

Bibliometric study: Project-based learning in education on learning outcomes Scopus publication 2021-2023

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ABSTRAK

Project-based learning merupakan suatu bentuk kegiatan yang berfokus kepada siswa sebagai pembelajar aktif. Penelitian ini bertujuan untuk membahas project-based learning dalam dunia pendidikan dengan mengambil data dari Scopus dan mengolah metadata menggunakan aplikasi bibliometric selama rentang 3 tahun terakhir, yakni 2021-2023. Pengumpulan data pada penelitian ini dengan 4 langkah, yaitu: 1) sumber data didapat dari jurnal yang terindeks Scopus; 2) metadata jurnal yang didapatkan kemudian diunduh dalam format CSV; 3) memeriksa hasil artikel dan mengambil sesuai dengan pertanyaan penelitian; 4) mengolah data yang didapatkan menggunakan aplikasi bibliometric. Hasil penemuan terhadap artikel sebelumnya diketahui bahwa publikasi artikel tentang project-based learning merupakan pembelajaran yang banyak mendapat perhatian dan minat di bidang pendidikan, mulai tingkat pendidikan dasar hingga pendidikan tinggi, khususnya pada rentang tahun 2021-2023. Penelitian ini berguna untuk memahami status penelitian terbaru saat ini, khususnya di bidang pendidikan anak usia dini agar bisa menentukan arah penelitian yang dilakukan ke depannya.

ABSTRACT

Project-based learning is a form of activity that focuses on students as active learners. This study aimed to discuss project-based learning in the world of education by taking data from Scopus and processing metadata using a bibliometric application for the last three years, namely from 2021-2023. The four steps to collect data of the study are: 1) data sources were obtained from Scopus-indexed journals; 2) the obtained journal metadata was then downloaded in CSV format; 3) the researchers examined the results of the articles and took them according to the research questions; 4) the researchers processed the data using the bibliometric application. The results of the findings on previous articles show that the publication of articles on project-based learning is learning that has received considerable attention and interest in education, both at the higher education level and at the initial foundation education, particularly in 2021-2023. This research is beneficial for understanding the status of the latest research, especially in early childhood education, to determine the direction of future research.



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INTRODUCTION

Scientific publication is a method used to present results or research data that has been processed by a researcher. The results of the research are packaged in a form of work called a journal. One of the benefits of disseminating the publication of a journal is to make this an activity that has positive value in the academic field and is able to contribute to certain institutions or agencies to disseminate knowledge based on the results of research. The need for raw data obtained from research results is then processed. To obtain the desired information, an application is needed to assist researchers in this regard which is useful for facilitating the processing of thousands of data if done manually. One application is bibliometric.

Bibliometrics was first introduced by [Pritchard \(1969\)](#) as a basis for scientific and quantitative research, so the results shown are very comprehensive regarding the understanding of data that has been processed for further research needs ([Tandon et al., 2021](#)). Bibliometrics is an application that aims to measure and analyze a literature with a mathematical and statistical approach. However, at this time, bibliometric applications also works in journals with two categories, evaluative and descriptive ([Himawanto, 2016](#)). The bibliometric techniques used are usually quantitative in nature, with the scope of analysis of keywords, authors, journals, and citations used with the aim of making it easier to identify research characteristics ([Wang et al., 2021](#)). There is a link between bibliometrics and easy access to reviewing articles, so the researchers decided to use this application in the research by limiting keywords to make it easier and narrow the discussion.

Some literature states that at the beginning of its emergence, bibliometrics was only advantageous for research in the field of library science, but now, the application is for all fields of education ([Haryani et al., 2020](#)). Bibliometrics assist researchers working with articles and is an easy way to explore existing scientific publications with methods that, on average, use immense numbers ([Tambunan et al., 2023](#)). Compared to reviewing studies manually, bibliometrics can uncover current issues and developments in specific fields of interest to a researcher so that this application guides and facilitates future researchers in finding and processing data ([Han et al., 2023](#)). Another ease offered by bibliometrics is that researchers can get overall ideas, discern cavities in knowledge, get eccentric designs for research studies, and position the results of research predictions in the field ([Salam & Senin, 2022](#)). However, among the deficiencies in bibliometrics is the difference in disciplines from the keywords used to index the data processing, which significantly influences the citations ([Vlase & Lähdesmäki, 2023](#)).

Research for the study of bibliometric applications in this article will discuss project-based learning (PjBL) based on Scopus data in 2021-2023. PjBL is a learning model that is well known today. A review of the relevant research-related literature in this study shows that the application of project-based learning to student objects has been widely applied. So from the thousands of article results found, it is possible to evaluate thousands of data bibliometrics in a short time which has implications for the finding of new discoveries ([Ercan, 2023](#)). The consequence of the research indicates that project-based learning has been widely used both from the lower education level to tertiary institutions with various aspects of assessment that will be seen and studied. So that learning using this model can foster students' mentality towards their curiosity in ongoing learning activities ([Umar & Ko, 2022](#)).

Project-based learning refers to the basic structure for MPL and PBL, which helps students implement project-based learning with independent learning and minimal assistance from the teacher ([Khandakar et al., 2022](#)). Learning like this has side effects, namely the form of developing students' positive manners in the ongoing learning process, work routines, problem-solving abilities, and self-esteem ([Asli et al., 2022](#)). The term project-based learning is also known as project-based activities, which are a form of expanding learning from problem-based models as a form of giving a real impression for children to be active and directly involved with the learning system. This learning provides opportunities for children to solve problems directly ([Kamil & Sultan, 2022](#)).

In addition, introducing project-based learning in teaching and learning activities will make it easier for teachers to convey the content or material discussed where curriculum objectives realize optimally. Therefore, the end result of this theory embodies matters relating to direct

learning experiences, finding solutions and planning an activity to overcome the problems faced (Paristiowati et al., 2022). The fact is that project-based learning is increasingly recommended in an educational institution so that it can be implemented in a lesson that stimulates students' motivation to innovate even higher (Peng et al., 2022). The importance of project-based learning is applied to review and analyze the extent to which students are curious about something that struggles with critical thinking skills. Another constructive indication of project-based learning is that it leads to an increase in students' ability to collaborate, express themselves, and negotiate in building each other's knowledge. Furthermore, project-based learning helps students to make a real commitment to their own learning, which eventually integrates academically, both in the form of knowledge and real-world practice.

This article aims to examine the extent to which the role of PjBL has been applied in education worldwide in health, social, teaching, and other scientific research. This article focuses on project-based learning in education with variable limitations, namely students. Then this research will see how far the enforcement of PjBL in the world of education in various parts of the world, especially in the scope of students as the main study.

METHOD

Problem solving used bibliometric research methods, especially in answering and solving problems in this study. The experimental data come from Scopus (<http://www.scopus.com>) because Scopus is a scientific literature/citation database owned by a leading publisher, Elsevier. Scopus was introduced in 2004. This type of data is the most commonly used and easily accessible online at various universities. The search results in the Scopus database for 2021-2023 with the categories of research titles, fields of study, author's names, and so forth are the references in this article. To process the search results for Scopus documents, software helped display the visualization results in bibliometric applications using R programming such as R studio, biblioshiny, and export metadata in CSV form. The data collection used author names, co-occurrence networks, three-field plots, thematic maps, affiliations, sources and countries. The writing systematics of this article uses American Psychological Association Meta-Analysis (Cumming et al., 2012) and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021) (see Figure 1).

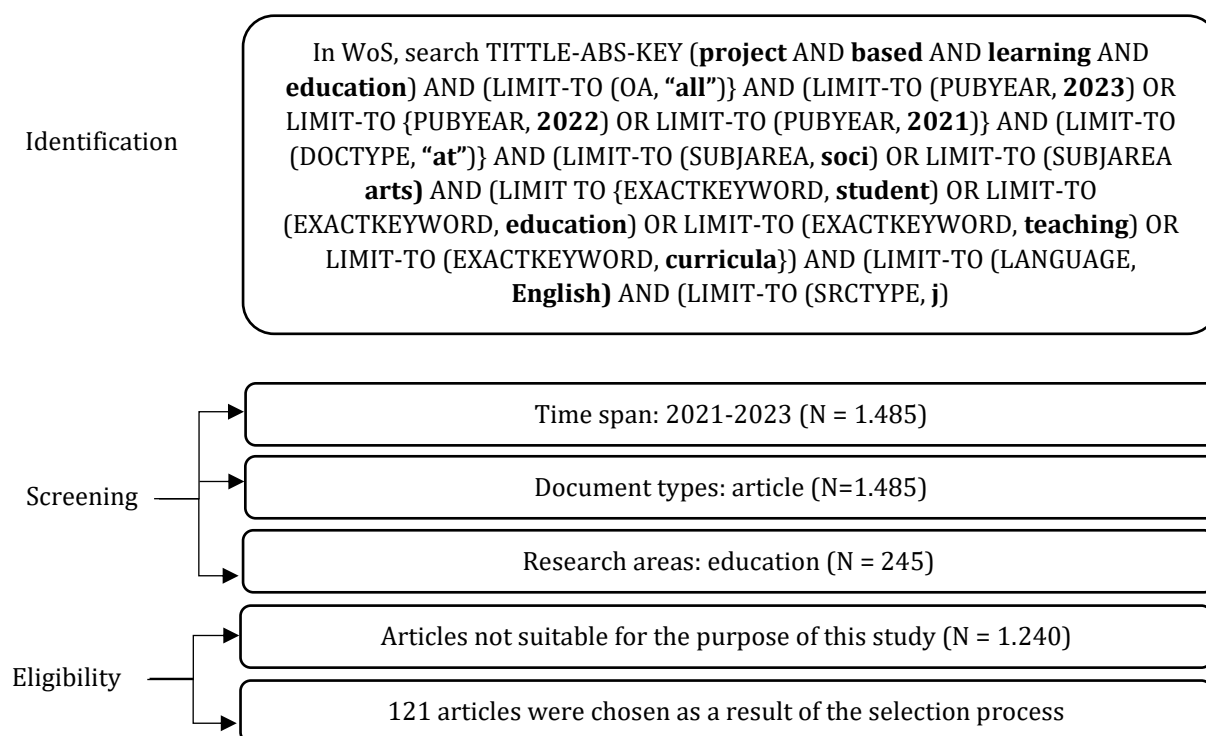


Figure 1. Stages of the method used

Table 1. Criteria of inclusion and exclusion

Inclusion criteria	Exclusion criteria
Published date from 1 January 2021 to 3 March 2023	Published outside of 1 January 2021 to 3 March 2023
Has been published by Scopus WOS indexed database journals	Conference paper, review, book chapter, conference review, letter, book, note, editorial, short survey, erratum, retracted and data paper
Written in English	Not written in English
Focus on project-based learning in education on learning outcomes	Not focused on project-based learning in education on learning outcomes
Available in full text and open access	Unavailable in full text and close access

From 1.485 articles downloaded, only 245 are the reference material of this study. Some considerations use English, 245 articles relating to the world of education, both discussing the implementation of PjBL to increase teacher competence and its application to students, as learning during the pandemic is online. As many as 1.240 articles do not meet the criteria because they are in economics, health, and psychology. In addition, the keywords in the search were limited to "student" with the type of open access articles, so 245 documents were obtained. After reviewing the articles found, 1.240 documents were eliminated because they are not in accordance with the scope of education, the intended goals, and the methodology used. [Table 1](#) shows the criteria of inclusion and exclusion ([Surahman & Wang, 2022](#)).

RESULT

To make it easier for researchers to find data on Scopus requires keywords. By typing in keywords, search results can be minimized based on the author's name, year of publication, type of document, and research title or field of research, making it easier for anyone to access. Then, the data is stored in excel form, which will later be processed using the bibliometric application. The bibliometrics in this article purposes to get an overview regarding the spread of the number of the previous publications from various literature. In addition, the bibliometrics will provide convenience for researchers and the public because they can convert publication metadata into maps or visualizations, making it easier to manage in order to provide useful information and insights.

Based on the publication of the Scopus database in 2021-2023 regarding project-based learning and students, in general, it can be classified into several categories. [Figure 2](#) shows the results of a search conducted on Friday, March 3, 2023.

The screenshot displays the Scopus search results interface. At the top, the Scopus logo is visible on the left, and navigation links for Search, Lists, Sources, and SciVal are on the right. A notification banner states, "The new, enhanced version of the search results page is available. Try the new version." Below this, the main heading reads "245 document results". A complex search query is displayed: "TITLE-ABS-KEY (project AND based AND learning AND education) AND (LIMIT-TO (OA, "all")) AND (LIMIT-TO (PUBYEAR, 2023) OR LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2021)) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SUBJAREA, "SOC") OR LIMIT-TO (SUBJAREA, "ARTS")) AND (LIMIT-TO (EXACTKEYWORD, "Students") OR LIMIT-TO (EXACTKEYWORD, "Education") OR LIMIT-TO (EXACTKEYWORD, "Teaching") OR LIMIT-TO (EXACTKEYWORD, "Curricub")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (SRCTYPE, "j"))". Below the query are options to Edit, Save, and Set alert. The interface includes a search bar for "Search within results...", tabs for Documents, Secondary documents, and Patents, and a "View Mendeley Data (2391)" link. A section for "Refine results" is visible on the left. At the bottom, there are options to "Analyze search results", "Show all abstracts", and "Sort on: Date (newest)". A toolbar at the very bottom contains icons for All, Export, Download, View citation overview, View cited by, and Add to List.

Figure 2. Scopus database search results

Based on the project-based learning and student keywords used in the search for the articles, around 1.485 documents from various countries discussed a similar topic in 2021-2023. Keyword restrictions were also followed by restrictions on language selection, namely English, the year of publication is only in the last three years, and the type of publication was articles. Then, the results were downloaded in metadata with the CSV storage type, which was then exported into the bibliometric application so it displayed some information about related research. The following are the metadata results processed by bibliometrics, which were then presented in the mold of pictures and graphs. Keyword restrictions were made on the type of document to be selected, namely only those in the form of articles. Furthermore, the discussion on PjBL was narrowed only to the education section. In addition, the article types were then limited to open access. Then, the mapping search results based on keywords from several categories are listed in the discussion below based on most relevant authors, co-occurrence network, three-field plot, thematic map, most relevant affiliations, most relevant sources, and country scientific production.

Figure 3 shows that the authors who discuss project-based learning and student topics have done a lot regarding previous research. It is indicated by the dark blue horizontal line at the very top. The first line is occupied by an author named LI X with five published articles. Then, the second, third, and fourth ranks with the light blue horizontal line are DU X, LAVICZA Z, and ZHU M, with four published articles each. Meanwhile, the penman with the minimum number of published articles is in the last 6 with three articles each (see Figure 4).

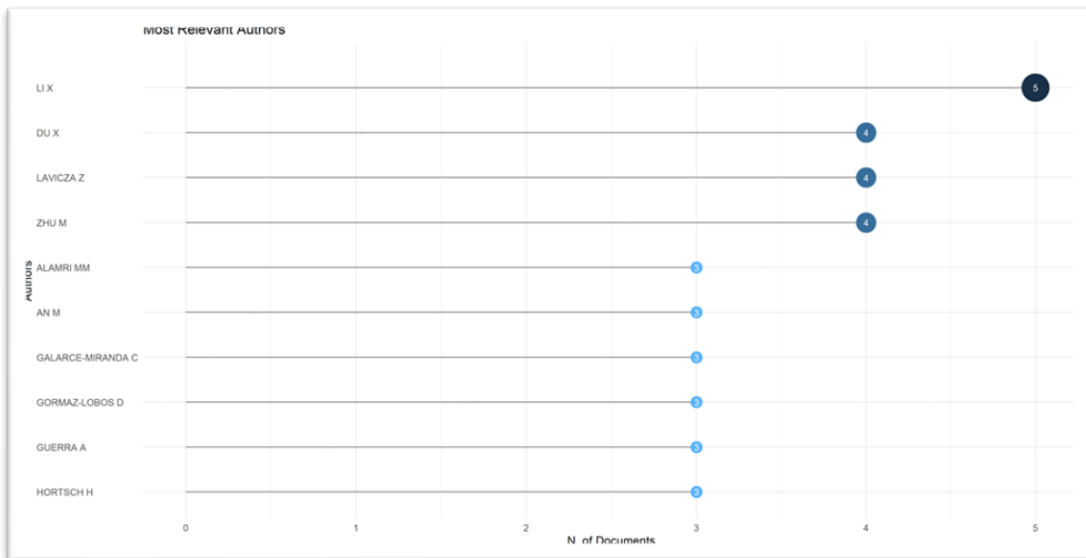


Figure 3. Article publication based on most relevant authors

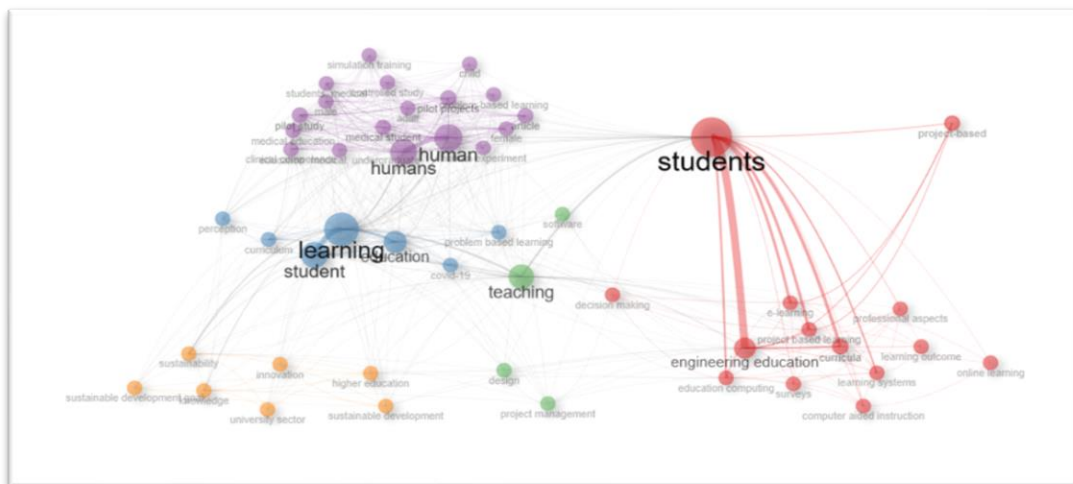


Figure 4. Article publication based on the co-occurrence network

Analysis based on the co-occurrence network makes it easy for identifying and classifying the main topics under investigation. The figure shows the processed results of the bibliometrics application related to the search for project-based learning and student keywords previously obtained in the Scopus database. These results indicate that the keywords project-based learning and student relevant to each other, as indicated by interrelated lines in red. The green line shows that research on these two variables is rarely done. This means very little research in this field is available when searched using these two keywords in 2021-2023, with search results for these documents totaling 1.485.

Figure 5 illustrates the development of project-based learning and student topics in 2021-2023. This topic occupies the first place for research that is mostly done in the student group. Each author's name has taken on this topic as many as 9 people with each author's name Li X, Lin c-y, Lavicza Z, Alamri MM, Lavonen, Ture Krajcik, and Zhu M. This aims to make it easier for other researchers to find data and relevant research.

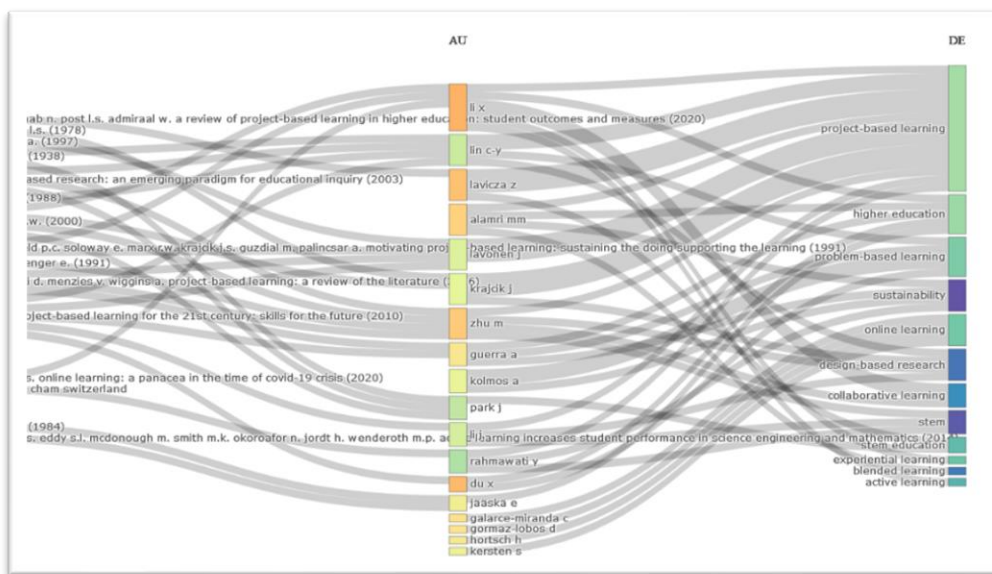


Figure 5. Article publication based on three-field plot

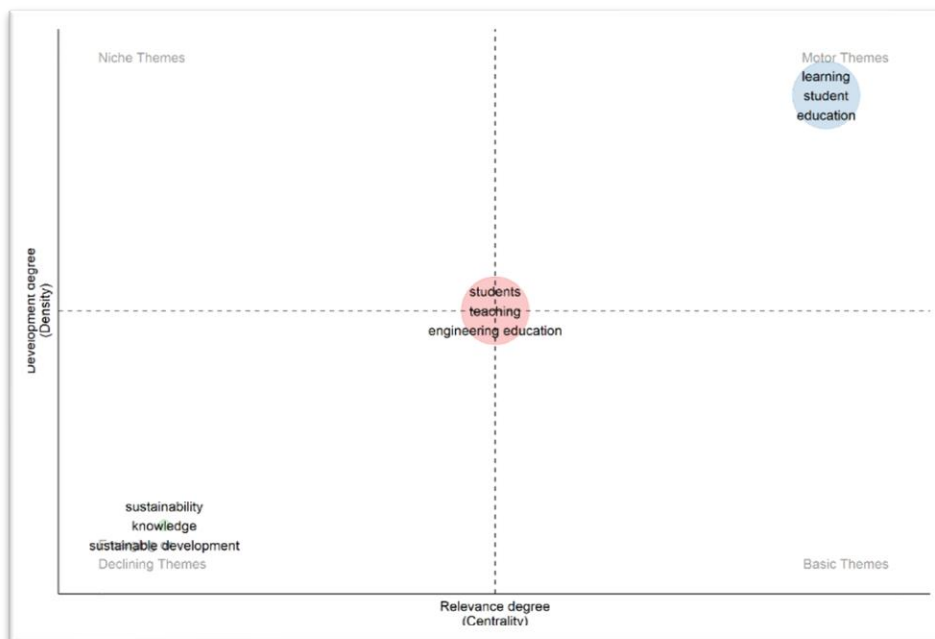


Figure 6. Article publication based on thematic map

Thematic maps are useful for analyzing a particular topic based on density and centrality (Figure 6). The higher the density, the more research has been done, while the centrality means the topic under study is relevant to the big topic being studied. That is, the more consistent the results of the thematic map are, the more influential the topic being discussed is. The thematic map above illustrates that there has been numerous research on the topics for the two keywords used in this article in 2021-2023. This is based on the position of the red circle which is right in the middle of the density line. This means that if this research is carried out again, it is still relevant to do the appropriate study or variable. Figure 7 shows that the most relevant affiliations related to project-based learning and student topics were mostly Aalborg University, with 30 article publications, followed by the University of Helsinki, with 29 published articles. Meanwhile, the third position is the School of Engineering and Science, with 25 published articles. This shows that universities in Denmark and Finland are ranked in the top 3 for topics related to the ones being discussed. The universities in Indonesia that have examined this variable were the State University of Malang, with 19 publications and the Ganesha University of Education, with 18 publications. In addition, the one with minimal publications is Purdue University, with 16 articles. The purpose of this most relevant affiliation is to make it easier for other researchers to retrieve sources and references associated to the topic being discussed and to provide an overview of which universities and countries researched this topic.

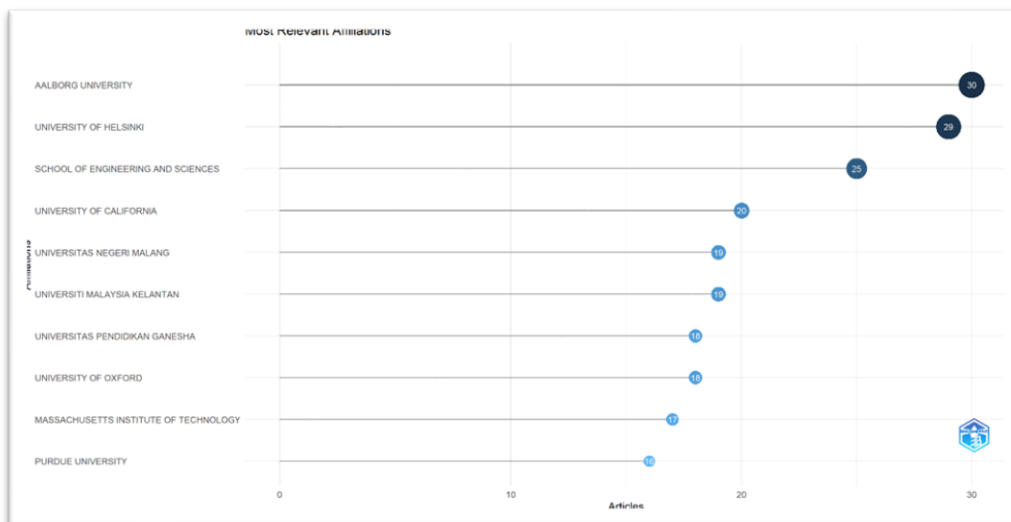


Figure 7. Article publication based on most relevant affiliations

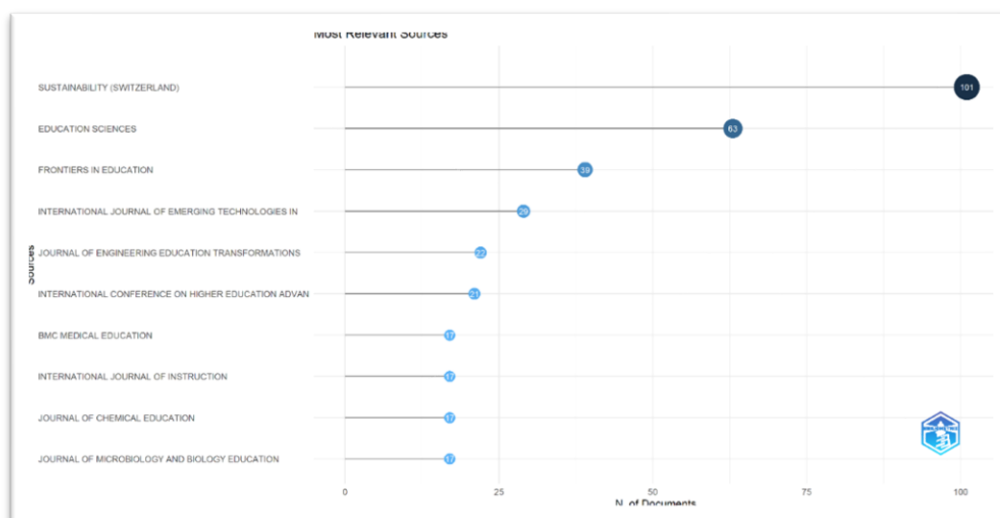


Figure 8. Publications based on most relevant sources

Table 2. Percentage of publication based on country scientific production

Region	Freq	%
USA	857	57.71%
Spain	421	28.35%
Indonesia	283	19.05%
UK	205	13.80%
Australia	157	10.57%
Germany	146	9.83%
China	139	9.36%
Malaysia	121	8.14%
Portugal	86	5.79%
Norway	80	5.38%

The use of the two previous keywords based on the most relevant sources is dominated by Switzerland in publications in sustainability journals as the number of publications for the two topics of discussion in this article can be found in many sustainability journal houses, as many as 101 pieces. Then, the second place is occupied by Education Science, with 63 published articles. Meanwhile, the third place is Frontiers Education, with 39 articles. In addition, publications in the three lowest positions are occupied by the International Instruction journal, chemistry education journal, and biology and microbiology education journal, with 17 articles each (see [Figure 8](#)). This can be a reference for further researchers who will use literature sources to see which journal publishers publish many research-related topics for discussion, making it easier for researchers to find reference sources in terms of data processing.

[Table 2](#) shows the countries with many scientific publications based on the topic in this article. Most publications are from the United States, a total of 578 articles. Meanwhile, Spain has published 421 publications. The lowest publication is in Norway, with 80 articles during the last year. The purpose of having a country scientific production is to equip access to researchers to provide an overview of which countries are conducting research related to the topic being discussed, making it easier in the process of collecting data by reducing classification by country.

The outcome of the data analysis displayed in the bibliometrics explains that project-based learning is learning that has become a trending topic in the last three years. This is evidenced by the article publication from diverse countries in the fields of health, education, industry, and online learning with the target of various parties. Learning using PjBL is an alternative that can be relevant to all groups in achieving educational goals in accordance with the curriculum. This type of learning makes it easier for educators and students to be involved in every learning activity, so two-way communication occurs. However, the difficulties encountered in the implementation of PjBL are the requirement of relatively large funds and the time tends to be longer and is continuous, so this becomes a burden for educational institutions or other institutions that apply project-based learning.

DISCUSSION

Project-based learning is defined as learning with real-life models or actions. The category to be prioritized in PjBL is project-based learning means learning that focuses on learning students as learning objects. Therefore, in carrying out learning, students are motivated to explore real-life concepts and theories that guide them to think constructively ([Asli et al., 2022](#)). Students are directly involved in actions and decision-making as the final result of the learning that has been carried out, while the teacher only functions as a mediator in providing facilities to students in launching each stage of the activity ([Terrón-López et al., 2020](#)).

In other words, PjBL is defined as one of the learning stages starting from action, attempt, solving problem, cooperation, social skills, concept understanding, a collaboration between members, and responsibility. Therefore, the practice and theory related to PjBL are closely cohesive to the concept presented by Vygotsky in learning in the world of education. With this concept, each student gets direct real-life experience to build their new knowledge independently in finding and solving the problems they face. The link between John Dewey's theory as the

originator of this learning model and Vygotsky's construction theory has become a reference in the development of this learning model in education so far (Ghosheh Wahbeh et al., 2021).

As learning that provides many positive benefits to students, project-based learning or PjBL has been widely applied in both developed and developing countries. Much previous research has explained that the application of PjBL during the learning process has a significant impact on student development systematically. Stimulated developments in this aspect include sensitivity to social-emotional development, developing a sense of empathy, decisions in taking a perspective on things, and growing interest in partnering and collaborating with others by forming certain groups (Zhou & Li, 2022). Another impact of implementing PjBL on learning is that students are able to develop creative attitudes, foster motivation, and have the ability to be able to face challenges that exist in an inclusive perspective (Hosseini-Mohand et al., 2021).

The many benefits experienced by various parties have made PjBL formulated into the educational curriculum of several educational institutions, with the hope of being able to provide positive responses and concrete actions in helping students build their own new knowledge and develop existing knowledge and skills by interconnecting them into real situations (Terrón-López et al., 2020). In some cases, the type of problem solving that students solve is generally a transversal skill, so the solving requires teamwork by taking into account changes in the latest issues (Wróblewska & Okraszewska, 2020). As an effort to provide the latest and sustainable innovations in the world of education, the PjBL model is constantly being improved and developed in the methods used with the aim of perfecting things believed to need more in-depth study.

Supporting students in interpreting this type of learning has many factors that must be considered such as students' prior knowledge of the material to be discussed, the existence of a system of mixing problem-based learning methods in this method is also a form of effort to make PjBL a learning that provides effective results (Santoso et al., 2023). In early childhood education, PjBL learning can collaborate with various types of media and methods, one of which is by combining STEAM in every learning activity in the PjBL pattern. This is because students develop their curiosity about something related to nature, increase their courage in discussions and explore various sources to fulfill the duties and responsibilities that are being carried out (Lu et al., 2022).

From the exposure of the articles reviewed, it is not unsafe to claim that the PjBL has been widely implemented in learning and health sectors. From the various PjBL applications in the articles reviewed, this learning is frequent in elementary school and higher education institutions. In addition, some of them are massively applied in the world of health practice and improving the quality of educators during the promotion period. However, the implementation of PjBL learning itself is still so minimal in early foundation educational institutions that it opens up great opportunities for PAUD educators to apply this learning in various fun activities by involving students as active and critical learners. The country with the most implementation of PjBL is the United States. This is evidenced by the number of published articles of 857 documents spread across various fields.

The output of this research article are expected to serve information to future researchers in terms of seeking information regarding the same research focus, namely PjBL, making it easier for them to immediately narrow down the goals of which countries published a lot on the research focus. In addition, the mapping of the metadata results of international journals such as Scopus also equips more information to readers if they are interested in seeing the extent to which countries and the highest number of publications have been carried out on the focus of PjBL studies. It is hoped that this information will provide convenience in terms of the time to search for data sources, reduce the research space in a more significant direction, and review the extent to which authors from other countries do most of the research studies.

CONCLUSION

According to the explanation above, it can be deduced that learning with PjBL in education, especially in student studies, is still minimal. This is evident by the very small number of publications, especially in early foundation educational institutions. Therefore, it becomes an update in further research to conduct research related to early childhood in learning. The country with the most publications related to PjBL is the United States, with a number of publications of around 857 documents in various fields of educator associations which can serve as references for researchers in finding data sources. Thus, it opens up great opportunities for future researchers to conduct research, especially on the relationship between PjBL and students in educational institutions.

Author contributions

In writing this article, the author made a real contribution to the perception of PjBL in the context of students to see how far it exists in various countries. The author is responsible for every stage of data processing starting from collection to data analysis and conclusions as the end result of each previously processed data. The last text that has been corrected has been read and approved by the author as the final follow-up to this article.

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Conflict of interest

The authors declare that no conflicts are contained in this article.

Data availability statement

All data provided by the authors.

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