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Research Trends in Project-Based Learning in Elementary Schools (2001-2024): Bibliometric Analysis

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Abstract

Project-Based Learning (PjBL) is an educational method that engages students in completing projects relevant to real-life contexts, fostering critical thinking and problem-solving skills. This study aims to systematically analyze trends and developments in research related to PjBL in primary schools through a bibliometric approach, providing insights into the method's implementation in primary education. The study employs data retrieved from the Scopus database using the Publish or Perish tool, which is analyzed with VOSviewer to visualize trends in collaboration, keywords, and contributions of prominent authors. Over the past two decades (2001–2024), 173 publications have been identified, with a notable surge in research output beginning in 2017 and peaking in 2020. The analysis highlights keywords such as "STEM," "digital literacy," and "multiple intelligences," underscoring the multidimensionality of PjBL. Additionally, the study identifies key contributors and institutions driving research in this field. The findings are organized logically, presenting a clear sequence of scientific activities conducted in this study. This research underscores the pivotal role of PjBL in enhancing students' 21st-century skills, particularly through technology integration and fostering collaboration among researchers. It also lays the groundwork for future studies to delve into the effective and contextual application of PjBL in primary schools, addressing current educational challenges.

Keywords Bibliometrics; Elementary School; Project-Based Learning

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1. INTRODUCTION

Project-Based Learning (PjBL) is a learning method that emphasizes the active involvement of students in solving real problems through projects relevant to their lives. This method aims to engage students deeply by challenging them to complete complex and in-depth tasks, which require more than memorizing concepts (Isman et al., 2022; Larmer et al., 2015). In project-based learning, students are directed to design, develop, and present projects independently and in groups. PjBL supports learning by providing opportunities for students to explore crucial critical thinking and problem-solving skills in the real world (Abidin et al., 2021; Hossain, 2020). Because it actively engages students, PjBL also encourages them to take responsibility for their learning, which can increase their motivation and

involvement in the learning process (Blumenfeld et al., 1991). With the growing active learning approach, PjBL has been implemented at various levels of education, including in primary schools, to prepare students for real-world challenges from an early age.

The role of PjBL in learning is quite significant because it teaches academic concepts and instills essential social and cooperation skills for students. In PjBL, students are encouraged to collaborate with their classmates to achieve common goals, which in turn develops communication and collaboration skills that are in demand in the modern world of work (Larmer et al., 2015; Oktaviani, 2022). Teachers in this context act as facilitators, helping to direct students and provide the support they need to achieve optimal outcomes (Hung, 2012; Lee, 2004). In addition, the PjBL model allows students to learn in relevant and authentic situations, thus helping them see the relevance of the knowledge they are learning to their daily lives (Afriana, 2016; Isman et al., 2022).

Despite having various advantages, PjBL also has several disadvantages and challenges that need to be overcome to improve its effectiveness in learning. One of the main advantages of PjBL is its ability to encourage active student engagement and improve critical thinking skills, which are not always achieved through conventional learning methods (Abidin et al., 2020; Barron, 2006). On the other hand, PjBL can be a challenge because it requires careful preparation from teachers as well as adequate infrastructure support, especially in elementary schools (Krajcik, 2018). Some studies show that without good preparation, PjBL can lose its essence and become poorly structured learning (Al-Kamzari, 2024; Merritt, 2017). Despite these challenges, various innovations have been proposed to improve the implementation of PjBL, such as the use of digital technologies in projects to increase student engagement and facilitate online collaboration (Boss & Krauss, 2022). However, many innovations in PjBL still need to be explored, especially related to adapting this method in different educational contexts and with various resource limitations.

Understanding research trends related to PjBL is very important to improve student learning outcomes. These trends can help educators and researchers understand how the application of PjBL is evolving and how this approach can be adapted to the changing needs of students (Arisa, 2023; Burlbaw, 2013). In primary school, applying PjBL becomes increasingly relevant as students at this stage are in an important developmental phase where they build a foundation of academic and social skills (López, 2014). This trend also shows aspects of PjBL that still need to be studied in more depth, such as the impact of this method on students' motivation and non-cognitive skills, which are crucial in supporting lifelong learning (Sari et al., 2018; Serpara et al., 2022). Understanding research trends allows educators to identify and adapt effective best practices to local contexts. By understanding the development of this trend, evidence-based education can be applied to support the overall success of students in facing future challenges.

Various studies have explored the effectiveness of PjBL in improving student learning at the primary to higher levels. Larmer et al. (2015) For example, PjBL can encourage deeper student understanding if supported by an appropriate curriculum and adequate teacher training. Meanwhile, Lotherington, (2017) Emphasizing the importance of clear project planning and measurable learning objectives to ensure the success of PjBL in achieving the desired outcomes. Other research by Fleming, (2000) Highlighting challenges in implementing PjBL, including lack of teacher readiness and limited infrastructure, can affect these methods' effectiveness. Even so, these studies consistently show that PjBL can improve students' engagement and critical thinking skills in primary school when applied correctly. The existing literature also notes that PjBL, although challenging, makes a positive contribution to the quality of learning.

However, there are still significant research gaps related to PjBL, especially in the form of a lack of bibliometric analysis that evaluates the development and dissemination of PjBL research in elementary schools. Bibliometric analysis is important because it can provide a comprehensive picture of how PjBL research has evolved, the contributions of different countries, and the topics that are the main focus of

researchers (Ariani et al., 2022). This lack of analysis can hinder a comprehensive understanding of PjBL trends, especially in looking at the factors that support or hinder the widespread adoption of this method. The lack of research that maps the literature also makes it difficult for educators and researchers to understand the long-term potential of PjBL in various educational contexts. With bibliometric analysis, it is hoped that the direction of PjBL development in the future and areas that still need to be explored can be known.

This bibliometric analysis aims to systematically evaluate research trends related to Project-Based Learning (PjBL) in primary schools, focusing on its impact on improving the quality of learning. The primary objective is to identify key research patterns, including the contributions of different countries or institutions and the most studied topics in the context of PjBL. In addition, this analysis seeks to examine the collaborative relationships between authors, offering insights into research networks and potential gaps in the existing literature. By focusing on these aspects, the research will provide a clearer understanding of how PjBL is being explored and applied in primary education (Rafiq et al., 2023). The significance of this study lies in its potential to inform educators, researchers, and policymakers about the current state of research in PjBL and its implications for educational practice. By synthesizing existing research, this analysis aims to identify trends and challenges that could help improve teaching practices, strengthen evidence-based approaches, and enhance the overall learning experience for primary school students. Ultimately, the findings will support the development of students' critical skills, essential for adapting to the demands of education in the 21st century.

2. METHODS

This study uses a bibliometric analysis approach to evaluate the trend of publications and scientific collaboration on Project-Based Learning (PjBL) in elementary schools. This methodology allows researchers to evaluate various aspects of scientific publications, such as the number of publications, collaborations between authors, and keyword networks, thus providing a comprehensive picture of the development of a research field (Muhammad & Triansyah, 2023). The data was collected using the Publish or Perish tool with the Scopus database, widely recognized for its in-depth coverage and relevance in scientific research. The selection of Scopus as the main data source is based on its excellence in providing access to well-selected high-quality publications.

The data collection process is carried out systematically through several stages. The first stage is identification, where the keywords "project-based learning" and "elementary school" are entered into Publish or Perish to pull relevant data from the Scopus database. The specified research period covers the last two decades to reflect recent developments. The next stage is screening, which aims to select data so that it only includes publications in the form of journal articles and proceedings, thus ensuring relevance to the focus of the research. After that, the eligibility stage is carried out by checking the suitability of the title and abstract of the article to verify that the publication meets the inclusion criteria. This process results in 173 articles ready to be analyzed after meeting all the selection requirements. The following is a data collection diagram.

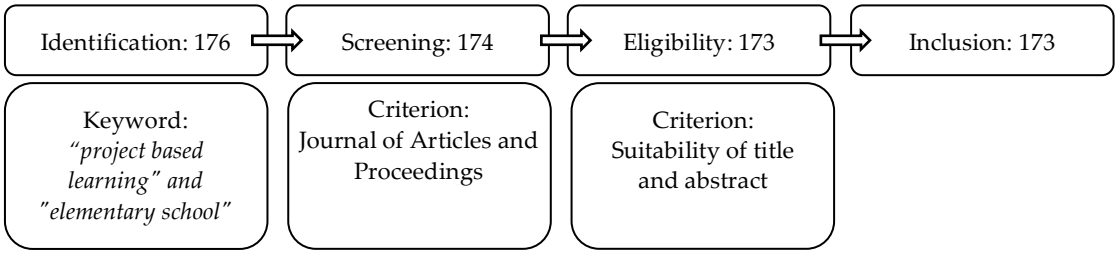

Figure 1. Data Collection Flow

To support the analysis, several tools are used that have special advantages. VOSviewer was chosen for its ability to visualize bibliometric data such as co-word and co-authorship analysis and create author collaboration network maps (Van Eck & Waltman, 2010). In this research, vosviewer was chosen to visualize co-word to know the main keyword. The app provides an easy-to-understand visual representation and helps identify publication patterns and trends. MS Excel processes data further and presents the results as informative tables and diagrams. Data analysis techniques include identifying trends in the number of publications over time, mapping frequently occurring key keywords, analyzing citation trends, and identifying author networks to understand collaboration between researchers. Emphasis is placed on how the results of this analysis can show the development of research topics and their contributions to the literature of PjBL in primary schools. The implementation of this analysis is expected to inform the direction of future research.

3. FINDINGS AND DISCUSSIONS

The number of publications obtained at the inclusion stage includes 173 selected publications in the last two-decade period, from 2001 to 2024. The distribution of publications showed that the contribution of journal articles reached 51.45%, while the remaining 48.55% came from conference proceedings. This reflects that the topic of Project-Based Learning (PjBL) in elementary schools has received significant attention in scientific articles and presentations in academic forums.

Publication Distribution

The data shows the development of research publications from 2001 to 2024. During this period, there were a total of 173 publications documented. At the beginning of the period, the number of publications was relatively low, with only one publication per year in 2001, 2002, 2003, and 2006. During these early years, attention to relevant research topics was minimal. However, starting in 2017, there was a gradual increase in the number of publications, reflecting the growing interest in this topic. The peak in the number of publications occurred in 2020, with 34 publications, which signals a significant surge in research activity. The following years, such as 2022, 2024, and 2021, also showed a fairly high number of publications, as many as 20, 19, and 18, respectively. This trend shows that research in this field has accelerated in recent years. The period 2017–2024 appears to be a time in which interest in this topic begins to increase consistently, perhaps due to the growing need for innovation in education or increased access to research resources.

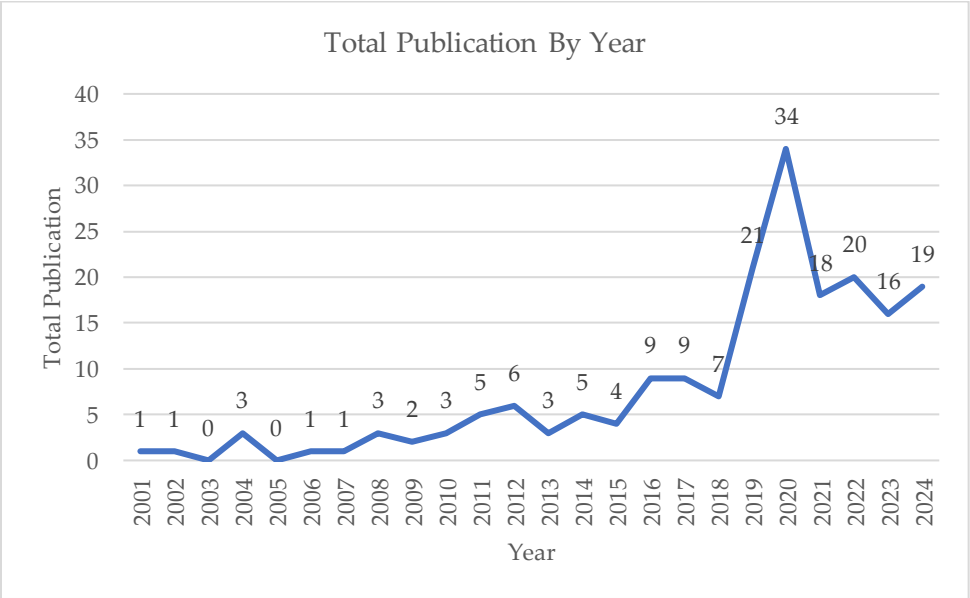

Figure 2. Publication Trends

Based on data on the development of publications related to Project-Based Learning (PjBL) in elementary schools from 2001 to 2024, it can be concluded that this topic has experienced a significant increase in the number of research, especially in the last decade. In the early years (2001–2010), the number of publications was very low, with only one to three publications per year. This indicates that PjBL had not received much attention among researchers in that period, and its application in basic education was still limited. The increase began in 2011–2016, when the number of publications tended to be stable although still relatively low, with figures ranging from three to six publications per year. This period marked the beginning of an increase in interest in PjBL, along with increasing awareness of the importance of innovative learning approaches to improve student learning outcomes in primary school.

The 2017–2024 period showed a significant spike in the number of publications, with the highest peak occurring in 2020, with 34 publications. These years marked a turning point for PjBL research in primary schools, which may have been driven by changes in education policy, technological advancements, and the need for more interactive and creative learning methods, especially in the face of the challenges of 21st-century learning (Torres, 2024). The increase in the number of publications in 2022, 2023, and 2024, with 20, 16, and 19 publications, respectively, shows that interest in PjBL continues and continues to be relevant in the study of basic education (Alkautsar et al., 2023). From this analysis, it can be concluded that research related to PJBL in primary schools is growing over time, reflecting the increasing need for innovative learning methods. However, the peak of research activity in 2020 may also be related to the impact of the COVID-19 pandemic, where adaptation of learning methods is very important. In the future, further research can explore the effectiveness of implementing PjBL more specifically in various contexts and educational conditions at the primary level (Ika Maryani et al., 2021).

Citation Trend

Table 1 contains the total number of publications related to PjBL in elementary schools from 2001 to 2024, showing significant fluctuations. The peak number of publications occurred in 2020, with 34 publications, while other years, such as 2002, 2006, and 2007, only had one publication. The number of publications cited (NCP) varies and tends to follow the total number of publications per year; for example, in 2020, 28 publications were cited, while several other years, such as 2002 and 2006, have an NCP of 0. The highest total citations (TC) were achieved in 2016 with 588 citations, although the total number of publications that year was only 9, indicating the significant influence of that year's publications. The following is Table 1 of the citation trend.

Table 1. Citation Trend

Year	TP	NCP	TC	C/P	C/CP	*h*	*g*
2024	19	6	16	0.84	0.38	2	3
2023	16	7	15	0.94	0.47	2	3
2022	20	16	91	4.55	0.18	5	8
2021	18	13	80	4.44	0.16	5	8
2020	34	28	189	5.56	0.15	9	12
2019	21	18	171	8.14	0.11	8	12
2018	7	6	109	15,57	0.06	5	7
2017	9	8	164	18.22	0.05	4	9
2016	9	9	588	65.33	0.02	7	9
2015	4	3	99	24.75	0.03	3	4
2014	5	4	49	9.80	0.08	2	5

Year	TP	NCP	TC	C/P	C/CP	*h*	*g*
2024	19	6	16	0.84	0.38	2	3
2013	3	3	81	27.00	0.04	3	3
2012	6	5	255	42.50	0.02	2	6
2011	5	2	9	1.80	0.22	2	3
2010	3	2	64	21.33	0.03	2	3
2009	2	2	23	11.50	0.09	2	2
2008	3	2	89	29.67	0.02	1	3
2007	1	1	11	11	0.09	1	1
2006	1	0	0	0	0	0	0
2005	-	-	-	-	-	-	-
2004	3	2	69	23	0.03	2	3
2003	-	-	-	-	-	-	-
2002	1	0	0	0	0	0	0
2001	1	1	8	8	0.13	1	1

Notes. *TP*= total of publication, *NCP*= number of cited publication, *TC*= total citations, *C/P*= average citations per publication, *C/CP*= average citations per cited publication, *h*= h-index, *g*= g-index

The highest average citations per publication (C/P) was also found in 2016, with 65.33 citations per publication, while 2024 has the lowest average citations per publication, with 0.84. C/CP measuring citation distribution shows similar variations, with the highest in 2016 and the lowest in 2024. The highest h index is nine recorded in 2020, indicating at least nine publications with nine or more citations in that year. Meanwhile, lower h-indices in years such as 2002 and 2006 show a limited number of publications in terms of influence.

The g-index supporting the h measurement shows a similar pattern, confirming the contribution of certain studies to the overall citation. Years like 2011 and 2015, although not among the most prolific, had a steady contribution of citations. 2020 to 2024 shows an increasing trend in the total number of publications, although the average citations per publication are lower than previous peaks. The year 2024, with 19 publications, marks continued interest in PjBL research, although its impact still needs time to develop.

The trend of publication citations related to Project-Based Learning (PjBL) in elementary schools has shown quite interesting developments in the last two decades. Based on the data, 2020 stood out as the most productive year, with 34 publications showing a significant increase compared to previous years. This indicates a surge in interest and more intensive research in that period, possibly due to the development of educational technology and more modern learning methods. However, the highest number of citations occurred in 2016, with 588 citations, even though there were only nine publications. This suggests that although the quantity of publications is not always high, their quality and influence can be significant, resulting in extensive citations. In contrast, in 2024, despite having 19 publications, it only gets an average of 0.84 citations per publication, indicating that the publication has not been widely cited, perhaps because it is still new or the topic is not in demand in the current scientific community.

Years with strong citation influences, such as 2016, reflect the importance of quality research that can have a wide impact, even if the number of publications is small. This shows that the amount, relevance, and contribution of the content produced influence research in the field of PjBL. Years like 2020 with the highest h index (9) indicate that in that year, there were at least nine publications with

nine or more citations, indicating that there are some studies that have consistently received attention from the academic community. On the other hand, years such as 2002, 2006, and 2007, with very few publications and citations, show that the topic of PjBL in elementary schools was still not widely explored in the early 2000s.

Overall, this analysis of citation trends shows that while the number of publications can provide an overview of productivity, the real influence is seen in the total and average citations per publication. High-citation publications, especially in years like 2016, reflect an important and relevant contribution to basic education. The use of higher citations indicates that the research is an important reference, both in theory and practice in the field (Molenaar et al., 2023) . Therefore, to increase the influence of citations, researchers should not only focus on quantity but also pay attention to the quality and relevance of the research produced to contribute more significantly to the progress of learning methods in elementary schools.

5 Most cited publications

Data collected using the Publish or Perish tool resulted in 173 publications sorted by citation frequency to identify influential or frequently referenced publications over the past two decades. The data processing results are presented in the form of tables containing the main findings of each study as well as an in-depth analysis of why these articles are significant references. This analysis is expected to provide insight into research trends and contributions of scientific works in related fields. The following is a display of data on the *Publish or Perish application.*

	Cites	Authors	Title	Year	Publication
h	368	J. Sáez-López	Visual programming languages integrated across the curriculum in elementary ...	2016	Computers and Educ...
h	197	C.M. Hung	A project-based digital storytelling approach for improving students' learning ...	2012	Educational Technolo...
h	88	L. ChanLin	Technology integration applied to project-based learning in science	2008	Innovations in Educat...
h	77	J. Afriana	Project based learning integrated to stem to enhance elementary school's stude...	2016	Jurnal Pendidikan IPA...
h	60	G. Baş	Effects of multiple intelligences supported project-based learning on students' ...	2010	International Electron...

Figure 3. Data display in *the Publish or Perish app*

The following table shows the five most cited publications and their findings.

Table 2. 5 Most cited publications

Author and Year of Publication	Title	Findings
(Sáez-López, 2016)	Visual programming languages integrated across the Curriculum in elementary school: A two-year case study using "Scratch" in five schools	Using VPL with an active approach and ***project-based learning*** significantly improves students' understanding of programming concepts, logic, and computational practices. Students also show increased motivation, commitment, and enthusiasm during the learning process, where they can create content related to the curriculum, thus adding to their enjoyment and engagement. The implementation of VPL has proven to be effective in basic education, where the Project Based Learning approach encourages students' commitment and understanding of computing concepts. Based on the positive results and benefits found, it is recommended that VPL be integrated across the curriculum to teach grade 5 and 6 students in primary education.
(Hung, 2012)	A project-based digital storytelling approach for improving students' learning motivation, problem-solving	This article discusses using project-based digital storytelling approaches to overcome the challenges of implementing effective project-based learning strategies in improving student learning performance. The results show that ***project-based learning*** with digital storytelling

	competence, and learning achievement	effectively increases students' motivation to learn science, problem-solving competence, and learning achievement.
(ChanLin, 2008)	Technology Integration Applied to Project-Based Learning in Science	This article discusses the results of a study that observes the use of technology by 10-11-year-old students in project-based learning activities in science. In this learning process, students use computer technology to gather, organize, and present information to their peers. The research process involves directed research, interaction with friends, teachers, and the community through personal interviews and visits, and the presentation of their understanding through web pages. The results showed that all students successfully achieved their research goals. Student learning outcomes are evaluated based on their skills in synthesizing and elaborating knowledge, engaging in scientific exploration tasks, and using technology to support and report on their research work. Teacher support in providing mentoring skills proved crucial to student success in ***a project-based learning environment.***
(Afriana, 2016)	Project-based learning integrated to enhance elementary school students' scientific literacy	This article discusses the application of ***Project-Based Learning*** (PjBL) integrated with STEM (science, technology, engineering, and mathematics) to improve the science literacy of elementary school students. PjBL STEM learning, gaining an impressive experience during learning, and experiencing increased motivation and interest in learning.
(Baş, 2010)	Effects of Multiple Intelligences Supported project-based Learning on Students' Achievement Levels and Attitudes Towards English Lesson	This article discusses research on the influence of ***project-based learning*** supported by multiple intelligence theory compared to traditional foreign language teaching methods on student achievement and attitudes toward English lessons. This research was conducted in the 2009-2010 school year at Karatli Sehit Sahin Yilmaz Elementary School, Nigde, Turkey, involving 50 grade 5 students from two different classes. The results showed a significant difference between the students' attitude scores in the experimental group and the control group. It was found that activities based on the multiple intelligence approach were more effective in developing students' positive attitudes. The study also revealed that students who learn with project-based learning methods supported by multiple intelligences are more successful and have higher motivation levels than students who learn with traditional teaching methods.

These findings confirm that various PjBL approaches supported by technology, STEM, and modern educational theories, such as multiple intelligences, can improve learning outcomes, motivation, and students' positive attitudes toward learning. This approach strengthens the understanding of the content and develops critical thinking and problem-solving skills. A project-based learning approach (PjBL) supported by technology and contemporary educational principles in improving student learning outcomes. The integration of Visual Programming Language (VPL) with PjBL, such as the use of Scratch, has been shown to significantly impact the understanding of programming concepts and the mastery of computing skills. This approach encourages students to not only learn the content passively but also actively participate in the learning process, which in turn increases their motivation and

engagement.

In addition, implementing project-based digital storytelling adds a creative dimension to PjBL. This method combines digital narratives to increase students' motivation and problem-solving skills. The use of technology as a medium of teaching also highlights the importance of facilitating interactive learning that allows students to explore and communicate their findings effectively. Integrating PjBL with STEM in science learning shows that combining these elements provides a more comprehensive learning experience, where students can develop better science literacy and increased interest in learning. The hands-on experience students gain from this cross-disciplinary approach facilitates a deeper understanding of the concept and its relevance to the real world. The approach based on the theory of multiple intelligences adds a pedagogical dimension that recognizes and utilizes individual differences in how students learn. The results showed that students who engaged in PjBL learning with the support of multiple intelligences had higher achievement and more positive attitudes, confirming the importance of personalized teaching strategies to improve academic success and student engagement.

These findings reinforce the argument that PjBL equipped with technology, STEM principles, and a multiple intelligence-based approach plays a role in teaching content and building essential critical thinking and problem-solving skills. It demonstrates the need for a curriculum that allows innovative teaching methods to prepare students with 21st-century skills. Teachers' support in providing relevant guidance is also a key element of success, as they play a crucial role in facilitating challenging but supportive learning.

Main Keywords

The results of the VOSviewer visualization analysis show that this diagram includes 411 nodes with 1,413 links and a total link strength of 1,537. There are 38 clusters, each marked with a color indicating a group of closely related research topics or themes. The nodes in this visualization represent the keywords that appear in the related literature. In contrast, the node size indicates the frequency with which they appear in the dataset—the larger the node, the more often it appears in the analyzed research.

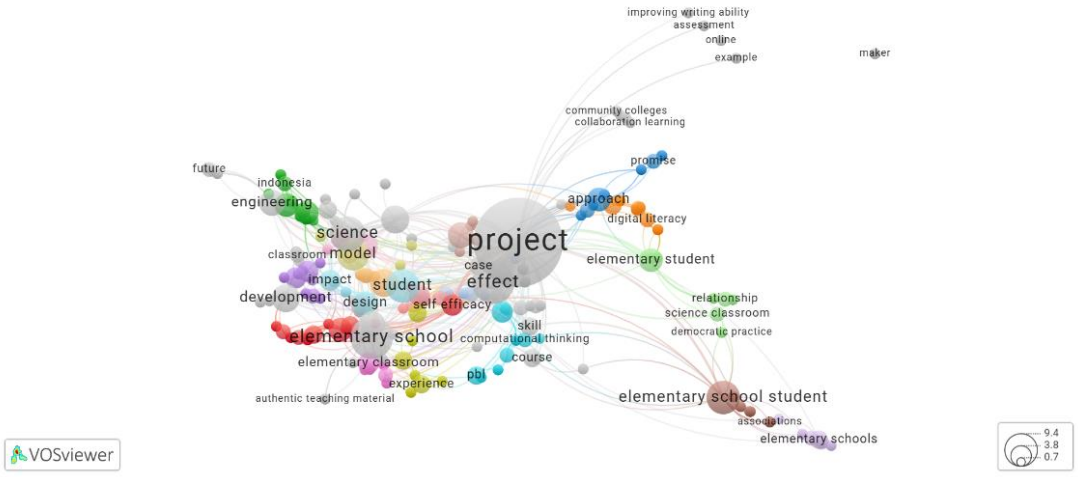

Figure 3. Main Keywords

Based on the results of the VOSviewer visualization analysis, it can be seen that the keyword *"project"* is the main focus in research related to project-based learning methods. The *"project"* node is very large, indicating that this keyword most often appears in the literature and has extensive connections with other keywords. A close relationship is seen with keywords such as *"effect," "approach," and "student,"* indicating that research in this area not only discusses project implementation

but also focuses on the approach used and its impact on students. The existence of this strong node shows that *project-based learning (PjBL)* is considered a significant method applied to improve student learning outcomes in various educational contexts, especially at the primary school level (Wahyuningtyas et al., 2023).

In addition, this visualization shows the existence of keyword clusters that form various research focuses. For example, the green cluster connects *"project"* with aspects *of "engineering," "science,"* and *"technology,"* suggesting that PjBL is often associated with STEM (Science, Technology, Engineering, and Mathematics) education (Arisa, 2023). On the other hand, the red cluster includes keywords such as *"elementary school"* and *"development,"* highlighting the application of these methods at the primary school level and efforts to develop learning methods and models. There is also a blue cluster that includes keywords such as *"social study"* and *"digital literacy,"* emphasizing that PjBL is used in a broader context, including digital literacy and social studies (Maharani et al., 2024; Subakir et al., 2023). The existence of these various clusters indicates that PjBL research includes multidimensional aspects involving technology integration, model development, and other learning contexts (Agustini et al., 2020; Triprani et al., 2023).

From the visualization, it can be seen that research on PjBL has a deeper relationship with certain aspects, such as *"improving writing ability,"* *"assessment,"* and *"collaborative learning,"* which are located further on the right side of the diagram (Abu Dharin et al., 2023; Graven, 2023). This indicates a research interest in more specific subtopics, such as improving students' writing skills and learning assessments. This vast network also features a total *link strength* of 1,537 with 411 items and 38 clusters, indicating the breadth of connections and diversity of topics covered in the literature. This shows that although the main focus is on the application of PjBL, many other aspects are also considered in the research, both in terms of methods, outcomes, and the broader educational context (Budiarti et al., 2023).

4. CONCLUSION

This study shows that Project-Based Learning (PjBL) in primary schools has experienced a significant increase in the last two decades. From 2001 to 2024, there were 173 publications related to PjBL, with an almost even distribution between journal articles and conference proceedings. Although initial publications are still low, starting in 2017, the number of studies increased rapidly, peaking in 2020 with 34 publications. This increase may be triggered by the need for interactive learning methods and the challenges arising from the pandemic, emphasizing educational innovation's importance. Citation trends indicate that high-quality research can have a wide impact even in a limited number of publications. The year 2016, for example, recorded the highest number of citations despite having only nine publications, showing that the quality of the content plays an important role in attracting academic attention. VOSviewer data also shows that STEM, digital literacy and multiple intelligences are becoming key elements integrated into PjBL, creating an effective multidimensional approach. Overall, the findings of this study emphasize that PjBL, accompanied by the integration of technology and innovative approaches such as STEM, can improve students' critical thinking skills, motivation, and achievement. The support from teachers in the learning process has also proven essential for the successful implementation of PjBL in primary education. This research trend recommends the need for curriculum adaptation to support learning methods that are relevant to the needs of the 21st century.

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