 (Affiliations' Production Over Time).

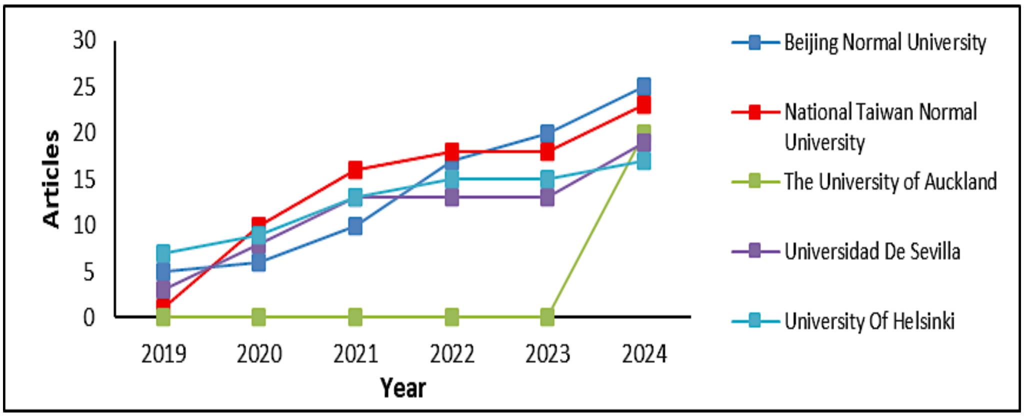

Figure 3: Affiliations' Production Over Time

Scientific Production by Most Cited Countries

The Most Cited Countries analysis in Table 6 shows that the United States (USA) has a total of 1,721 citations, with an average citation per article of 11.50. This high number of citations reflects the influence and quality of research conducted by researchers in the USA, as well as indicating a broad level of acceptance and recognition of their contributions within the international academic community. The significant citation average indicates that research originating from the USA is often used as a primary reference in scientific literature, reinforcing the country's position as a leader in global scientific development. This data also demonstrates the important role the USA plays in fostering innovation and supporting high-impact scientific discussions in various research areas, including inquiry learning strategies in science education.

Table 6 shows that Hong Kong, despite having a lower number of citations at 175, has the highest average article citations among all countries at 21.90. Although the number of articles published by researchers from Hong Kong is less than other countries, the average citations per article from Hong Kong is the highest, at 21.90. This reflects that each article produced is of very high quality, resulting in more referrals and recognition by the global scientific community. As such, research from Hong Kong has a greater impact on a per-article basis than publications from other countries, giving it an edge in scientific effectiveness and influence on an international level. The combination of in-depth research quality and high relevance reinforces Hong Kong's position as an important contributor to academic literature. Countries such as Germany, China, Australia and Spain each contributed significantly to the development of related literature. Other countries such as Finland, Hong Kong, the United Kingdom, Turkey, and Ireland also made the top 10 list, reflecting the wide geographical distribution of scholarly influence. The contributions of these countries demonstrate the diversity in research perspectives, while opening up opportunities for closer international collaboration to support the development of research on inquiry strategies in science education.

Table 6: Most Cited Countries

Country	TC	Average Article Citations
USA	1721	11.50
Germany	661	16.10
China	298	7.40
Australia	269	8.40
Spain	263	6.40
Finland	196	17.80
Hong Kong	175	21.90
United Kingdom	168	14.00
Turkey	132	6.90
Ireland	91	11.40

Table 7: Country Production Over Time

Country	Articles on Year					
	2019	2020	2021	2022	2023	2024
Australia	19	34	52	67	81	95
China	22	41	72	97	110	165
Germany	20	54	69	88	124	145
Spain	15	39	66	112	133	189
USA	117	205	343	420	503	607

The production of articles on inquiry learning in education from the top 5 countries can be seen in Table 7.

An analysis of article production across different countries shows a significant upward trend in scientific publications related to inquiry-based learning in science education. Spain is one of the largest contributors, with the number of articles increasing sharply from 15 in 2019 to 189 in 2024. This increase shows consistent attention to the development of inquiry-based learning strategies in the country. China also shows a positive trend, with the number of articles growing from 22 in 2019 to 165 in 2024, reflecting a commitment to advancing research in science education. Germany has a steady growth pattern, with the number of articles increasing from 20 in 2019 to 145 in 2024. This data shows that these countries continue to contribute significantly to scientific literature in science education.

Australia, despite having a smaller number than Spain, China and Germany, still shows a consistent increase from 19 articles in 2019 to reach 95 articles in 2024. This reflects substantial academic engagement in supporting the development of literature related to inquiry strategies in science learning. Overall, the year-on-year increase in article production in these countries suggests that research in inquiry-based learning is a major focus that continues to receive academic attention. This development provides a strong basis for international collaboration and further development in the field of research-based science education, as illustrated in Figure 4.

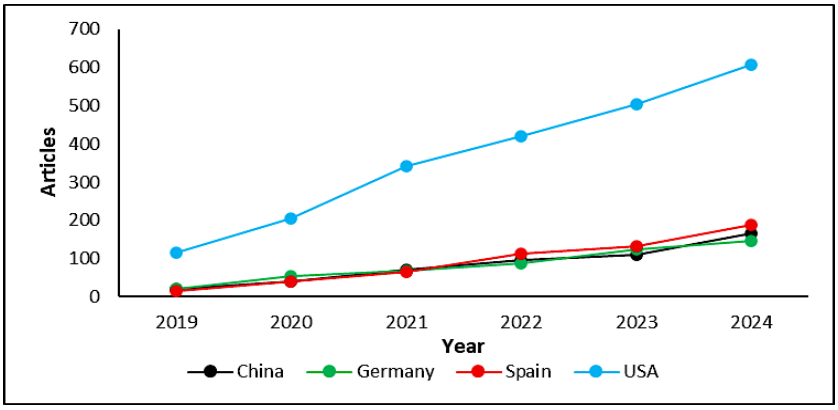

Figure 4: Country Production over Time

Corresponding Author's Countries

In bibliometric analysis using Biblioshiny, two key indicators are employed to describe collaboration patterns: SCP (Single Country Publications), which refers to publications authored entirely by researchers from the same country and reflects domestic collaboration, and MCP (Multiple Country Publications), which refers to publications involving authors from different countries and indicates international collaboration. The top 5 Corresponding Author's Countries of articles on inquiry learning in education can be seen in. Table 8.

Table 8: Corresponding Author's Countries

Country	Articles	Articles %	SCP	MCP	MCP %
USA	150	21.4	136	14	9.3
Germany	41	5.9	29	12	29.3
Spain	41	5.9	35	6	14.6
China	40	5.7	28	12	30
Australia	32	4.6	26	6	18.8

Based on the results, the five countries with the highest number of publications from corresponding authors are the United States, Germany, Spain, China, and Australia. The United States demonstrates a strong dominance in domestic research activity with relatively limited international engagement. In contrast, Germany and China present a more balanced pattern between national and international collaboration, suggesting greater openness to cross-border partnerships. Spain and Australia, meanwhile, emphasize domestic collaboration with comparatively modest international involvement. Although the United States leads in publication volume, European and Asian countries demonstrate greater openness to international collaboration, thereby strengthening the global landscape of inquiry-based science education research.

Local Impact Article

Based on Table 9, the most cited document is entitled Guidance in Inquiry-Based Instruction – An Attempt to Disentangle a Manifold Construct, authored by Vorholzer and published in 2019. The documents analyzed are part of the 700 documents retrieved in the Scopus database. The purpose of this analysis was to show significant contributions in scientific literature related to inquiry-based education. This document has 13 local citations (LC) within the scope of 700 documents retrieved from Scopus, and 51 global citations (GC), which includes citations outside the 700 documents, such as from Web of Science (WoS) and other sources. The LC/GC ratio was 25.49%. This data shows that despite its global impact, the document received stronger attention at the local level compared to its global citations. The Normalized Local Citations value of 20.48 reflects significant influence in the local context, while the Normalized Global Citations of 3.70 indicate that the document remains relevant and widely appreciated in international literature. This data confirms that the research is not only relevant to the local community but also makes a significant contribution to global academic discussions, thus strengthening the position of this document in supporting the development of inquiry-based education.

A document entitled Coming to terms: Addressing the persistence of "hands-on" and other reform terminology in the era of science as practice by Furtak Em, was also published in 2019. The document authored by Furtak Em recorded 7 local citations and a much higher global citation of 113, with an LC/GC ratio of 6.19%, indicating that the impact is more extensive at the global level than local. The Normalized Local Citations of 11.03 and Normalized Global Citations of 8.19 reflect a consistently higher global contribution in international literature. This comparison confirms that Vorholzer's paper is more widely recognized in the local community, whereas Furtak Em's paper dominates on a global scale, exerting a distinct influence on academic discussions regarding inquiry-based science education

Table 9: Most Local Cited Documents

Title	doi	Year	Local Citations	Global Citations	LC/GC Ratio (%)	Normalized Local Citations	Normalized Global Citations
Guidance in inquiry-based instruction - an attempt to disentangle a manifold construct (18)	10.1080/09500693.2019.1616124	2019	13	51	25.49	20.48	3.70
Coming to terms: Addressing the persistence of "hands-on" and other reform terminology in the era of science as practice (19)	10.1002/sce.21488	2019	7	113	6.19	11.03	8.19
An international collaborative investigation of beginning seventh grade students' understandings of scientific inquiry: Establishing a baseline (20)	10.1002/tea.21512	2019	6	52	11.54	9.45	3.77
Inquiry as a context-based practice - a case study of pre-service teachers' beliefs and implementation of inquiry in context-based science teaching (21)	10.1080/09500693.2019.1655679	2019	5	19	26.32	7.88	1.38
Views About Scientific Inquiry: A Study of Students' Understanding of Scientific Inquiry in Grade 7 and 12 in Sweden (22)	10.1080/00313831.2020.1869080	2021	4	22	18.18	19.45	3.11
Comparative Learning Performance and Mental Involvement in Collaborative Inquiry Learning: Three Modalities of Using Virtual Lever Manipulative (23)	10.1007/s10956-020-09838-4	2020	4	12	33.33	12.57	0.77
Student-question-based inquiry in science education (24)	10.1080/03057267.2019.1658059	2019	4	41	9.76	6.30	2.97

Project-based learning in integrated science education: Active teachers' perceptions and practices (25)	10.31129/LUMAT.9.1.1392	2021	3	30	10.00	13.56	3.14
Supporting middle school students' science talk: A comparison of physical and virtual labs (26)	10.1002/tea.21664	2021	3	33	9.09	13.56	3.46
International collaborative follow-up investigation of graduating high school students' understandings of the nature of scientific inquiry: is progress being made? (27)	10.1080/09500693.2021.1894500	2021	3	23	13.04	13.56	2.41

Trend and Theme Research

Based on Table 10, the word "inquiry-based instruction" appears 56 times throughout 2020 to 2023, the word "inquiry" 53 times throughout 2020 to 2023 and the word "scientific inquiry" 41 times throughout 2020 to 2023. This indicates that the inquiry-based approach has become a central focus in science education research, particularly in enhancing critical thinking skills and deepening the understanding of scientific concepts. This is also supported by the results of research that explains there is a strong correlation between critical thinking skills and science literacy (28).

Table 10 also shows that the words "computer science education" and "computational thinking" are at the top where the frequency of the word computer science education appears 11 times from 2020-2024, and the word computational thinking appears 13 times from 2021-2024. Based on the research results, it was found that Inquiry-Based Learning (IBL) has become a major cornerstone in modern science education, supported by frameworks such as the Next Generation Science Standards (NGSS) (29). Next Generation Science Standards (NGSS) are science education standards developed to improve students' understanding of scientific concepts through inquiry-based and exploratory approaches. Although NGSS focuses on science education in general, in its development there is NGSS support in the use of technology in Science learning such as STEM (Science, Technology, Engineering, and Mathematics) (30). With the support of NGSS in the use of technology in science learning, this explains the frequent appearance of words such as computational thinking and computer science education in research on inquiry strategies in science learning.

Table 10: Most Frequent Words

Term	Frequency	Year (Q1)	Year (Median)	Year (Q3)
Computational Thinking	13	2021	2023	2024
Computer Science Education	11	2020	2023	2024
Science Process Skills	8	2022	2024	2024
Ecology	6	2022	2024	2024
Mathematics Education	6	2022	2024	2024
Inquiry-based Instruction	7	2019	2019	2023
Creativity	10	2020	2020	2023
Inquiry-based Learning	56	2020	2021	2023
Inquiry	53	2020	2021	2023
Scientific Inquiry	41	2020	2021	2023
Science Education	223	2020	2022	2023
Professional Development	28	2020	2022	2023
Teacher Education	27	2021	2022	2023
Elementary Education	9	2021	2023	2023
Stem Education	12	2020	2020	2022
Curriculum	8	2019	2020	2022
Chemical Education Research	5	2019	2019	2019

Based on Figure 5, there are several terms related to research on science learning with inquiry strategies such as scientific inquiry, inquiry, and inquiry-based learning where this research started in 2019 and stopped in 2023. The next development is the emergence of the word science process skills 8 times starting from 2022 to 2024. Science process skills are the basis for critical thinking and inquiry in science education. This explains that research on inquiry strategies in science learning is a topic that is still developing to be researched.

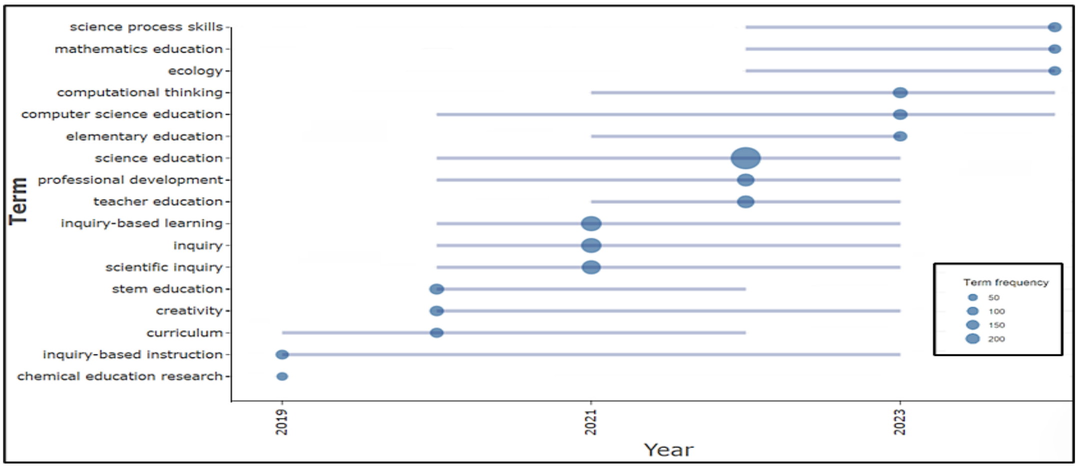

Figure 5: Trend Topics

Through the Authors' Word Cloud analysis in Figure 6, the term "Science Education" has the largest font size, reflecting its dominant frequency of occurrence in the literature on inquiry strategies in science learning. This term reflects the primary focus on science education as the foundation of theory and practice. "Inquiry-based Learning" is the second largest font size, indicating significant attention to inquiry-based learning strategies. The terms "Inquiry" and "Scientific Inquiry" at a large font size reflect the focus on the process of scientific investigation as the core of inquiry-based learning. Finally, the term "Inquiry-based Science Education" has the smallest font size, signaling a more specific appearance in the literature, which is also relevant in the context of inquiry-based science education. This pattern illustrates the hierarchy of attention and influence in research articles with inquiry strategies being an important topic in scientific discussions related to science learning.

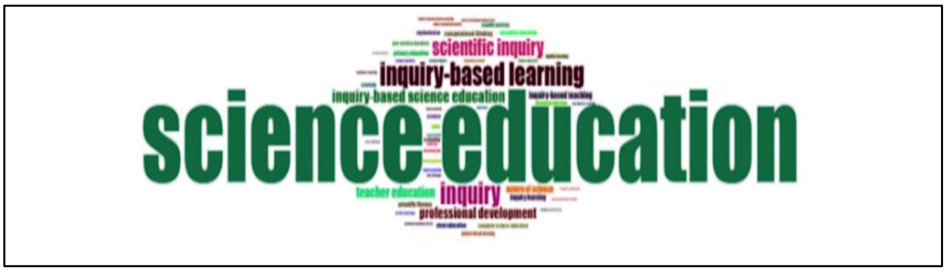

Figure 6: Word Cloud

Thematic Map

The thematic map provides a comprehensive overview of the trends and development of research topics and publications. This can be seen in Figure 7, which illustrates the evolution of study themes categorized into four groups. Thematic maps are one of the tools used to map research areas based on keywords and related themes.

In this case, based on the analysis using Program R, the results show that "inquiry-based science education" is in the Upper Right (Motor Themes) where the themes in this quadrant have high centrality and density. This means that the theme of "inquiry-based science education" is considered established and relevant and can be the center of attention in research. This shows that this research is still evolving and is relevant to be a research topic. This can be seen in Figure 7.

To understand the evolution of research themes, Figure 8 illustrates the co-occurrence network generated in VOSViewer. In this network, nodes represent keywords or research topics, with larger nodes indicating higher frequency of occurrence in the dataset. Edges connect nodes and depict co-occurrence relationships between keywords; thicker edges signify stronger associations. Clusters are distinguished by different colors, grouping keywords according to thematic linkages. As shown in Figure 8, scientific inquiry appears as a small node that remains unconnected to other clusters, indicating that this theme still offers considerable potential for further investigation.

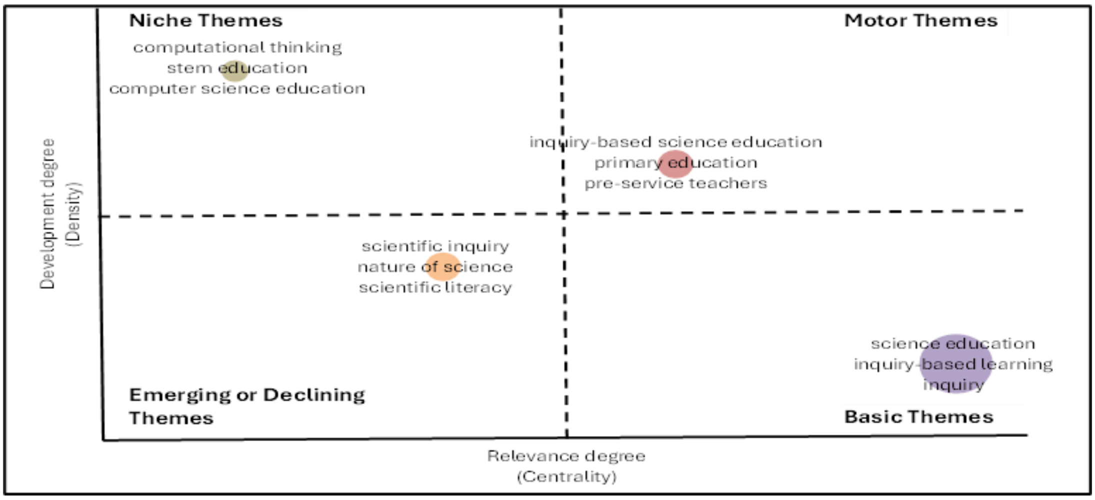

Figure 7: Thematic Map

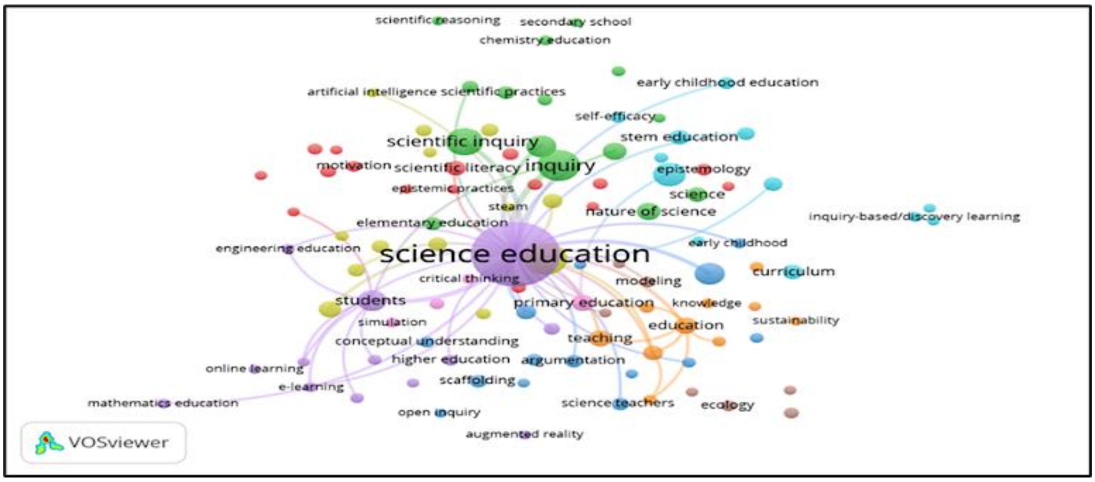

Figure 8: Co-occurrence Network

Thematic Evolution

In 2019-2022 there was a change in Author's Keyword where the keyword "inquiry" expanded to include "science education", "nature of science" and still includes "inquiry" in 2023-2024. In addition, the keyword "Science Education" in 2019-2022 expand to "science literacy", "science education", "inquiry-based learning" and "computer science education" in 2023-2024. This illustrates the effort to integrate science literacy and technology-based approaches. In 2019-2022 there was also a change in the keyword "scientific inquiry" which shifted to "scientific literacy", "science education" and "nature of science" in 2023-2024. This shows attention to scientific literacy and a fundamental understanding of the nature of science. The change in keywords from 'scientific inquiry' to 'scientific literacy', 'science education' and 'nature of science' in 2023-2024 reflect the shift in research focus towards a broader and deeper approach in science education. This shows increasing attention to the development of scientific literacy as an important ability to understand and apply science concepts in everyday contexts. This shift encourages science education to be more relevant and can strengthen critical thinking skills and reflection in inquiry-based learning. It is hoped that this shift will provide a basis for greater innovation in science education, as seen in Figure 9.

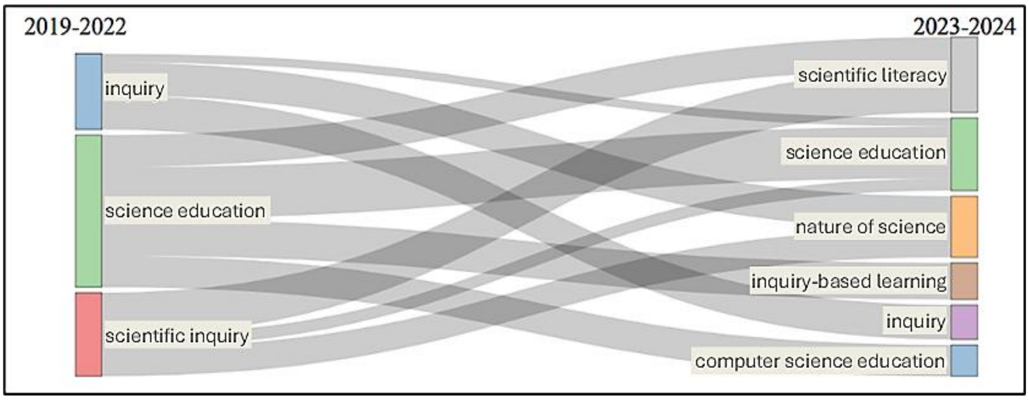

Figure 9: Thematic Evolution

Discussion

Inquiry-based learning is fundamentally grounded in constructivist theory, which emphasizes that learners build knowledge through direct experiences and social interactions (31). This model encourages students to actively engage in problem-solving and critical thinking, shifting the learning process from passive information reception to active knowledge construction through exploration. Consistent with constructivist principles, the implementation of inquiry-based learning has been shown to enhance student engagement and improve learning outcomes, as it fosters reflective and meaningful experiences (31, 32). The current integration of technology into Inquiry-Based Learning (IBL) signifies a profound paradigm shift in education, characterized by the incorporation of digital tools and methodologies that enrich learning experiences, making them more interactive and student-centered. This transformation not only facilitates the construction of knowledge but also aligns with contemporary educational imperatives by fostering critical thinking and problem-solving skills. Empirical evidence demonstrates this evolution, such as the integration of games, gamification, and artificial intelligence (AI) in Grade 12 Life Sciences classrooms in South Africa to address learners' cognitive needs (33). Similarly, blended learning, which strategically combines traditional and digital pedagogies, offers a flexible environment that accommodates diverse student needs and is supported by theoretical frameworks such as the Community of Inquiry model, thereby enhancing educational outcomes (34). Collectively, these developments underscore the evolution of IBL into a more relevant, adaptive, and transformative approach capable of addressing the challenges of contemporary education.

Inquiry-Based Science Education (IBSE) has been shown to significantly enhance students' critical thinking and problem-solving abilities, with medium to large effect sizes across various educational levels, ranging from primary to tertiary education (35). This finding is further supported by a meta-analysis reporting an average effect size of 0.69, which indicates a moderate impact on student learning outcomes (36). Such evidence highlights the robustness of IBSE in fostering essential cognitive skills that are crucial for academic success. Moreover, the consistency of these results across diverse educational contexts underscores the broad applicability of this pedagogical approach. Collectively, these findings affirm IBSE as an effective and sustainable model for advancing students' higher-order thinking skills.

The results of bibliometric research analysis on publications related to inquiry-based learning indicate a rising trend in the number of articles discussing this strategy in science education from 2019 to 2024. The bibliometric analysis of inquiry learning in science education from 2019 to 2024 demonstrates a consistent rise in publications, with the International Journal of Science Education emerging as the leading outlet through 42 articles that underscore its central role in advancing research in this area (37, 38). The contributions of individual scholars are also evident, particularly Bogner Fx, who records the highest local impact based on the h-index (38), while the United States stands out as a major contributor with 1,721 citations and an average of 11.50 citations per article, reflecting both the quality and influence of its research output. These findings indicate that the landscape of inquiry learning research is expanding rapidly, supported by influential journals and key researchers, that provide new opportunities to strengthen inquiry-based practices in science education worldwide.

The increase in publications on Inquiry-Based Learning (IBL) reflects a growing recognition of its pivotal role in science education, particularly in fostering critical thinking, creativity, and problem-solving skills (39, 40). This trend reflects the global agenda on 21st-century competencies, underscores the effectiveness of inquiry-based learning (IBL) across diverse contexts, and highlights its synergy with active learning strategies, framing the rise in IBL publications as a call to adapt science education to contemporary demands.

The United States holds a dominant position in science education research, particularly in STEM, with substantial contributions from its institutions and scholars. This prominence is evidenced by the high volume of publications, reputable journals, and influential international conferences (41). A distinctive hallmark is the integration of inquiry-based learning, which functions as a fundamental dimension of the scientific process by fostering critical thinking and problem-solving. Aligned with global objectives such as SDG 4, and reinforced by the evolution toward holistic STEM/STEAM frameworks, inquiry-based learning connects scientific concepts to real-world contexts while promoting interdisciplinary innovation (42).

Bibliometric analyses indicate a substantial shift in science education research, with traditional concepts such as scientific inquiry increasingly replaced by contemporary themes including scientific literacy, science education, and the nature of science. Scientific literacy is now considered essential for preparing students to make informed personal and societal decisions, with explicit instruction on the nature of science recognized as a critical means of strengthening this literacy (43). In parallel, the nature of science has emerged as a significant area of inquiry, with studies mapping its influence on pedagogical practices and curriculum integration, although scholarly engagement in this domain remains somewhat inconsistent (44). Collectively, these trends underscore a new trajectory in science education that emphasizes social relevance, the integration of NOS, and the strengthening of scientific literacy as foundational elements of curriculum development.

The network analysis of inquiry-based science learning reveals persistent global inequalities, particularly affecting peripheral or underrepresented regions through citation bias, limited publication output, and restricted collaboration opportunities. Bibliometric evidence highlights the dominance of countries with strong academic infrastructures, such as the United States, Germany, and China, whose extensive collaborations often overshadow contributions from less connected regions. Scholars from peripheral areas remain consistently undercited, reinforcing systemic biases and cycles of exclusion (45). Addressing these disparities requires removing financial barriers, implementing structural reforms, and adopting inclusive practices. Initiatives such as discounted open-access fees, transformative agreements, and local capacity-building programs provide pathways toward a more equitable publishing ecosystem (46).

The exploration of Inquiry-Based Learning (IBL) in the context of emerging economies remains relatively under-researched, despite its considerable potential to transform educational practices in these regions. Most studies on IBL and technology-enhanced learning are concentrated in developed countries, leaving the challenges and opportunities of emerging economies insufficiently addressed. The successful implementation of IBL in such contexts requires a deep understanding of local conditions, including language, cultural norms, and educational infrastructure (47). Unfortunately, existing research often neglects these contextual dimensions, which are crucial for designing effective IBL interventions. Therefore, this research gap presents an opportunity to develop IBL strategies that are more adaptive to the socio-economic and cultural realities of emerging economies.

The discussion of collaboration patterns in inquiry-based science education research underscores diverse national strategies that reflect both priorities and varying degrees of openness to international partnerships. The United States occupies the leading position in terms of publication volume; however, its relatively limited international engagement reinforces a strong emphasis on domestic research agendas. In contrast, Germany and China exhibit a balance between national and international collaboration, signaling strategic openness to cross-border partnerships and strengthening the global landscape of inquiry-based science education research. International collaboration patterns reveal differences in national strategies: while the United States tends to prioritize domestic partnerships, Indonesia, China, and India emerge as more globally integrated actors. Regional collaborations across Europe, Asia, and the Americas further highlight the importance of shared language and cultural proximity in shaping research networks (48).

Bibliometric analysis also indicates steady growth in collaborative research across disciplines, with interdisciplinary approaches and international partnerships enhancing research outputs and innovation. Overall, these patterns affirm the significance of balanced collaboration strategies that integrate domestic strengths with international opportunities, thereby expanding research agendas and fostering sustainable innovation in inquiry-based science education.

The ability of science teachers to implement inquiry-based learning (IBL) is essential for strengthening the quality of science education, which underscores the need for systematic professional development. Critical reflection on teaching experiences reveals that, without structured training, teachers often remain confined to traditional lecture-based methods that limit students' scientific exploration. Collaborative professional development programs, including workshops and seminars, can introduce diverse IBL strategies that foster investigation, open discussion, and pedagogical innovation (49). Such initiatives not only empower teachers but also enrich curricula and create more dynamic learning environments. Consequently, restructuring professional development around IBL emerges as a key pathway to sustaining improvements in science education.

Conclusion

This study provides a comprehensive overview of the development of inquiry-based learning (IBL) in science education through bibliometric analysis. Findings from the period 2019–2024 reveal a significant increase in the number of publications, reflecting global recognition of IBL's role in fostering 21st-century skills such as critical thinking, creativity, and problem-solving. The United States occupies a dominant position in science education research, particularly in STEM fields, while developing regions remain underrepresented, highlighting global disparities in knowledge production. The main contribution of this study lies in mapping the evolution of research themes, shifting from traditional approaches such as scientific inquiry toward contemporary issues including scientific literacy, the nature of science, and the integration of digital technologies. This transition signals a paradigm shift in science education, with gamification, educational games, and artificial intelligence emerging as innovations that expand the scope and effectiveness of IBL. The practical implications of these findings underscore the importance of strengthening teacher capacity through collaborative professional development programs to ensure more contextualized implementation of IBL. Nevertheless, this study has limitations, particularly regarding geographical bias and the dominance of publications from certain countries. Future research should therefore emphasize technology-driven pedagogical innovations, expand cross-national collaboration, and integrate local contexts into the design of educational interventions. In alignment with global goals such as SDG 4 and the holistic STEM/STEAM framework, IBL is increasingly positioned as a sustainable strategy to enhance the quality of science education worldwide, while connecting scientific concepts to real-world contexts.

Abbreviations

CSV: Comma- Separated Values, GC: Global Citations, IBL: Inquiry-Based Learning, LC: Local Citations, MCP: Multi-Country Publication, NGSS: Next Generation Science Standards, NP: Number of Publications, PY: Publication Year Start, STEM:

Science, Technology, Engineering, and Mathema-ti-cs, TC: Total Citations.

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Author Contributions

Kurniawati Martha: conceptualization, methodo-logy, investigation, data collection, software management, data curation, project administration, resource coordination, drafting the original manuscript, preparing visualizations, validation, editing, Anik Ghufron: conceptualiza-tion, supervision, formal analysis, supported validation, manuscript review, reviewing the manuscript, Insih Wilujeng: supervision throughout the research process, validation of results, critical review of the manuscript, Sugito: supervision, validation of methodology and findings, manuscript review, Tanti Listiani: supervision of the study, validation of analysis and interpretation, refinement of the manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest.

Data Availability

The data used in this study were obtained from Scopus, a subscription-based bibliographic database. Access to the data is subject to licensing agreements and is not publicly available. Researchers interested in the dataset may refer to Scopus through institutional access.

Declaration of Artificial Intelligence (AI) Assistance

The authors declare that the generative artificial intelligence (Al) tool was used exclusively for language editing and/or grammatical improve-ment. The use of Al did not influence the scientific content, study design, data analysis, data interpretation, results, or conclusions of the manuscript. Full responsibility for the content remains with the authors.

Ethics Approval

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References

1. Wulandari A, Sukarno S, Matsuri M. A bibliometric analysis of inquiry learning in primary education. J Educ Learn. 2025;19(1):340–9. https://doi.org/10.11591/edulearn.v19i1.21245
2. Qablan A, Alkaabi A, Aljanabi MH, Almaamari SA. Inquiry-Based Learning : Encouraging Exploration and Curiosity in the Classroom. IGI Global. 2024. 1–12 p. https://doi.org/10.4018/979-8-3693-0880-6.ch001
3. Hmelo-Silver CE, Duncan RG, Chinn CA. Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller, and Clark (2006). Educ Psychol. 2007;42(2):99–107. https://doi.org/10.1080/00461520701263368
4. National Research Council. A framework for K-12 science education: Practices, crosscutting concepts, and core ideas. The National Academies Press. Washington, D.C.: The National Academies Press; 2012. 1–385 p. https://doi.org/10.17226/13165
5. Furtak EM, Penuel WR. Coming to terms: Addressing the persistence of “hands-on” and other reform terminology in the era of science as practice. Sci Educ. 2018;103(1):167–86. https://doi.org/10.1002/sce.21488
6. Corrigan D. Navigating the Changing Landscape of Formal and Informal Science Learning Opportunities. Springer International Publishing; 2018. https://doi.org/10.1007/978-3-319-89761-5
7. Hermansyah H, Gunawan G, Harjono A, Adawiyah R. Guided inquiry model with virtual labs to improve students’ understanding on heat concept. J Phys Conf Ser. 2019;1153. https://doi.org/10.1088/1742-6596/1153/1/012116
8. Guerra RM de A, Chiappin MA, Bertoni RB, Olea PM, Dorion ECH. Overview Of International Publications On The Innovation Process: A Bibliometric Study. Indep J Manag Prod. 2015;6(1):64–82. http://dx.doi.org/10.14807/ijmp.v6i1.197
9. Donthu N, Kumar S, Mukherjee D, Pandey N, Lim WM. How to conduct a How to conduct a bibliometric analysis: An overview and guidelines. J Bus Res. 2021;133:285–96. https://doi.org/10.1016/j.jbusres.2021.04.070
10. Kerans G, Sanjaya Y, Liliasari L. Authentic Inquiry in Science Education Between 2003 and 2023 : A Bibliometric Analysis Use RStudio. KnE Soc Sci. 2024;9(19):91–101.

https://doi.org/10.18502/kss.v9i19.16481
11. Passas I. Bibliometric Analysis : The Main Steps. Encylopedia. 2024;4(2):1014–25. https://doi.org/10.3390/encyclopedia4020065
12. İRİ R, ÜNAL E. Bibliometric Analysis Bibliometric Analysis of Research (1980-2023). Ahi Evran Üniversitesi Sos Bilim Enstitüsü Derg. 2024;10(2):386–401. https://doi.org/10.31592/aeusbed.1446738
13. Zupic I, Čater T. Bibliometric Methods in Management and Organization. Organ Res Methods. 2015;18(3):429–72. https://doi.org/10.1177/1094428114562629
14. Baas J, Schotten M, Plume A, Côté G, Karimi R. Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies. Quant Sci Stud. 2020;1(1):1–10. https://doi.org/10.1162/qss_a_00019
15. Aria M, Cuccurullo C. bibliometrix: An R-tool for comprehensive science mapping analysis. J Informetr. 2017;11(4):959–75. https://doi.org/10.1016/j.joi.2017.08.007
16. Kurniawan B, Meyliana M, Warnars HLHS, Suharjo B, Ahiase G. Bibliometric Analysis using Vos Viewer with Publish or Perish of Intelligent Tutoring System in Private Universities. Int J Informatics, Inf Syst Comput Eng. 2024;5(2):166–77. https://doi.org/10.34010/injiiscom.v5i2.12732
17. Bhat WA, Khan NL, Manzoor A, Dada ZA, Qureshi. How to Conduct Bibliometric Analysis Using R-Studio : A Practical Guide. Eur Econ Lett. 2023;13(3):681–700. https://doi.org/10.52783/eel.v13i3.350
18. Vorholzer A, Aufschnaiter C von. Guidance in inquiry-based instruction-an attempt to disentangle a manifold construct. Int J Sci Educ. 2019;41(11):1562–77. https://doi.org/10.1080/09500693.2019.1616124
19. Furtak EM, Penuel WR. Coming to terms: Addressing the persistence of "hands-on" and other reform terminology in the era of science as practice. Sci Educ. 2019;103(1):167–86. https://doi.org/10.1002/sce.21488
20. Lederman J, Lederman N, Bartels S, Jimenez J, Akubo M. An international collaborative investigation of beginning seventh grade students' understandings of scientific inquiry: Establishing a baseline. J Res Sci Teach. 2019;56(4):486–515. https://doi.org/10.1002/tea.21512
21. Herranen J, Kousa P, Fooladi E, Aksela M. Inquiry as a context-based practice – a case study of pre-service teachers' beliefs and implementation of inquiry in context-based science teaching. Int J Sci Educ. 2019;41(14):1977–1998. https://doi.org/10.1080/09500693.2019.1655679
22. Gyllenpalma J, Rundgren CJ. Views About Scientific Inquiry: A Study of Students' Understanding of Scientific Inquiry in Grade 7 and 12 in Sweden. Scand J Educ Res. 2021;66(2):336–54. https://doi.org/10.1080/00313831.2020.1869080
23. Wang C, Ma Y, Wu F. Comparative Learning Performance and Mental Involvement in Collaborative Inquiry Learning: Three Modalities of Using Virtual Lever Manipulative. J Sci Educ Technol. 2020;29:587–96. https://doi.org/10.1007/s10956-020-09838-4
24. Herranen J, Aksela M. Student-question-based inquiry in science education. Stud Sci Educ. 2019;55(1):1–36. https://doi.org/10.1080/03057267.2019.1658059
25. Haatainen O, Aksela M. Project-based learning in integrated science education: Active teachers' perceptions and practices. LUMAT Int J Math, Sci Technol Educ. 2021;9(1):149–73. https://doi.org/10.31129/LUMAT.9.1.1392
26. Puntambekar S, Gnesdilow D, Tissenbaum CD, Narayanan NH. Supporting middle school students' science talk: A comparison of physical and virtual labs. J Res Sci Teach. 2021;58(3):392–419. https://doi.org/10.1002/tea.21664
27. Lederman J., Lederman N., Bartels S, Jimenez J, Acosta K, Akubo M. International collaborative follow-up investigation of graduating high school students' understandings of the nature of scientific inquiry: is progress Being made? Int J Sci Educ. 2021;43(7):991–1016. https://doi.org/10.1080/09500693.2021.1894500
28. Morris DL. Rethinking Science Education Practices : Shifting from Investigation- Centric to Comprehensive Inquiry-Based Instruction. 2025;15(1):73. https://doi.org/10.3390/educsci15010073
29. Jacob S, Nguyen H, Garcia L, Richardson D, Warschauer M. Teaching Computational Thinking to Multilingual Students through Inquiry-based Learning. 2020 Res Equity Sustain Particip Eng Comput Technol. 2020;1:1–8. https://doi.org/10.1109/RESPECT49803.2020.9272487
30. Foley BJ, Reveles JM. Pedagogy for the Connected Science Classroom: Computer Supported Collaborative Science and the Next Generation Science Standards. Contemp Issues Technol Teach Educ. 2014;14(4):401–18. https://citejournal.org/volume-14/issue-4-14/science/pedagogy-for-the-connected-science-classroom-computer-supported-collaborative-science-and-the-next-generation-science-standards
31. Adaylarının A. Student Teachers ' Experiences of Constructivism in a Theoretical Course Built on Inquiry-based Learning. J Qual Res Educ - JOQRE. 2020;8(1):136–55. https://doi.org/10.14689/issn.2148-2624.1.8c.1s.7m
32. Anugrah A, Anggraeni L, Syaifullah S. Inquiry-Based Learning and Its Impact on Critical Thinking : An Empirical Analysis. Eurasia Proc Educ Soc Sci. 2025;42:70–80. https://doi.org/10.55549/epess.912
33. Naiye OD, Goosen L. Technology-Integrated Inquiry-Based Learning in South African Classrooms: A Case of Selected Grade 12 Secondary Schools. In: Sanmugam M, Edwards BI, Mohd Barkhaya N, Khlaif Z, editors. Fostering Inclusive Education With AI and Emerging Technologies. IGI Global Scientific Publishing; 2025. 251–76.

https://doi.org/10.4018/979-8-3693-7255-5.ch011

34. Vishal A. Theoretical Perspectives on Blended Learning Integrating Traditional and Digital Pedagogies. Int J Multidiscip Res. 2024;6(5):1–9. https://doi.org/10.36948/ijfmr.2024.v06i05.27895
35. Soomro RBK, Soomro AB, Memon I. Inquiry-Based Science Teaching and Its Impact on Critical Thinking and Problem-Solving Skills : A Meta- Analysis of STEM Education. Res Sq. 2025;1–22. https://doi.org/10.21203/rs.3.rs-6365963/v1
36. Devega AT, Herasmus H, Lubis AL, Basriadi A. Realizing 21st Century Learning Through Inquirybased Learning : A Meta-Analysis. J Penelit Pendidik IPA. 2025;11(8):78–85. https://doi.org/10.29303/jppipa.v11i8.12687
37. Noris M, Sajidan S, Saputro S, Yamtinah S. Trends and Issues of Inquiry and Socio- Scientific Issue (SSI) Research in the Last 20 Years : A Bibliometric Analysis. Int J Educ Math Sci Technol. 2024;12(3):773–92. https://doi.org/10.46328/ijemst.3767
38. Atmaca AC, Aksoy A. Using Technology in Science Education : A Bibliometric Analysis. J Educ Sci Environ Heal. 2024;10(3):230–44. https://doi.org/10.55549/jeseh.730
39. Muthmainnah M, Munzil M, Rahayu S. Learning Models in Mathematics and Science Education to Improve High Order Thinking Skill (HOTS): A Systematic Literature Review. J Pendidik Sains. 2025;13(1):13–24. https://doi.org/10.26714/jps.13.1.2025.13-24
40. Bayani F, Rokhmat J, Hakim A, Sukarso A. Research Trends in Analytical Thinking Skills for Science Educationa; Insights, Pedagogical Approaches, and Future Directions. Int J Ethnoscience Technol Educ. 2025;2(1):129–57. https://doi.org/10.33394/ijete.v2i1.14142
41. Cai Z, Zhu J, Tian S. Research Progress of STEM Education Based on Visual Bibliometric Analysis. SAGE Open. 2023;13(3):1–13. https://doi.org/10.1177/21582440231200157
42. Şeker F. Trends and Thematic Focuses on STEM Education : Bibliometric Analysis of Quality Education with Web of Science Data (1993-2024). Res Sq. 2025;1:1–34. https://doi.org/10.21203/rs.3.rs-6681110/v1
43. Lederman NG, Lederman JS, Antink A. Nature of Science and Scientific Inquiry as Contexts for the Learning of Science and Achievement of Scientific Literacy. Int J Educ Math Sci Technol. 2013;1(3):138–47. https://doi.org/10.18404/IJEMST.19784
44. Supriyadi S, Suhandi A, Samsudin A. Study on the Nature of Science (NOS) in Science Education Since 1895-2022 : Bibliometric Analysis. Equator Sci J. 2023;1(2):57–63. https://doi.org/10.61142/esj.v1i2.32
45. Guba K, Chechik E, Tsivinskaya AO, Pecherskikh A, Buravoy N. Geographies of Underrecognition : Citation Disparities in Russian Studies. Int Conf Sci Inf. 2025;2:2154–60. https://doi.org/10.51408/issi2025_146
46. Soares BE, Barbosa VP, Benone NL, *et al*. Building Meaningful Relationships for Equity in the Publishing Ecosystem : Empowering Latin American Research Through Engagement. Ecol Evol. 2025;15(9):1–7. https://doi.org/10.1002/ece3.71964
47. Muchtar M, Singh A, Arnesen E, Srivastava S. Conceptualizing Hyperlocal Information Systems for Developing Countries. Proc ACM Human-Computer Interact. 2021;5(CSCW2):365: 1-26. https://doi.org/10.1145/3479509
48. Syamsidar S, Harjanti TW, Rugaiyah R, *et al.* Collaboration Pattern in Recent STEM Education Research: A Bibliometric Perspective. Int J Basic Appl Sci. 2025;14(4):250–5. https://doi.org/10.14419/grfje289
49. Acharya KP. Exploring Critical Reflection on Science Teachers ' Experiences : A Qualitative Inquiry. TQR (The Qual Report). 2024;29(8):2195–209. https://doi.org/10.46743/2160-3715/2024.6955

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