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Trend and research focus on Problem-Based Learning and learning outcome in the world: A bibliometric analysis

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ABSTRACT

A problem-based learning approach is a learning approach that is student-centered, allowing them to confront real-world problems, encouraging critical thinking, collaboration and problem solving. This research aims to investigate several key aspects related to PBL and learning outcomes at a global level and generate in-depth insights into research trends and focuses related to problem-based learning (PBL) approaches and learning outcomes. through bibliometric analysis. From 1132 Scopus database articles, after going through the selection process there were 742 articles. It was found that interest and research focus on this topic has increased significantly in recent years, reflecting the importance of PBL in developing students' critical and collaborative skills. The importance of developing valid and reliable educational measurement tools to measure learning outcomes. The importance of international collaboration in enriching understanding of PBL and learning outcomes. Human factors, such as student characteristics, were found to be important in designing a PBL curriculum that is responsive to student needs. These findings provide guidance for future research directions, highlighting the innovative potential in PBL development. In conclusion, these results and discussion provide a strong foundation for the development of education oriented towards effective learning outcomes in the modern era.

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ABSTRAK

Pendekatan pembelajaran berbasis masalah adalah pendekatan pembelajaran yang berpusat pada peserta didik, memungkinkan mereka menghadapi masalah dunia nyata, mendorong pemikiran kritis, kolaborasi, dan pemecahan masalah. Penelitian ini bertujuan untuk menyelidiki beberapa aspek kunci terkait dengan PBL dan hasil pembelajaran di tingkat global dan menghasilkan wawasan mendalam tentang tren dan fokus penelitian terkait pendekatan pembelajaran berbasis masalah (PBL) dan hasil pembelajaran. melalui analisis bibliometrik. dari sebanyak 1132 artikel database scopus, setelah melalui proses seleksi menjadi 742 artikel. Ditemukan bahwa minat dan fokus penelitian terhadap topik ini meningkat secara signifikan dalam beberapa tahun terakhir, mencerminkan pentingnya PBL dalam mengembangkan keterampilan kritis dan kolaboratif peserta didik. Pentingnya pengembangan alat pengukuran pendidikan yang valid dan reliabel untuk mengukur hasil pembelajaran. Pentingnya kerja sama internasional dalam memperkaya pemahaman tentang PBL dan hasil pembelajaran. Faktor-faktor manusia, seperti karakteristik peserta didik ditemukan penting dalam merancang kurikulum PBL yang responsif terhadap kebutuhan peserta didik. Temuan ini memberikan panduan arah penelitian mendatang, menyoroti potensi inovatif dalam pengembangan PBL. Kesimpulannya, hasil dan pembahasan ini memberikan landasan yang kuat untuk pengembangan pendidikan yang berorientasi pada hasil pembelajaran yang efektif di era modern.

Kata Kunci: *bibliometrik; hasil belajar; pembelajaran berbasis masalah*

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INTRODUCTION

Education plays an essential role in shaping and directing the evolution of society toward sustainable progress. Effective education becomes increasingly important in a constantly changing global context to prepare younger generations to face future challenges. Social, economic, and technological changes demand learning methods to develop critical and adaptive skills (Omelchenko, 2021; Rıstanto et al., 2022). One approach that has shown great potential in meeting these needs is Problem-Based Learning (PBL). The PBL approach encourages students to think critically, collaborate, and solve real-world problems, which is highly relevant to the demands of the modern age. Recent studies show that this method improves conceptual understanding and practical skills needed in the workplace (Hegade & Shettar, 2022). Therefore, PBL has gained widespread attention from researchers and education practitioners as an innovative and compelling learning model (Aristin et al., 2023).

Previous studies relevant to this research have highlighted various aspects of Problem-Based Learning (PBL) and its impact on learning outcomes. Earlier research showed that PBL can enhance students' ability to think critically, collaborate, and solve real problems (Lubis et al., 2022). Another study by Subandowo (2022) also emphasized the importance of PBL in guiding the evolution of society toward sustainable progress. This research found that PBL helps students develop practical skills required in the workplace and deepen conceptual understanding. Another study found that PBL could improve students' critical thinking, collaboration skills, and problem-solving abilities (Amelia, 2023). Additional research also explained the importance of PBL in developing vital and adaptive skills needed in dynamic environments (Harini et al., 2023). Prior studies also concluded that PBL helps students enhance both practical skills required in the workforce and conceptual comprehension (Jaya et al., 2023).

These previous studies show that PBL has attracted widespread attention from researchers and education practitioners as an innovative and compelling learning model. They also highlight the importance of PBL in developing critical and adaptive skills required in dynamic environments, while enhancing students' ability to think critically and collaborate. Understanding the trends and research focus on PBL and its impact on learning outcomes is essential globally. Therefore, conducting research using bibliometric analysis on literature related to PBL and learning outcomes worldwide is a compelling pursuit. This is what differentiates this study from previously conducted research.

By integrating these findings and investigating key aspects of PBL and learning outcomes through bibliometric analysis, this study aims first to identify citation trends, providing insights into the engagement and impact of PBL-related research among academics and education practitioners. Second, it examines publication trends to understand how the volume of literature related to PBL and learning outcomes has evolved and how active this research area is in various countries. Next, this study will analyze the geographic distribution of research to reveal the relative contribution of different regions in PBL and learning outcomes research. Additionally, it will map out the most common research focuses, such as frequently discussed subtopics and research methods used, to understand the primary directions and interests of existing literature. Finally, this study will evaluate the novelty of the research by identifying underrepresented or underexplored areas, which could serve as sources of inspiration for researchers to explore new domains within the context of PBL and learning outcomes.

LITERATURE REVIEW

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Problem-Based Learning (PBL)

The Problem-Based Learning (PBL) approach is an educational method that prioritizes using real-world problems as a context for students to learn critical thinking, collaboration, and problem-solving skills. This method was first introduced in medical education and has since been widely adopted across various disciplines. PBL originated from McMaster University in Canada in the 1960s. The Netherlands and the United States were among the earliest countries to adopt this method (Hallinger, 2021). PBL was introduced as a solution to traditional medical education issues that hindered clinical reasoning skills. It is an instructional approach characterized by patient-based problem-solving in small groups with guidance from a tutor. PBL is a learning approach where students are encouraged to work collaboratively in small groups to identify authentic problems from real life (Kaeedi et al., 2023). Students actively search for relevant facts and apply their current knowledge and experiences to offer possible solutions to those problems. PBL is a student-centered active learning approach where students play a significant role in learning and construct their knowledge rather than merely receiving information.

PBL is a learning strategy in which students work in small groups to solve complex and unstructured problems. This approach differs from traditional learning methods, focusing on teacher-led information delivery. The fundamental principles of PBL include student-centered learning, learning in small groups, the tutor acting as a facilitator or guide, authentic problems being presented at the beginning to provide relevance and motivation to learn, knowledge construction and development of clinical problem-solving skills, and acquiring new knowledge through self-directed learning (Kulo & Cestone, 2023).

The Impact of PBL on Learning Outcomes

Previous studies have shown various positive impacts of PBL on learning outcomes. The study titled *"The Quantitative and Qualitative Study of The Effectiveness of The Problem-Based Learning Approach in The Teaching Research Approach"* found that students in the PBL group were generally more effective in improving academic performance, knowledge acquisition, research skills, motivation, and autonomy compared to students in the Lecture-Based Learning (LBL) group (Kaeedi et al., 2023). Another study titled "The Application of PBL to Improve Chemistry Learning Outcomes" found that implementing PBL improved students' cognitive, affective, and psychomotor learning outcomes. PBL also enhanced students' scientific attitudes, increased their engagement in the learning process, fostered interpersonal relationships, and raised their internal motivation to learn (Suswati, 2021). Applying PBL can increase student engagement and learning outcomes across chemistry concepts such as buffer solutions, chemical bonds, and elemental chemistry.

Several other studies have also shown that PBL helps develop students' critical and adaptive skills. Prior research demonstrated that PBL could improve students' ability to analyze and provide solutions to problems encountered in subjects like Management Information Systems (Kardoyo et al., 2020). However, that study had limitations in measuring learning outcomes, relying only on qualitative assessments. Earlier research stated that the impact of PBL on learning outcomes involves several vital aspects (Smith et al., 2022). PBL develops flexible thinking that enables the smooth acquisition, transfer, and application of knowledge, skills, and capabilities across different situations. PBL also emphasizes the importance of redefining failure as a valuable part of the learning process, helping students see failure as a necessary learning experience.

In addition, PBL actively engages students in constructing knowledge, which can improve metacognition and learning independence. Research has shown that applying the PBL model significantly impacts junior

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high school students' mathematical critical thinking skills, with an effect size of 0.970. The same study emphasized that PBL could improve essential thinking skills more generally across various subjects (Yohannes et al., 2021).

PBL has also enhanced students' conceptual understanding and practical skills. Research on the impact of PBL on learning output shows varied results. Most studies report that PBL outperforms traditional or lecture-based learning methods regarding academic performance and knowledge retention (Trullàs et al., 2022). Furthermore, PBL is also more effective in improving problem-solving skills and self-directed learning. Other studies have demonstrated various PBL adaptation approaches that enhance critical thinking skills, conceptual understanding, and students' practical abilities (Su et al., 2023).

METHODS

This research uses bibliometric analysis. This method was chosen for its ability to provide a comprehensive overview of existing trends, patterns, and research focuses within a particular field (Kurdi & Kurdi, 2021; Wardhana, Salim et al., 2023; Wardhana, Sugihartati et al., 2023). This bibliometric analysis is expected to offer in-depth insights into the development of PBL and learning outcomes research and to identify emerging research trends across different regions globally. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol was used in this study. Data sources were obtained from a leading academic database, Scopus, which provides access to various scientific articles, journals, conferences, and other related literature.

The selection procedure consisted of four steps: identification, screening, eligibility, and inclusion (Liberati et al., 2009). The first step, identification, involved entering the keywords "Problem-Based Learning" and "learning outcome" into the Scopus database. This initial search resulted in 1132 articles.

The next step was screening, during which the researchers set inclusion criteria, such as only including journal-published articles. After this screening process, 753 publications met the criteria. The third step involved filtering based on language, in this case, selecting only articles written in English. Publications that met these criteria were then analyzed in the subsequent phase. A total of 742 documents entered the inclusion phase.

Descriptive bibliometric analysis was performed using data from the Scopus database to identify publication trends. Data that met the inclusion criteria and passed all four PRISMA stages were analyzed using several tools, including Microsoft Excel, Publish or Perish, and VOSviewer. Microsoft Excel was used to observe publication trends. Publish or Perish was used to calculate annual citation rates and total citations. VOSviewer was employed to visualize relationships between countries and to examine research focuses and novelty.

RESULTS AND DISCUSSION

Publication Trends

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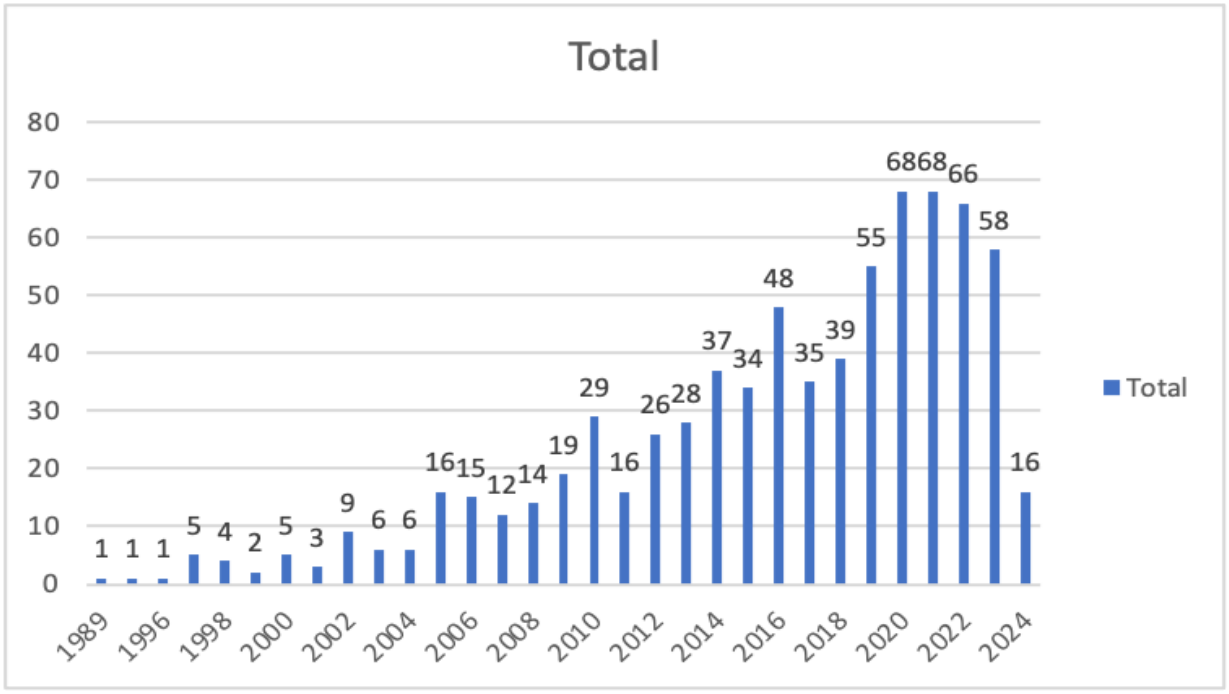

Figure 1: Publication Trends
Source: Author's documentation 2024

Based on Figure 1, research on PBL and learning outcomes worldwide peaked in 2020 and 2021, with 68 publications each year. This increase in the number of publications reflects the growing interest and research focus on implementing PBL and learning outcomes at the global level. It indicates that during these years, the academic community and education practitioners paid significant attention to the concept of PBL and the evaluation of the learning outcomes it produces. The increase also represents efforts to better understand the effectiveness, challenges, and implications of applying the PBL approach in various educational contexts worldwide. This aligns with previous studies showing a significant increase in publications discussing the application of PBL in diverse educational settings (Zhang et al., 2022). These findings reflect growing interest from researchers and educators in the concept of PBL and its impact on learning outcomes. Thus, the rise in publications during these years indicates that PBL has become a highly relevant and important topic in global education discussions and research.

The increased publications may also reflect the challenges or problems encountered in problem-based learning and learning outcomes. Despite the high interest and focus in this research area, several challenges persist, such as unequal student engagement in PBL processes (Sari, 2023); difficulties in designing problems that align with curriculum needs and learning objectives; and limited resources and infrastructure to implement PBL effectively (Rasyada, 2023; Sutrisno & Syukur, 2023). Furthermore, consistent and objective measurement and evaluation of learning outcomes from PBL approaches remain challenging (Sucipta et al., 2023). With increasing curriculum complexity and diverse learning outcome demands, educators must develop innovative strategies to optimize PBL effectiveness in global education.

Citation Trends

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A total of 742 articles were included in the study. Of these, 647 articles had been cited by other researchers, while 94 had not received any citations by the time this article was written. There were 58 articles cited more than 100 times. Prince and Felder (2006) noted the most-cited article, with 1,552 citations. The top four most-cited articles are shown in Table 1.

.

Table 1. Cite trends

No	Author	Title	Much cited
1	Prince & Felder (2006)	Inductive teaching and learning methods: Definitions, comparisons, and research bases	1.552
2	Dost *et al*. (2020)	Perceptions of medical students towards online teaching during the COVID-19 pandemic: A national cross-sectional survey of 2721 UK medical students	443
3	Yadav *et al*. (2011)	Problem-based learning: Influence on students' learning in an electrical engineering course	352
4	Moravec *et al*. (2010)	Learn before lecture: A strategy that improves learning outcomes in a large introductory biology class	255
5	Biggs (2012)	What the student does: Teaching for enhanced learning	211
6	Hung (2011)	Theory to reality: A few issues in implementing problem-based learning	187
7	Fatmi *et al*. (2013)	The effectiveness of team-based learning on learning outcomes in health professions education: BEME Guide No. 30	180

Source: Research 2024

Based on **Table 1**, the most cited article related to PBL and learning outcomes worldwide is “Inductive teaching and learning methods: Definitions, comparisons, and research bases” (Prince & Felder, 2006). Many other researchers have cited this article because it explains the effectiveness of inquiry-based, problem-based, and case-based teaching in science and engineering education. This article comprehensively reviews the evidence supporting these learning approaches, including meta-analyses, empirical studies, and expert opinions. In addition, this article also offers practical examples and case studies of the successful implementation of these methods in various educational settings. The thorough evaluation of these teaching approaches and their impact on student learning makes this article a valuable resource for researchers and educators in science and engineering education.

The following article that other researchers widely cite is the article titled “Perceptions of medical students towards online teaching during the COVID-19 pandemic: A national cross-sectional survey of 2721 UK medical students” (Dost et al., 2020). This article provides valuable insights into medical students’ perceptions of online teaching during the COVID-19 pandemic. Using data from a national survey of 2,721 medical students in the UK, the study provides an in-depth understanding of how online teaching has impacted medical education during this challenging time. Key findings, such as significant differences in the time spent by preclinical and clinical students on online platforms during the pandemic and positive evaluations of faculty preparedness and students’ professional preparation, provide essential contributions to the literature on medical education in the digital age. The recommendations generated from this study also provide valuable guidance for educational institutions to improve online teaching in the future, making this article an essential reference for researchers interested in medical education and learning technologies.

International Collaboration

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Cooperation between countries in research on PBL and learning outcomes can be presented in **Figure 2** below.

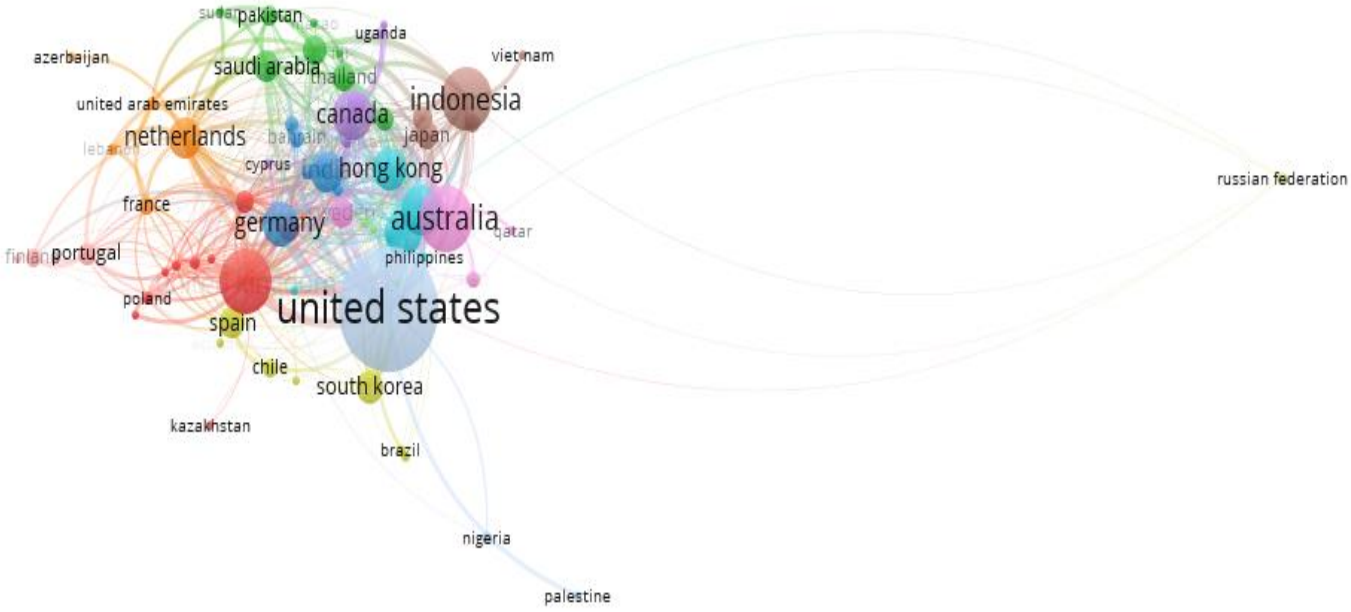

Figure 2: Cooperation between countries in publishing articles on the theme of PBL and learning outcomes
Source: Author's documentation 2024

Figure 2 shows that researchers from the United States actively collaborate with international research partners, especially Australia, contributing significantly to "Problem-Based Learning and Learning Outcomes." Involving as many as 69 countries in collaborative research, the United States is central in fostering international partnerships, opening opportunities for broader knowledge and experience exchange. This indicates that the U.S. is an active regionally and globally, reinforcing its reputation in educational research. The strong collaboration with Australia demonstrates that the U.S. is not solely focused on internal research development but equally invested in strengthening regional and global connections. This international collaboration is a crucial pillar in establishing a robust and sustainable research network, positively impacting the advancement of PBL and learning outcomes within education curricula worldwide.

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Research Focus

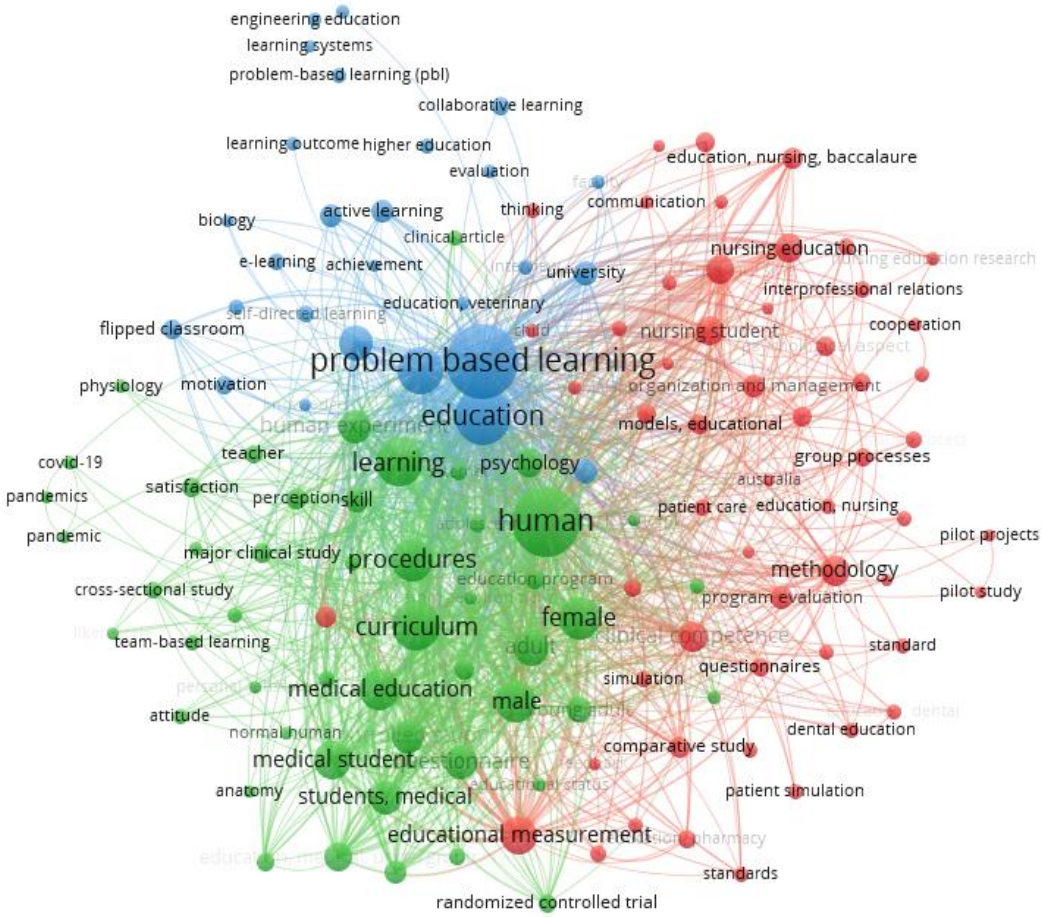

Figure 3: Network Visualization
Source: Author's documentation 2024

In Figure 3, the network visualization shows the number of research focuses in the context of Problem-Based Learning and Learning Outcomes. Three colors represent three research focuses from 742 data points collected. Thus, previous studies related to this topic focus on three main areas.

The first research focus, marked in red, features two main keywords: "educational measurement" and "methodology." The largest circles in this visualization indicate that "educational measurement and methodology" is the primary focus of previous studies on Problem-Based Learning and Learning Outcomes. This shows that prior research has highlighted the relationship between educational measurement and methodology. The emphasis on educational measurement indicates the importance of developing and implementing valid and reliable assessment tools to evaluate learning outcomes in the PBL context. Meanwhile, the focus on methodology highlights the importance of using appropriate research methods to design, implement, and assess PBL models. Therefore, these studies are most likely aimed at understanding how applied educational measurement methods and research methodologies can influence the understanding and evaluation of the effectiveness of PBL in achieving the desired learning objectives.

The second research focus, marked in green, involves the main keywords "human" and "curriculum." The largest circle in this cluster indicates that research on Problem-Based Learning and Learning Outcomes

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tends to focus more on the relationship between human aspects and the curriculum. The keywords “human” and “curriculum” emphasize that past studies in this context have centered on how human factors, such as student characteristics, learning needs, and student engagement, interact with the curriculum in PBL settings. This indicates that researchers tend to examine how PBL curriculum design affects student participation and learning outcomes. By understanding this dynamic, research can assist in developing more effective and responsive curricula to meet learners' needs and characteristics and strengthen the relationship between the PBL learning method and achieving the desired learning outcomes.

The third research focus, marked in blue, consists of two keywords: “Problem-Based Learning” and “education.” The largest circle in this cluster shows that significant research has highlighted the relationship between “Problem-Based Learning” and “education” in the context of PBL and learning outcomes worldwide. This indicates researchers' strong interest in understanding how PBL is applied in broader educational contexts at various levels and academic settings. The focus on the keyword “Problem-Based Learning” emphasizes developing and implementing problem-centered learning approaches to improve student learning outcomes. Meanwhile, the keyword “education” indicates that the studies not only consider the implementation of PBL in formal education but also possibly consider aspects of non-formal and informal education. Thus, this research can provide broad insights into how PBL influences educational processes, covering various aspects from curriculum to student learning outcomes worldwide.

Emerging Themes in Problem-Based Learning Research

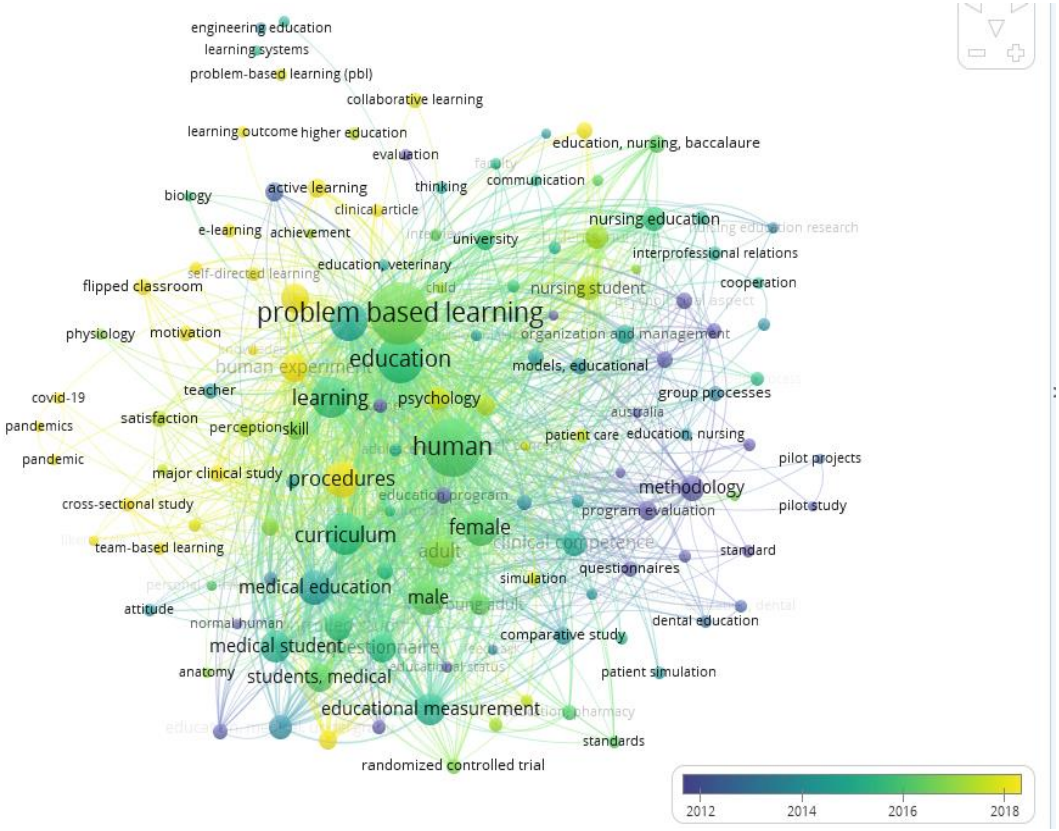

Figure 4: New research theme on PBL PBL
Source: Author’s documentation 2024

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In Figure 4, the colors differentiate the years of keyword appearances: blue indicates older themes, while yellow highlights more recent topics. Yellow keywords show that research has recently intensified in those areas. By analyzing keyword relationships, researchers have identified themes reflecting current interests and novelty in PBL research.

Newly identified themes include team-based learning, cross-sectional studies, e-learning, flipped classrooms, and motivation. These indicate a shift toward integrating PBL with technology-enhanced learning and more diverse methodological approaches. As education systems adapt to digital transformation and student-centered pedagogy, these themes suggest opportunities for future research and curriculum development focused on blended learning, digital platforms, and intrinsic motivation within the PBL framework.

This better understanding of trends and research focuses on PBL and learning outcomes is expected to guide researchers, educators, and policymakers in enhancing future teaching practices and research. Moreover, bibliometric analysis helps identify research gaps for further exploration and supports informed decision-making in educational innovation and policy.

Discussion

The results and discussions above are relevant in developing problem-based education (PBL) and evaluating learning outcomes. Based on the bibliometric analysis, it can be concluded that research interest and focus on PBL and learning outcomes have increased significantly, especially in recent years. Previous studies show that PBL has been recognized as an essential and practical learning approach in developing learners' critical thinking, problem-solving, and collaboration skills (Trullàs et al., 2022). One of the main implications of this study is the importance of developing valid and reliable educational measurement tools to evaluate learning outcomes in the context of PBL. The findings indicate that the primary research focus is educational measurement and methodology. Therefore, curriculum developers and education practitioners need to pay attention to the importance of improving evaluation tools to measure the effectiveness of PBL in achieving the desired learning objectives.

The results of the bibliometric analysis show that research on PBL and learning outcomes has involved extensive international collaboration. This indicates that cross-border cooperation is essential in enriching the understanding of PBL and learning outcomes and expanding the application of this approach in various educational contexts. Previous research has shown that PBL can improve students' critical thinking and collaboration skills and solve real-world problems (Lubis et al., 2022). Furthermore, this study underlines the importance of considering human factors, such as student characteristics and their involvement, in designing PBL curricula. This highlights the need for a responsive approach to student needs and preferences in developing problem-based curricula. Identifying new themes in this study provides clues for future research directions in PBL and learning outcomes. Educational researchers and practitioners can use these findings to identify unexplored research areas and to explore innovative potential in developing problem-based education.

CONCLUSION

Based on the results and discussion of this bibliometric analysis, several things can be concluded: First, there has been an increase in interest and research focus on PBL and learning outcomes, especially in recent years. This confirms that PBL is recognized as an essential and practical learning approach in developing critical and collaborative skills among learners. Second, the importance of creating valid and reliable educational measurement tools to evaluate learning outcomes in the context of PBL is reinforced.

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The primary research focus is related to the aspects of educational measurement and research methodology, emphasizing the need for improved evaluation tools to measure the effectiveness of PBL in achieving the desired learning objectives.

Third, extensive international collaboration in research on PBL and learning outcomes indicates that cross-border cooperation is essential in understanding PBL and learning outcomes. This provides an opportunity to expand the application of this approach in various educational contexts. Fourth, the importance of considering human factors, such as learner characteristics and their involvement, in designing PBL curricula is emphasized. This highlights the need for a responsive approach to learners' needs and preferences in developing problem-based curricula. Fifth, identifying new themes in this study provides clues for future research directions in PBL and learning outcomes. Researchers and educational practitioners can use these findings to identify unexplored research areas and to explore innovative potentials in the development of problem-based education.

Overall, the results and discussions of this bibliometric analysis provide valuable insights into the development and application of PBL in sustainable education and are oriented towards effective learning outcomes. They provide a strong foundation for further research and development in this field and emphasize the importance of PBL in facing the complex educational challenges of the modern era.

AUTHOR'S NOTE

The author declares that there is no conflict of interest regarding the publication of this article and confirms that the data and content of the article are free from plagiarism.

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