Jurnal Pendidikan Sains Universitas Muhammadiyah Semarang. Vol. 14(1) pp 88-102 ISSN:2339-0786
DOI: https://doi.org/10.26714/jps.14.1.2026.88-102

JPS JOURNAL PENDIDIKAN SAINS
JURNAL PENDIDIKAN SAINS
p-ISSN : 2339-0786 o-ISSN : 2502-1443
UNIVERSITAS MUHAMMADIYAH SEMARANG

A Bibliometric Analysis and Systematic Literature Review of Inquiry-Based Learning: Trends, Contributions, and Future Directions

Kurniawan Arizona[a,1*], Joni Rokhmat[b,2], Agus Ramdani[c,3], Gunawan[d,4], AA Sukarso[e,5] Ramdhani Sucilestari[f,6]

[a,b,c,d,e,f] Doctor of Science Education, Postgraduate University of Mataram, Mataram, 83125, Indonesia

[1]arizona@uinmataram.ac.id; [2]joni.fkip@unram.ac.id; [3]aramdani07@unram.ac.id; [4]gunawan@unram.ac.id; [5]asukarso@unram.ac.id; [6]sucilestari@uinmataram.ac.id
*corresponding author

Article history

Submission : 2025-09-29
Revised : 2026-04-11
Accepted : 2026-04-14

Keyword

Inquiry-Based Learning
Bibliometric Analysis
Systematic Literature Review

Abstract

Inquiry-Based Learning (IBL) is a widely recognized pedagogical approach that fosters student engagement through critical thinking, problem-solving, and active exploration. Despite its theoretical benefits, the gap between IBL's potential and its practical implementation in educational practice remains a challenge. This study aims to examine global trends in IBL research by conducting a bibliometric analysis and systematic literature review (SLR) of articles published between 2001 and 2025. Using data from the Scopus database, the study identifies key trends, geographical contributions, and influential authors in the field of IBL. The results show a significant increase in IBL-related publications, particularly from 2008 onwards, with a peak in 2020. The United States and Indonesia are the leading contributors, with substantial involvement from other countries like the United Kingdom, Germany, and China. The study also highlights the growing interdisciplinary application of IBL beyond the social sciences, noting its expanding relevance in diverse educational contexts. However, challenges such as teacher preparedness, curriculum constraints, and technology integration continue to be barriers to effective implementation. The study recommends further research to address these challenges, with a focus on enhancing teacher training, fostering global collaboration, and expanding IBL's application across various disciplines to ensure its sustained impact on educational practices worldwide.

1. INTRODUCTION

IBL has emerged as a transformative pedagogical approach that prioritizes student engagement through exploration, critical thinking, and problem-solving (Costes-Onishi & Kwek, 2023; Dewi et al., 2021; Song et al., 2022). This learner-centred method encourages students to take an active role in their own learning, fostering inquiry, reflection, and a deeper understanding of the subject matter (Voet & De Wever, 2019; Yamwongsri & Chen, 2025). As an instructional strategy, IBL is underpinned by the belief that learning is most effective when students are empowered to ask questions, investigate solutions, and develop their understanding through hands-on experiences (Dagys, 2017; Eltanahy & Forawi, 2019; Yoshinobu et al., 2023). The approach has become increasingly recognized for its potential to cultivate essential skills such as critical thinking (Arifin et al., 2025; Rapi et al., 2025), creativity (Kırıcı, 2021; Nahar & Machado, 2025), colla boration (Santoso et al., 2022; Song et al., 2022), and independent problem-solving (Nagaraj et al., 2025). These attributes are fundamental for preparing students to thrive in complex, dynamic real-world environments. Given its alignment with modern educational objectives that emphasize lifelong learning and the development of autonomous learners, IBL has garnered widespread interest across diverse educational contexts and disciplines (Liu & Wang, 2022; Nahar & Machado, 2025; Rapi et al., 2025).

Despite the widespread advocacy for IBL's effectiveness in improving student outcomes, there remains a notable gap between its theoretical potential and its actual implementation in educational practice. Many studies highlight the positive impact of IBL on student learning. However, there is limited understanding of the broader trends in its adoption and application, as well as the challenges that educators face in implementing IBL strategies in varied teaching environments (Chong et al., 2017; Jiang, 2021; Shephard, 2023). Additionally, while a growing body of literature supports the benefits of IBL, there is a lack of comprehensive analysis of the evolving patterns of IBL research, including the geographical and institutional contributions, as well as the factors that drive or hinder its integration across different educational systems. This knowledge gap presents an opportunity to systematically examine trends in IBL research to understand better its global trajectory, key influencers, and areas requiring further development. Furthermore, research indicates that integrating socioscientific issues (SSI) with IBL enhances student engagement and critical thinking, suggesting that the real-world relevance of SSI can be a powerful driver for the application of IBL strategies in classrooms worldwide (Setianingsih et al., 2025; Zia & Joharmawan, 2025). However, barriers such as teacher readiness, curriculum limitations, and technology accessibility continue to hinder the full potential of IBL in diverse educational settings.

The primary objective of this study is to bridge this gap by conducting a detailed bibliometric analysis and Systematic Literature Review (SLR) of research on IBL. By leveraging the Scopus database, this study aims to provide a comprehensive overview of trends in IBL research over time, highlighting the key authors, institutions, and countries that contribute to the field. This bibliometric approach will not only track the evolution of IBL-related publications but will also offer insights into the interrelationships between various contributors to the field (Arizona, Rokhmat, Ramdani, et al., 2025; Sucilestari et al., 2025b). The novelty of this research lies in its methodological approach, which combines SLR with bibliometric analysis to provide a data-driven, structured examination of IBL research on a global scale. In particular, the study will address significant gaps in the literature by uncovering the most influential publications, analysing publication trends, and identifying factors such as institutional support, geographic diversity, and subject-area focus that shape the development of IBL research.

Furthermore, this study aims to assess the alignment between IBL research and its practical applications in classrooms worldwide. By examining trends in the number of publications, institutional affiliations, and the geographical distribution of IBL research, the study seeks to identify areas where the most substantial contributions are being made and pinpoint those that require further exploration. This research will provide a comprehensive understanding of the current state of IBL, highlighting key trends and gaps. The findings will inform educators, policymakers, and researchers, guiding future pedagogical strategies and research agendas.

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2. METHOD

This study employs a Systematic Literature Review (SLR) and a bibliometric analysis to explore IBL (Sucilestari et al., 2025a). The data used in this study were sourced from the Scopus database, allowing for a comprehensive review of relevant articles. SLR was applied to systematically identify, evaluate, and synthesize the literature, while bibliometric analysis was used to examine publication trends, author collaborations, institutional affiliations, and geographic distribution. This approach provides a data-driven insight into the development and impact of research on IBL.

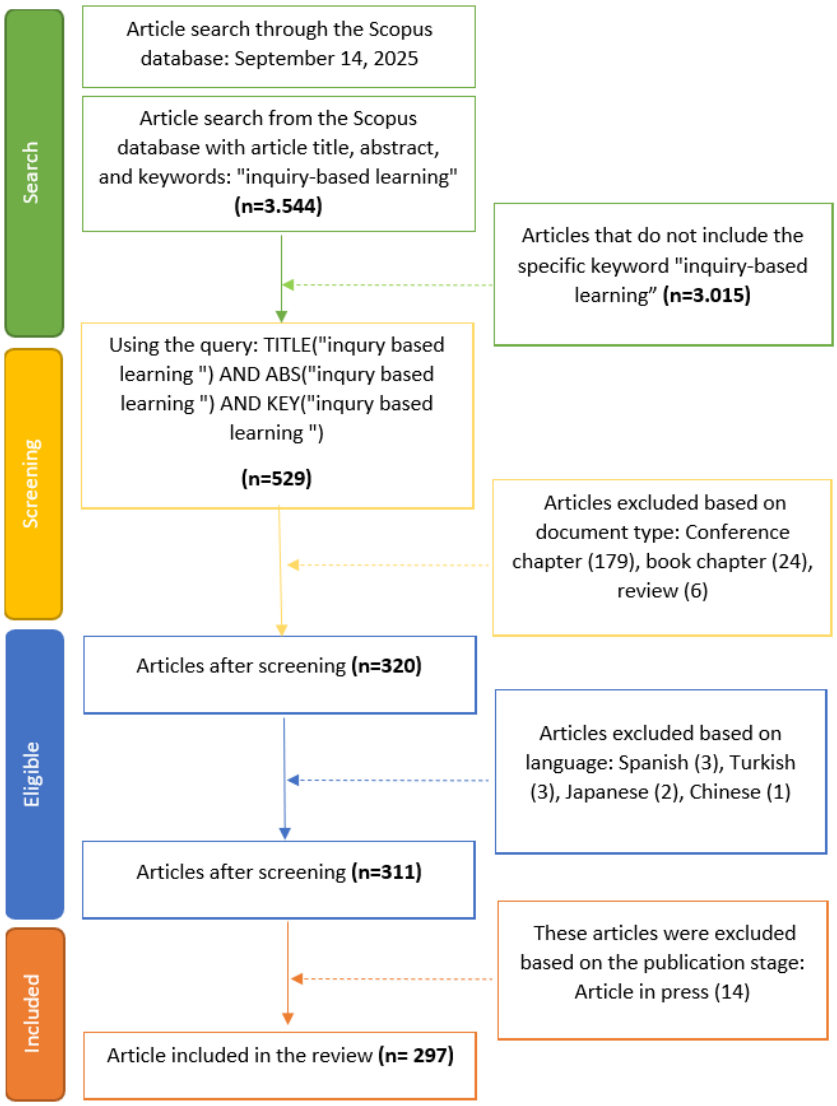

Figure 1. Information Flow of Systematic Literature Review (SLR) on IBL

Figure 1 illustrates the article filtering process conducted through the Scopus database on September 14, 2025, concerning the topic of "inquiry-based learning." The process began with a search for articles using the query "inquiry-based learning," yielding 3,544 results. From this total, 529 articles specifically covering "inquiry-based learning" in the title, abstract, and keywords were identified. These articles were then filtered by document type, excluding conference chapters, book chapters, and reviews, resulting in 320 articles that met the review criteria. The remaining articles were further filtered by language, removing those in Spanish, Turkish, Japanese, and Mandarin, leaving 311 articles that met the language criteria.

Additionally, articles marked as "in press" were excluded, narrowing the selection to 297 articles suitable for further review. This literature study focuses on the results from 297 relevant articles in the Scopus database on IBL. This data was obtained by identifying the number of articles

published, publication trends over the years, and the journals in which these articles were published. The study also highlights the most influential elements in IBL, including the authors, institutional affiliations, and the countries contributing to this field.

3. RESULTS AND DISCUSSION

This section presents the results of an analysis of the distribution and trends of IBL research based on various bibliometric factors. The analysis covers key dimensions including publication year, country of origin, institutional affiliation, publication sources, subject areas, and the contributions of authors involved in this field. The data utilized in this analysis is sourced from the Scopus database, encompassing articles published between 2001 and 2025. The findings aim to provide an overview of the development of IBL publications, identify patterns in contributions from different countries and institutions, and highlight the main topics of focus within IBL research. The results will be presented in the form of graphs and tables to offer a clearer understanding of the global trends in IBL research.

Figure 2 illustrates the distribution of articles related to IBL based on publication year from 2001 to 2025. In the early period (2001-2007), the number of published articles was relatively low (1 document), with minimal fluctuations. However, starting in 2008 (4 documents), there was a significant increase, reflecting a growing interest in the topic. The peak of publications occurred in 2020, with 38 articles, indicating a substantial surge in attention toward IBL that year. Although there was a decline after this peak, publications remained stable at relatively high levels through to 2025. This trend reflects a significant rise in academic interest in IBL, making it an increasingly relevant topic that has attracted greater attention from researchers and educators over the past decade.

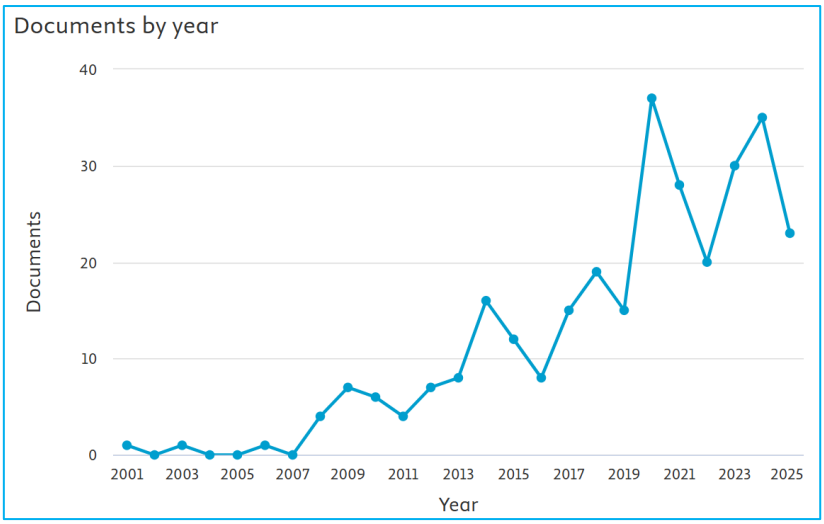

Figure 2. Distribution of IBL Articles by Year

Figure 3 illustrates the distribution of IBL articles by country or region. According to the graph, the United States has the most articles (42), followed by Indonesia (25). The United Kingdom (24 articles) and Germany (18 articles) also make significant contributions to the publication of IBL articles. Additionally, countries such as China, the Netherlands, Turkey, Taiwan, Thailand, and Australia have also contributed to publications, although in relatively smaller numbers. This graph indicates that countries like the United States and Indonesia dominate the inquiry-based learning topic, with greater attention to it in these regions than in other countries.

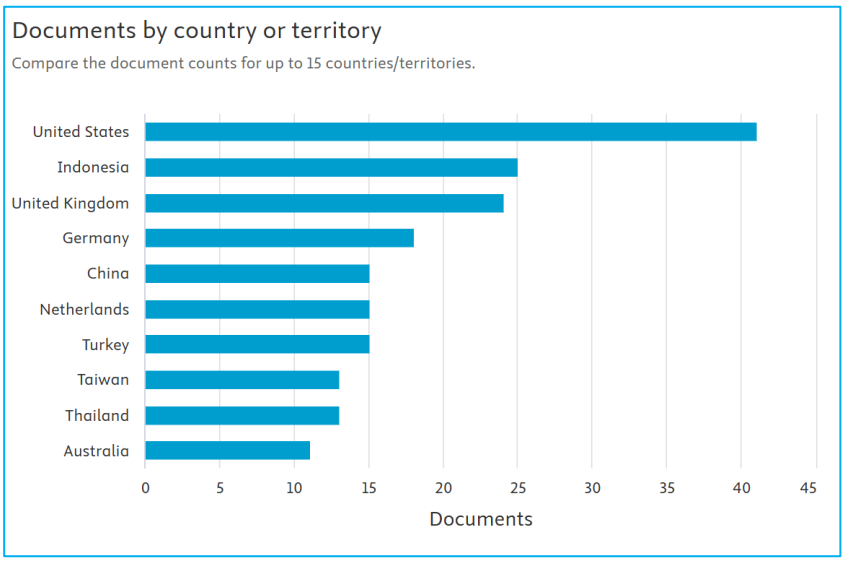

Figure 3. Distribution of IBL Articles by Country

Figure 4 illustrates the distribution of IBL articles based on country affiliation. This graph uses network-based mapping to depict the relationships among countries contributing to this topic. The United States stands out as the leading contributor, followed by Indonesia, the United Kingdom, Germany, and the Netherlands, which show strong affiliations in this research area. Other countries, including Taiwan, Australia, China, and several European nations (including Spain, Switzerland, and Finland), have also participated, though with smaller contributions. This mapping demonstrates a global network connected through IBL research, with the United States and Indonesia serving as the primary focal points in this field.

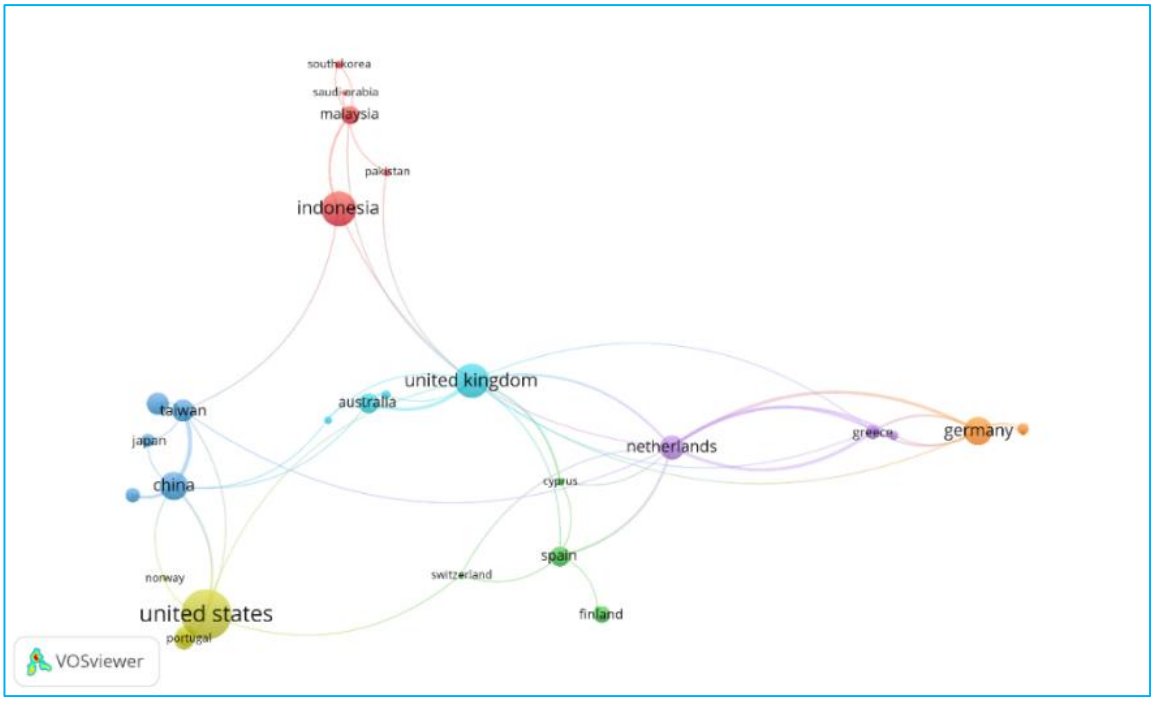

Figure 4. Distribution of IBL Articles by Affiliation

Figure 5 illustrates the distribution of IBL articles by institutional affiliation. In this graph, Nanyang Technological University and the University of Jyväskylä occupy the top positions with the highest number of publications (6 articles), followed by other prominent institutions such as the

University of Calgary, National Institute of Education, Universitas Negeri Malang, and Open Universiteit, each contributing significantly to the field with 5 articles.

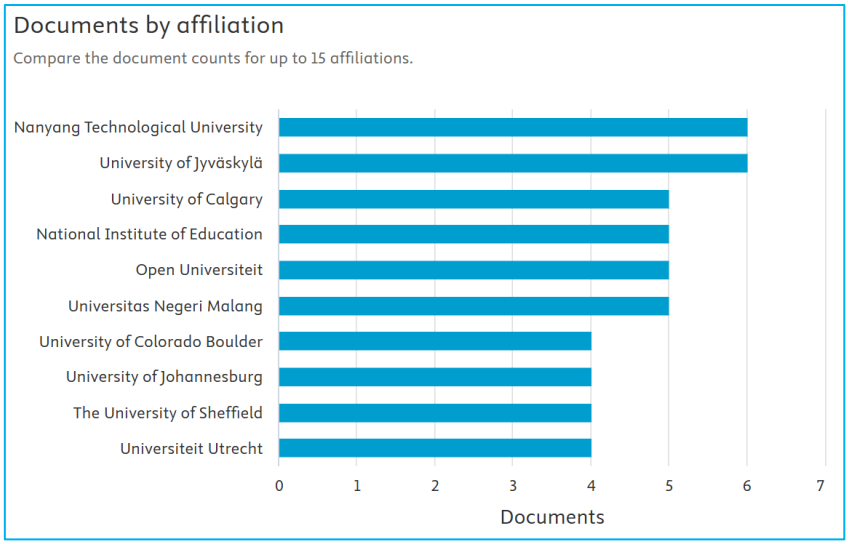

Figure 5. Distribution of IBL Articles by Institutional Affiliation

Universities from various countries, including the University of Colorado Boulder, the University of Johannesburg, the University of Sheffield, and Universiteit Utrecht, also make contributions with fewer publications but remain relevant. This graph shows a global network of educational institutions that play a crucial role in IBL development, with several universities from Asia, Europe, and North America dominating publications on the topic.

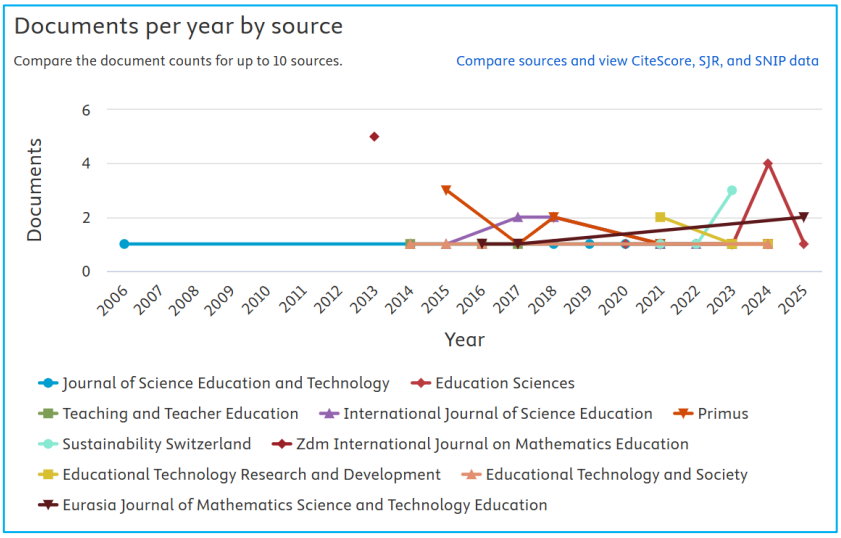

Figure 6. Distribution of IBL Articles by Source

Figure 6 illustrates the distribution of IBL articles based on publication sources from 2006 to 2025. This graph shows the number of articles published by several major journals in the fields of Education and educational technology. The *Journal of Science Education and Technology* and *Education Sciences* demonstrate a relatively stable number of publications over the years, with notable increases observed in 2023 and 2024. *Primus* shows a significant surge in publications starting in 2016, while other journals, such as *Teaching and Teacher Education* and *International Journal of Science Education*, exhibit smaller fluctuations. *ZDM International Journal on Mathematics Education* and *Educational Technology Research and Development* also show an increase in article numbers in recent years, with *Educational Technology and Society* and *Eurasia Journal of Mathematics Science and*

Technology Education contributing fewer articles, though they remain relevant. This graph reflects the dominant sources of publications on IBL, with a growing focus in recent years.

Figure 7 illustrates the distribution of IBL articles based on subject areas. This graph shows the percentage contributions of various disciplines to the publication of IBL articles. The *Social Sciences* dominate, accounting for 49.5%, indicating that IBL is most frequently discussed within the context of the social sciences. It is followed by *Computer Science*, contributing 11.7%, and *Engineering*, which accounts for 8.2%. Other fields, such as *Mathematics* (6.4%), *Psychology* (4.9%), and *Arts and Humanities* (3.7%), also contribute significantly, though to a lesser extent. Several disciplines, including *Environmental Science* (1.9%), *Health Professions* (2.1%), *Physics and Astronomy* (1.8%), and *Business and Management* (1.4%), make smaller contributions to IBL-related publications. This graph clearly depicts IBL's dominance in the *Social Sciences*, while also highlighting contributions from a range of other disciplines.

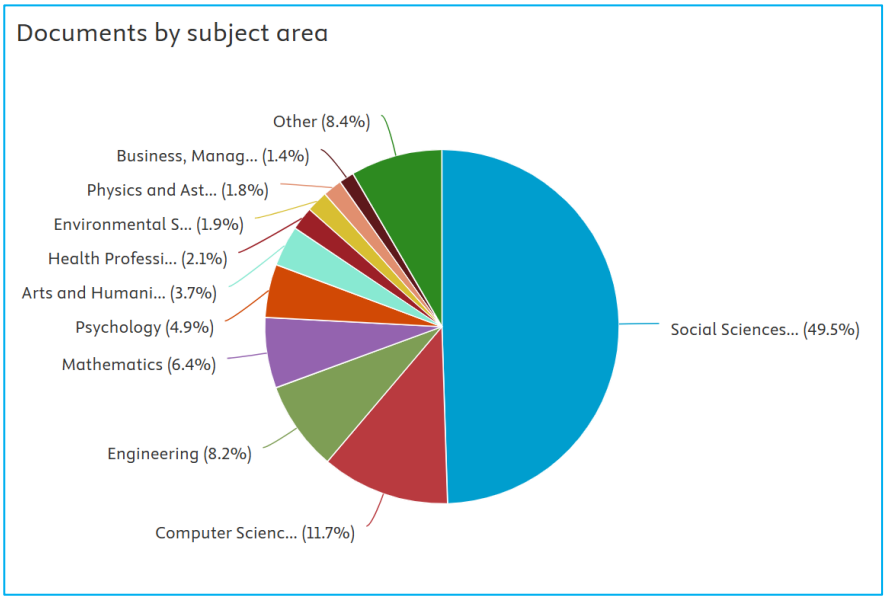

Figure 7. Distribution of IBL Articles by Subject Area

Figure 8 illustrates the distribution of IBL articles by author. According to the graph, the author Archer-Kuhn, B., leads with the highest number of publications (5 articles), followed by De Wever, B., Laursen, S.L., Nsengimana, V., Viiri, J., and Voet, M., each contributing 4 articles to the field. Other authors, such as Ahmed, S., Chaimala, F., Costes-Onishi, P., and Heindl, M., also contributed, with each author publishing 3 articles. This graph provides an overview of the most influential authors in IBL research, with Archer-Kuhn, B., standing out as the leading contributor.

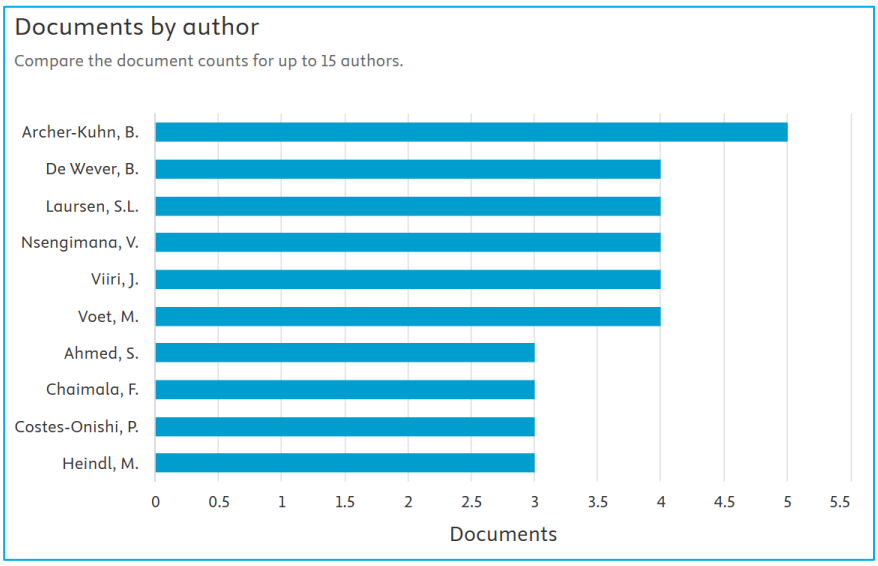

Figure 8. Distribution of IBL Articles by Author

Figure 9 illustrates the relationship between keywords used by authors in the topic of inquiry-based learning (IBL). This visualisation uses network-based mapping to depict the interconnections among concepts and terms frequently encountered in the literature. "Inquiry-based learning" emerges as the central node of the network, with related keywords encompassing various topics such as "science education," "students," "active learning," "critical thinking skills," and "education." The relationships between other keywords, such as "motivation," "teacher education," "nursing education," and "professional development," are also clearly visible, indicating the broad focus of this research on various aspects of Education and skill development. Overall, this mapping demonstrates that IBL spans multiple fields and applications, including science education, teacher professional development, and the enhancement of students' cognitive and critical thinking skills.

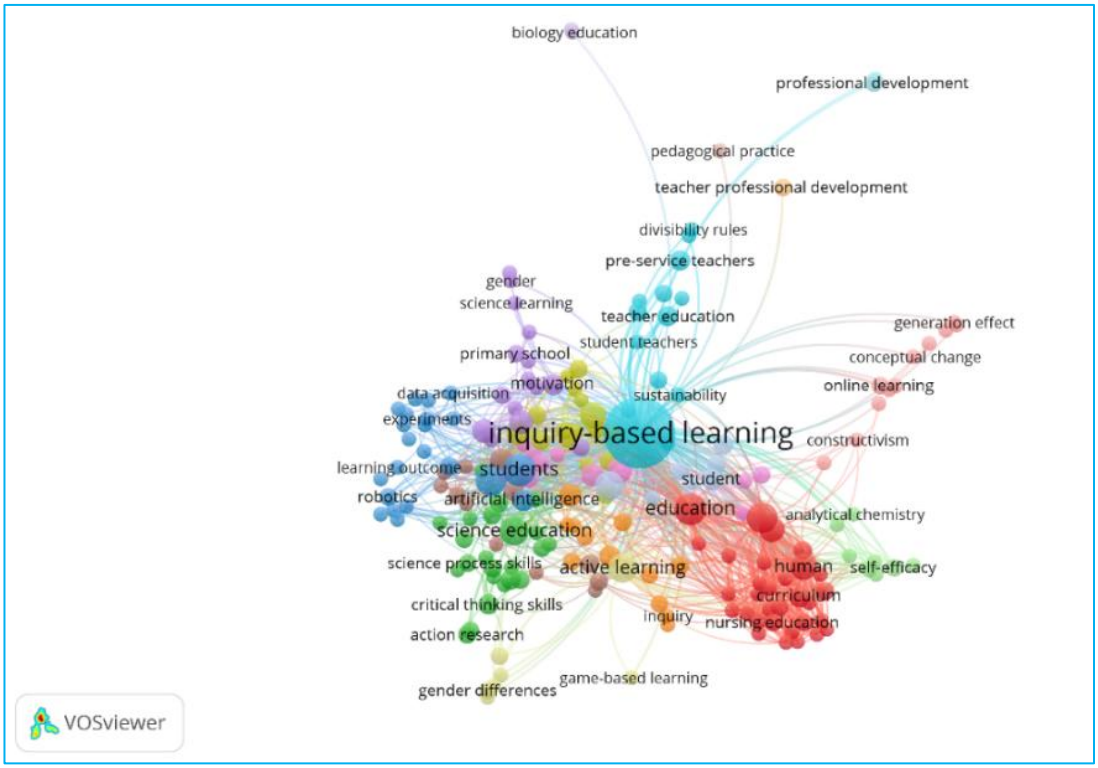

Figure 9. Relationship of IBL Keywords by Author

Table 1 presents the relationships among keywords identified by the authors in the context of IBL. The keyword "Inquiry-based learning" is the most dominant, with the highest frequency (246) and the strongest link strength (606), reflecting its central role in the literature. Other prominent keywords include "Learning" (18 occurrences, 175 link strength) and "Education" (19 occurrences, 172 link strength), indicating IBL's broad focus within the context of Education. "Students" (22 occurrences, 145 link strength) and "Teaching" (15 occurrences, 129 link strength) highlight the importance of student engagement and teaching practices in this approach. "Problem-based learning" (10 occurrences, 117 link strength) and "Active learning" (15 occurrences, 100 link strength) reflect pedagogical strategies related to IBL. "Curriculum" (6 occurrences, 83 link strength) and "Thinking" (3 occurrences, 64 link strength) show a focus on curriculum development and cognitive skills in IBL. This table illustrates how these concepts are interconnected and significant in the IBL literature.

Table 1. Relationship of Inquiry-Based Learning Keywords by Author

No	*Keyword*	*Occurences*	*Total link strength*
1	Inquiry-based learning	246	606
2	Learning	18	175
3	Education	19	172
4	Human	11	153
5	Students	22	145
6	Teaching	15	129
7	Problem-based learning	10	117
8	Active learning	15	100
9	Curriculum	6	83
10	Thinking	3	64

Table 2 presents the list of the most cited articles on IBL. The first article with the highest number of citations is "A contextual game-based learning approach to improving students' inquiry-based learning performance in social studies courses" by Hwang, G.-J., Chiu, L.-Y., and Chen, C.-H., published in *Computers and Education* in 2015, with 200 citations. The article follows this: "Can inquiry-based learning strengthen the links between teaching and disciplinary research?" by Spronken-Smith, R. and Walker, R., published in *Studies in Higher Education* in 2010, with 199 citations. The next article, "The effect of the inquiry-based learning approach on students' critical-thinking skills implementation" by Duran, M. and Dökme, I., published in *Eurasia Journal of Mathematics Science and Technology Education* in 2016, has 182 citations. Other articles in this list focus on various aspects of inquiry-based learning, including enhancing critical thinking skills, its implementation across diverse educational contexts, and its long-term effects. Overall, these articles demonstrate the significant impact of inquiry-based learning on Education and technology.

The growing academic interest in IBL over the past two decades highlights its increasing significance as a central pedagogical approach. Initially met with limited attention, the rise in IBL publications since 2008 reflects the growing recognition of its potential to engage students actively in their learning. This upward trend can be attributed to the global shift towards more student-centred teaching strategies, particularly in response to evolving educational demands for critical thinking, problem-solving, and active participation (Blanda, 2024; Luo et al., 2023). The peak in IBL research around 2020 signals not only heightened academic interest but also a response to the disruptions caused by the COVID-19 pandemic, which accelerated the adoption of innovative, interactive learning methodologies. Despite the slight decline following this peak, the steady volume of publications through 2025 reinforces the sustained relevance of IBL, marking it as a lasting and influential educational strategy (Khan & Ahmed, 2025; Nahar & Machado, 2025; Paseka et al., 2025; Rapi et al., 2025).

Table 2. Most Cited Inquiry-Based Learning Articles

No	Article Title	Authors	Journal Source	Year	Citations
1	A contextual game-based learning approach to improving students' inquiry-based learning performance in social studies courses	Hwang, G.-J., Chiu, L.-Y., Chen, C.-H.	Computers and Education, 81, pp. 13–25	2015	200
2	Can inquiry-based learning strengthen the links between teaching and disciplinary research?	Spronken-Smith, R., Walker, R.	Studies in Higher Education, 35(6), pp. 723–740	2010	199
3	The effect of the inquiry-based learning approach on the implementation of students' critical-thinking skills	Duran, M., Dökme, I.	Eurasia Journal of Mathematics, Science and Technology Education, 12(12), pp. 2887–2908	2016	182
4	How do first-year university students experience inquiry and research, and what are the implications for the practice of inquiry-based learning?	Levy, P., Petrulis, R.	Studies in Higher Education, 37(1), pp. 85–101	2012	163
5	Benefits for women and men of inquiry-based learning in college mathematics: A multi-institution study	Laursen, S.L., Hassi, M.-L., Kogan, M., Weston, T.J.	Journal for Research in Mathematics Education , 45(4), pp. 406–418	2014	142
6	Assessing Long-Term Effects of Inquiry-Based Learning: A Case Study from College Mathematics	Kogan, M., Laursen, S.L.	Innovative Higher Education, 39(3), pp. 183–199	2014	129
7	Implementation of inquiry-based learning in day-to-day teaching: A synthesis	Maaß, K., Artigue, M.	Zdm International Journal on Mathematics Education , 45(6), pp. 779–795	2013	124
8	Traditional and inquiry-based learning pedagogy: A systematic critical review	Khalaf, B.K., Zin, Z.B.M.	International Journal of Instruction, 11(4), pp. 545–564	2018	123
9	A review of the types of mobile activities in mobile inquiry-based learning	Suárez, Á., Specht, M., Prinsen, F., Kalz, M., Ternier, S.	Computers and Education, 118, pp. 38–55	2018	117
10	Promoting higher-order thinking skills using inquiry-based learning	Madhuri, G.V., Kantamreddi, V.S.S.N., Prakash Goteti, L.N.S.	European Journal of Engineering Education, 37(2), pp. 117–123	2012	106

The dominance of the United States in IBL research is not surprising given the country's long-standing leadership in educational innovation (Corral-Barraza et al., 2024). However, the significant contributions from Indonesia highlight a broader, more diverse engagement with IBL, indicating that this approach is not limited to Western educational systems but is gaining traction globally. The emergence of several countries, such as the United Kingdom, Germany, and China,

further illustrates the worldwide interest in IBL, suggesting that it is seen as an effective solution to enhance student engagement and learning outcomes across various cultural and academic contexts (Eppes et al., 2020; Gkagkas & Hatzikraniotis, 2024; C. Nzomo et al., 2023).

Moreover, the strong affiliation of certain institutions with IBL research underscores the role of higher Education in shaping and advancing pedagogical trends. Leading universities in Asia, Europe, and North America consistently produce valuable research, with cross-border collaboration playing a critical role in refining and promoting IBL. This global network of institutions not only supports the dissemination of IBL but also fosters the development of cross-cultural teaching practices that adapt IBL to different educational contexts.

IBL's interdisciplinary nature (Koutsianou & Emvalotis, 2021; Kunnath & Botes, 2025), particularly its prominence within the social sciences (Martín-Gámez et al., 2020; Moseley & Connolly, 2021; Watanabe et al., 2025; Yonezawa & Nakai, 2024), further reinforces its broad applicability and relevance (Nezhyva et al., 2024). The prominence of social sciences in IBL research indicates that the approach is perceived as particularly effective in promoting critical thinking (Costes-Onishi & Kwek, 2023; Dewi et al., 2021; Kunnath & Botes, 2025; Prayogi & Verawati, 2020) and active learning (Cushman et al., 2018; Tirado-Olivares et al., 2021), skills that are crucial in the social sciences. However, the significant contributions from fields such as computer science (Adhami & Taghizadeh, 2024; Chen et al., 2023), engineering (Meng & Jumaat, 2024; C. M. Nzomo et al., 2023; Wang et al., 2025), and even business management suggest that IBL's benefits extend beyond the traditional boundaries of social sciences, offering valuable insights for teaching and learning in various disciplines (Shelton et al., 2022).

Furthermore, the relationship between key authors and their research on Inquiry-Based Learning (IBL) highlights the intellectual leadership driving the field. Prominent scholars have significantly influenced the trajectory of IBL by developing foundational theories and exploring its practical applications across diverse educational settings. The continuous citation of their work indicates the lasting impact of their contributions, reinforcing the notion that IBL has transformative potential beyond specific academic institutions or regions, as suggested by previous studies (Sucilestari & Arizona, 2020; Yang et al., 2020).

In comparing these findings with existing literature, it is evident that IBL's application has evolved in various disciplines, strengthening its relevance in contemporary Education. While earlier studies emphasised IBL's role in fostering critical thinking and active learning, recent research has extended this focus to include teacher education, professional development, and the motivation required to implement IBL effectively in classrooms. This reflects the broader understanding that IBL is not solely about enhancing student engagement but also about providing substantial support to educators through training and institutional backing (Arizona et al., 2013; Arizona, Rokhmat, Gunawan, et al., 2025; Harjono et al., 2017).

These insights build on prior research that highlighted the need for a comprehensive IBL approach that integrates student and teacher development (Setianingsih et al., 2025; Sugiarto et al., 2026). By addressing the evolving nature of IBL, this study underscores the importance of continued investment in teacher preparation and curriculum adaptation to sustain the growth and application of IBL. Consequently, the expanding body of literature on IBL not only supports its capacity to reshape educational practices globally but also illustrates the need for further exploration into its long-term effects and cross-disciplinary applications, ensuring its continued relevance and impact in future educational paradigms.

Finally, the broad range of keywords associated with IBL research points to its multifaceted impact on Education. While terms like "active learning" and "critical thinking" dominate, there is a clear emphasis on teacher education, professional development, and motivation, which reflects the understanding that IBL is not solely about student engagement but also requires significant investment in teacher training and institutional support. This multifaceted approach demonstrates the comprehensive nature of IBL, in which both students and educators must evolve to fully realise its potential. Thus, the growing body of literature on IBL underscores its capacity to reshape educational practices globally, fostering a deeper, more engaging, and meaningful learning experience.

4. CONCLUSION

The findings of this study underscore the increasing global interest in IBL as an effective pedagogical approach. Since its initial introduction, IBL has gained significant traction, with a marked rise in publications beginning in 2008 and peaking in 2020. The dominance of countries like the United States and Indonesia, along with contributions from various academic disciplines, indicates the broad appeal and application of IBL across diverse educational systems. The research highlights the central role of key authors and institutions in advancing IBL, with a growing body of literature emphasising its impact on student engagement, critical thinking, and active learning. Despite some fluctuations, IBL's continued relevance suggests its enduring influence on global Education.

To fully realise IBL's potential, further research should focus on overcoming the practical challenges educators face when implementing IBL across diverse educational contexts. Teacher training programs should be prioritised to equip educators with the necessary tools and strategies to facilitate IBL effectively. Additionally, expanding IBL's application beyond the social sciences into disciplines such as computer science, engineering, and business management could enhance its interdisciplinary impact. Promoting global collaboration and knowledge sharing among institutions will foster a more cohesive understanding of IBL. At the same time, longitudinal studies will provide deeper insights into its long-term effects on student outcomes. These efforts will help maximise IBL's potential to transform educational practices worldwide.

ACKNOWLEDGMENT

We want to express our sincere gratitude to all those who contributed to this research, especially the Lectures of the Doctoral Program in Science Education at the Graduate School of the University of Mataram for their invaluable guidance and support. Their expertise and encouragement have been essential throughout this research process.

REFERENCES

Adhami, N., & Taghizadeh, M. (2024). Integrating inquiry-based learning and computer-supported collaborative learning into a flipped classroom: effects on academic writing performance and perceptions of students of railway engineering. *Computer Assisted Language Learning*, *37*(3), 521–557. https://doi.org/10.1080/09588221.2022.2046107

Arifin, Z., Saputro, S., & Kamari, A. (2025). The effect of inquiry-based learning on students' critical thinking skills in science education: A systematic review and meta-analysis. *Eurasia Journal of Mathematics, Science and Technology Education*, *21*(3). https://doi.org/10.29333/ejmste/15988

Arizona, K., Harjono, A., & Jufri, A. W. (2013). Pengaruh Implementasi Media Tiga Dimensi Kemagnetan Berbasis Inkuiri (Mtdkbi) Melalui Strategi Kooperatif Terhadap Kecakapan Sosial. *Erudio Journal of Educational Innovation*. https://doi.org/10.18551/erudio.1-2.9

Arizona, K., Rokhmat, J., Gunawan, G., Harjono, A., Ramdani, A., & Sukarso, A. A. (2025). The Kopi Lokal Islami Learning Model: Alternative Solution in Supporting 21st-Century Skills and Students' Character. *International Journal of Current Science Research and Review*, *08*(08), 4326–4341. https://doi.org/10.47191/ijcsrr/V8-i8-42

Arizona, K., Rokhmat, J., Ramdani, A., Gunawan, G., & Sukarso, A. (2025). Examining Global Trends In 21st Century Skills : A Systematic Literature Review And Bibliometric Analysis. *The 3rd International Conference On Islamic Education And Science Development (ICONSIDE)*, *May*, 585–610. https://proceeding.uinmataram.ac.id/index.php/iconside/article/view/264

Bedek, M. A., Firssova, O., Stefanova, E. P., Prinsen, F., & Chaimala, F. (2014). User-driven development of an inquiry-based learning platform: Formative evaluations in weSPOT. *Interaction Design and Architecture(S)*, *23*(1), 122–139. https://www.scopus.com/inward/record.uri?eid=2-s2.0-84987824987&partnerID=40&md5=1e82992e3716836542044c288365c625

Blanda, S. A. (2024). An Inquiry-Based Learning Approach to Teaching Undergraduate Cryptology. *PRIMUS*, *34*(1), 65–77. https://doi.org/10.1080/10511970.2023.2250766

Chen, H.-C., Gijlers, H., Sui, C.-J., & Chang, C.-Y. (2023). Asian Students' Cultural Orientation and Computer Self-Efficacy Significantly Related to Online Inquiry-Based Learning Outcomes on the Go-Lab Platform. *Journal of Science Education and Technology*, *32*(5), 743–758. https://doi.org/10.1007/s10956-023-10058-9

Chong, J. S. Y., Chong, M. S. F., Shahrill, M., & Abdullah, N. A. (2017). Implementing inquiry-based learning and examining the effects in junior college probability lessons. *Journal on Mathematics Education*, *8*(2), 157–164. https://doi.org/10.22342/jme.8.2.3964.157-164

Corral-Barraza, L., Gomez-Elizalde, J., Morán-Soto, G., Godínez-Garcia, F., & González Peña, O. I. G. (2024). Transforming Electronics Engineering Classrooms: Fostering Students' Motivation to Design Technological Solutions Through Inquiry-Based Learning. *IEEE Access*, *12*, 88585–88595. https://doi.org/10.1109/ACCESS.2024.3413011

Costes-Onishi, P., & Kwek, D. (2023). Inquiry-based learning in music: Indicators and relationships between key pedagogical practices and the quality of critical thinking. *Research Studies in Music Education*, *45*(2), 362–378. https://doi.org/10.1177/1321103X211057457

Cushman, J. R., Gantner, R., George, C. Y., Morrow, M. L., & Rault, P. X. (2018). A Model for Expanding Active Learning Regionally: The Greater Upstate New York Inquiry-Based Learning Consortium. *PRIMUS*, *28*(8), 754–771. https://doi.org/10.1080/10511970.2018.1424743

Dagys, D. (2017). Theoretical inquiry-based learning insights on natural science education: From the source to the 5E model. *Pedagogika*, *126*(2), 83–98. https://doi.org/10.15823/p.2017.21

Dewi, D. K., Ardhana, W., Chusniyah, T., & Sulianti, A. (2021). Inquiry-based learning implementation to improve the critical thinking of prospective teachers. *International Journal of Information and Education Technology*, *11*(12), 638–645. https://doi.org/10.18178/IJIET.2021.11.12.1575

Eltanahy, M., & Forawi, S. (2019). Science Teachers' and Students' Perceptions of the Implementation of Inquiry-Based Learning Instruction in a Middle School in Dubai. *Journal of Education*, *199*(1), 13–23. https://doi.org/10.1177/0022057419835791

Eppes, T. A., Milanovic, I., & Wright, K. (2020). Improving student readiness for inquiry-based learning: An engineering case study. *International Journal of Online and Biomedical Engineering*, *16*(1), 4–17. https://doi.org/10.3991/ijoe.v16i01.12051

Gkagkas, V., & Hatzikraniotis, E. (2024). Exploring the Development of Questioning Inquiry Skill in Secondary School Students via Physics Inquiry-Based Learning Experiments. *New Perspectives in Science Education - International Conference*, *2024*(13). https://www.scopus.com/inward/record.uri?eid=2-s2.0-85216812974&partnerID=40&md5=ad1ad18825049164f99e96d0800ed205

Harjono, A., Jufri, W., & Arizona, K. (2017). Implementasi Media Tiga Dimensi Kemagnetan Berbasis Inkuiri Melalui Strategi Kooperatif Terhadap Sikap Ilmiah Siswa. *Jurnal Pendidikan Fisika Dan Teknologi*. https://doi.org/10.29303/jpft.v1i1.231

Jiang, Y. (2021). Challenges of Implementing Inquiry-based Learning in Chinese Secondary School EFL Classrooms: A Review of Teachers' and Students' Perceptions. *Journal of Studies in the English Language*, *16*(2), 1–21. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85147577495&partnerID=40&md5=78043c9d33ba4ab544dc3585b0872102

Khan, B. F., & Ahmed, S. (2025). An Agile Approach for Collaborative Inquiry-Based Learning in a Ubiquitous Environment. *International Journal of Advanced Computer Science and Applications*, *16*(1), 323–333. https://doi.org/10.14569/IJACSA.2025.0160132

Kırıcı, M. G. (2021). The effect of STEM-supported research-inquiry-based learning approach on the scientific creativity of 7th-grade students. *Journal of Pedagogical Research*, *5*(2), 19–35. https://doi.org/10.33902/JPR.2021067921

Koutsianou, A., & Emvalotis, A. (2021). Unravelling the interplay of primary school teachers' topic-specific epistemic beliefs and their conceptions of inquiry-based learning in history and science. *Frontline Learning Research*, *9*(4), 35–75. https://doi.org/10.14786/flr.v9i4.777

Kunnath, A. J., & Botes, W. (2025). Transforming science education with artificial intelligence: Enhancing inquiry-based learning and critical thinking in South African science classrooms. *Eurasia Journal of Mathematics, Science and Technology Education*, *21*(6). https://doi.org/10.29333/ejmste/16532

Liu, Y., & Wang, J. (2022). The mediating–moderating model of inquiry-based learning and science self-efficacy: evidence from PISA 2015. *International Journal of Science Education*, *44*(7), 1096–1119. https://doi.org/10.1080/09500693.2022.2067364

Luo, T., Arcaute, K., & Muljana, P. S. (2023). Integrating inquiry-based learning into engineering education: A case study. *Innovations in Education and Teaching International*, *60*(6), 836–847.

https://doi.org/10.1080/14703297.2022.2130393

Martín-Gámez, C., Acebal Expósito, M. D. C., & Prieto, T. (2020). Developing the concept of 'ecosystem' through inquiry-based learning: a study of preservice primary teachers. *Journal of Biological Education*, *54*(2), 147–161. https://doi.org/10.1080/00219266.2018.1554596

Meng, F., & Jumaat, N. F. B. (2024). The Effectiveness of an Online Inquiry-Based Learning Environment towards Secondary School Students' Behavioural Engagement and Performance in Science. *International Journal of Interactive Mobile Technologies*, *18*(18), 112–124. https://doi.org/10.3991/ijim.v18i18.50547

Moseley, A., & Connolly, J. (2021). The use of inquiry-based learning in public administration education: Challenges and opportunities in the context of internationalisation. *Teaching Public Administration*, *39*(3), 270–286. https://doi.org/10.1177/0144739420935971

Nagaraj, P., Karthick Raja, M., J. S., & Muneeswaran, V. (2025). Effect of Inquiry-based Learning on Engineering Students as a Collaborative Approach in Problem-Solving and Research for the Formal Language Automata Course. *Journal of Engineering Education Transformations*, *38*(Special Issue), 23–29. https://doi.org/10.16920/jeet/2025/v38is2/25004

Nahar, L., & Machado, C. (2025). Inquiry-based learning in Bangladesh: insights into middle and high school students' experiences and 21st century skill development. *Disciplinary and Interdisciplinary Science Education Research*, *7*(1). https://doi.org/10.1186/s43031-025-00122-2

Nezhyva, M., Aerts, J. T., Sandbaumhüter, F. A., Vallianatou, T., & Jansson, E. T. (2024). Inquiry-based Learning of Proteomics and Metabolomics. *Journal of Chemical Education*, *101*(2), 521–529. https://doi.org/10.1021/acs.jchemed.3c01041

Nzomo, C. M., Rugano, P., & Njoroge Mungai, J. M. (2023). Relationship between inquiry-based learning and students' attitudes towards chemistry. *International Journal of Evaluation and Research in Education*, *12*(2), 991–997. https://doi.org/10.11591/ijere.v12i2.24165

Nzomo, C., Rugano, P., Njoroge Mungai, J., & Gitonga, C. (2023). Inquiry-based learning and students' self-efficacy in Chemistry among secondary schools in Kenya. *Heliyon*, *9*(1). https://doi.org/10.1016/j.heliyon.2022.e12672

Paseka, A., Hinzke, J.-H., & Boldt, V.-P. (2025). Learning through perplexity in inquiry-based teacher education settings. *Teachers and Teaching: Theory and Practice*, *31*(2), 281–296. https://doi.org/10.1080/13540602.2023.2266379

Prayogi, S., & Verawati, N. N. S. P. (2020). The effect of conflict cognitive strategy in inquiry-based learning on preservice teachers' critical thinking ability. *Journal of Educational, Cultural and Psychological Studies*, *2020*(21), 27–41. https://doi.org/10.7358/ecps-2020-021-pray

Rapi, N. K., Sujanem, R., Yasmini, L. P. B., & Setemen, K. (2025). Science process skills and critical thinking skills in an inquiry-based learning model with project-based assessment. *International Journal of Innovative Research and Scientific Studies*, *8*(2), 938–946. https://doi.org/10.53894/ijirss.v8i2.5393

Santoso, S., Lukitasari, M., & Hasan, R. (2022). School-community Collaboration in Inquiry-based Learning to Strengthen Religious Character and Improve Learning Outcomes of Students. *International Journal of Instruction*, *15*(3), 913–930. https://doi.org/10.29333/iji.2022.15349a

Setianingsih, I., Ismawati, R., & Juliyanto, E. (2025). The Effectiveness of Inquiry-Based Learning in the Context of Socioscientific Issues (SSI) in Improving Students' Critical Thinking Skills and Global Citizen Character Article history Abstract. *Jurnal Pendidikan Sains Universitas Muhammadiyah Semarang*, *13*(1), 2339–0786. https://jurnal.unimus.ac.id/index.php/JPKIMIA/index

Shelton, M. R., Bos, J. J., Collins, K. B., Ison, R. L., & Iaquinto, B. L. (2022). Characterising water sensitive cities through inquiry-based learning systems. *Australian Journal of Water Resources*, *26*(2), 162–174. https://doi.org/10.1080/13241583.2022.2076300

Shephard, A. J. (2023). Textiles Literacy: Implementing Inquiry-Based Learning in a Basic Textiles Class. *Clothing and Textiles Research Journal*, *41*(1), 71–88. https://doi.org/10.1177/0887302X221100434

Song, Y., Cao, J., Yang, Y., & Looi, C.-K. (2022). Mapping primary students' mobile, collaborative, inquiry-based learning behaviours in science collaborative problem-solving via learning analytics. *International Journal of Educational Research*, *114*.

https://doi.org/10.1016/j.ijer.2022.101992

Sucilestari, R., & Arizona, K. (2020). *The Impact of Inquiry-Based Learning on Students' Critical Thinking Skills*. *408*(Iconist, 2019), 172–175. https://doi.org/10.2991/assehr.k.200220.031

Sucilestari, R., Ramdani, A., Susilawati, S., Sukarso, A. A., & Rokhmat, J. (2025a). Examining The Global Trends of Environmental Literacy : A Systematic Literature Review and Bibliometric Analysis. *International Journal of Current Science Research and Review*, *08*(09), 4592–4607. https://doi.org/10.47191/ijcsrr/V8-i9-22

Sucilestari, R., Ramdani, A., Susilawati, S., Sukarso, A., & Rokhmat, J. (2025b). The impact of project-based learning on students ' creativity : a systematic literature review from 2005 to 2025. *The 3rd international conference on islamic education and science development (ICONSIDE)*, *May*, 611–633.

Sugiarto, W., Nurrohman, S., Wiyarsi, A., & Rahmawati, L. (2026). *Hypermodule Deep Learning Inquiry – Steam : A Theoretical Framework And Science Teachers ' Perceptions In The Digital Era*. *Jurnal Pendidikan Sains Universitas Muhammadiyah Semarang*, *14*(1), 49–58. https://doi.org/10.26714/jps.14.1.2026.49-58

Tirado-Olivares, S., Cózar-Gutiérrez, R., García-Olivares, R., & González-Calero, J. A. (2021). Active learning in history teaching in higher Education: The effect of inquiry-based learning and a student response system-based formative assessment in teacher training. *Australasian Journal of Educational Technology*, *37*(5), 61–76. https://doi.org/10.14742/ajet.7087

Voet, M., & De Wever, B. (2019). Teachers' Adoption of Inquiry-Based Learning Activities: The Importance of Beliefs About Education, the Self, and the Context. *Journal of Teacher Education*, *70*(5), 423–440. https://doi.org/10.1177/0022487117751399

Wang, Y., He, P., Geng, J., & Zhu, Z. (2025). An Innovative Teaching Practice in Analytical Chemistry Laboratory: Merging Photoelectric Technology with Inquiry-Based Learning through Cerium Analysis. *Journal of Chemical Education*, *102*(3), 1245–1251. https://doi.org/10.1021/acs.jchemed.4c01316

Watanabe, T., Yonezawa, T., Yamasaki, A., & Nagata, T. (2025). Scoping review of teaching methods for inquiry-based learning in Japanese elementary schools: focusing on the "period for integrated studies." *Pedagogies*, *20*(3), 349–363. https://doi.org/10.1080/1554480X.2024.2395264

Yamwongsri, P., & Chen, H.-L. (2025). The Effects of Spherical Video-Based Virtual Reality in Inquiry-Based Learning on Student Learning Outcomes, Higher-Order Thinking, and Learning Experiences in Geography Education. *Journal of Educational Computing Research*, *63*(6), 1550–1579. https://doi.org/10.1177/07356331251360440

Yang, J.-M., Sung, Y.-T., & Chang, K.-E. (2020). Use of Meta-Analysis to Uncover the Critical Issues of Mobile Inquiry-Based Learning. *Journal of Educational Computing Research*, *58*(4), 715–746. https://doi.org/10.1177/0735633119879366

Yonezawa, T., & Nakai, Y. (2024). ICT self-efficacy, self-efficacy for teamwork, and collegial collaborations: an exploratory study of elementary school teachers' ICT uses in inquiry-based learning in Japan. *Frontiers in Education*, *9*. https://doi.org/10.3389/feduc.2024.1410886

Yoshinobu, S., Jones, M. G., Hayward, C. N., Schumacher, C., & Laursen, S. L. (2023). A Broad Doorway to the Big Tent: A Four-Strand Model for Discipline-Based Faculty Development on Inquiry-Based Learning. *PRIMUS*, *33*(4), 329–354. https://doi.org/10.1080/10511970.2022.2072427

Zia, J., & Joharmawan, R. (2025). Research Trend in Socioscientific Issues Integrated Inquiry Learning on Science Education : A Systematic Literature Review. *Jurnal Pendidikan Sains Universitas Muhammadiyah Semarang 13*(2), 64–77. https://doi.org/10.26714/jps.13.2.2025.64-77