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Bibliometric Analysis: Research Trends in Project Based Learning Learning Models on Science Lesson Content (2003-2023)

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Abstract: The project-based learning model is a learning model that is often used in the science learning process, especially in the independent curriculum, which prioritizes the learning process over cognitive outcomes. The purpose of this research is to find out research trends that apply project-based learning models to natural science content over a period of twenty years (2003–2023). The method used in this study is bibliometric analysis based on Scopus and Google Scholar publication data accessed through the Publish or Perish (PoP) application. The results of the bibliometric analysis were then visualized using the Vosviwer application. There are 33 publications on Scopus and a maximum data limit of 500 on Google Scholar in the period 2003–2023. Based on these findings, it can be seen that for the past 20 years, research on the application of the project-based learning model has often been carried out and follows the development of scientific knowledge.

Keywords: Bibliometric; Project-Based Learning; Science Learning Process

Introduction

The project-based learning model is one of the many learning models that are often applied by teachers when teaching science. The project-based learning model is one of the ways used to improve collaboration skills, critical thinking, and creativity (Dahlan et al., 2020). The project-based learning model directly involves students in improving practical skills through project-based learning (Hernani et al., 2023). Project-based learning not only improves students' scientific abilities, but it also improves students' social skills (Ruskandi et al., 2019). This learning model really provides opportunities for students to be active in solving problems directly in small groups (Wu & Wu., 2020).

The application of the project-based learning model is often implemented in science learning because science does not only apply fact-based conceptual understanding but also becomes a means for students to find out a process in the discoveries made. This bibliometric research is very necessary to make it easier to find out about the development of journal publications with discussion themes related to project-based learning models within the scope of science (Permendikbud, 2016). Through the project-based learning model, it is hoped that students' ability to master the scientific process can become the main foundation for forming scientific attitudes (Khasanah et al., 2020).

The ability of educators to implement learning innovations does not always match the objectives of the project-based learning model's learning process with the implementation of the science learning process (Rahmawati, 2022). Therefore, the ability of educators to analyze the strengths and weaknesses of the learning process is needed.

During the period 2003–2023, there was a great deal of research conducted on the topic of discussing project-based learning models that were implemented in science

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learning content. Nonetheless, the research that was carried out focused more on the topic of discussing the project-based learning model, and the research that was carried out seemed to be dominantly researched in 2020. This was based on data obtained through bibliometric analysis using the Scopus and Google Scholar databases. Bibliometrics has the characteristics of librarianship, which makes it easier for researchers to find journal references within a certain period of time (Tupan et al., 2018). The database acquisition utilizes Publish or Perish (PoP) software to speed up data searches as needed (Eshchanov et al., 2021).

This study aims to identify research trends in the literature on the project based learning model that is implemented in science content within the next twenty years (2003–2023) through the Scopus and Google Scholar databases. This analysis can help future researchers analyze research opportunities that can be carried out on the topic of project-based learning models in science content.

Method

The research method used is using library research by analyzing articles related to Project Based Learning or what is called bibliometric analysis. Data analysis was carried out in this study using Scopus-indexed articles and articles on Google Scholar, which were limited to a maximum of 500 articles in the publish or peris (PoP) application in the period 2003–2023. Echchakoui (2020) Scopus was chosen as the database because it has a wide range of publication. Meanwhile, the Google Scholar database was chosen because it provides various scientific publications from various disciplines and is equipped with citation services from around the world (Zakiyyah et al., 2022).

A literature search on the Scopus and Google Scholar databases using the publish or perish (PoP) application focused on the title "project-based learning" and used the keyword "natural science". The data search was also limited to the period 2003–2003. Based on the search results, 33 Scopus publications and 500 Google Scholar publications were obtained.

After searching for data through the public or private (PoP) application, the data is stored in RIS format to facilitate data processing using the VOSviewer application. VOSviewer is software that makes it easy for researchers to create maps based on literature data (Nandiyanto & Husaeni, 2021). The data map that the VOSviewer application creates using sorted keywords can take the form of related maps, networks, overlays, and visualization density (Eck & Waltman, 2010; Fitri et al., 2022).

Result and Discussion

The results of bibliometric research by searching for project-based learning titles and using natural science keywords using Publish or Perish (PoP) software in the period 2003–2023 obtained 33 Scopus-indexed data sets and 500 data sets on Google Scholar. Saputra (2023) data obtained from the Scopus database will be scanned into RIS format, after which it will be processed using the VOSviewer application. Through VOSviewer visualization of research clusters from project based learning the results can be determined (Reis et al., 2017). All of this data is published in the form of book chapters, conference papers, and articles. Following are the 10 best rankings of world publications on project-based learning with the Scopus-indexed natural science keywords:

Tabel 1. The top 10 best project-based learning publications with Scopus-indexed natural science keywords

Rank	Authors	Title	Year
1	S. Chang	Impacts of an augmented reality-based flipped learning guiding approach on students' scientific project performance and perceptions (Chang & Hwang, 2018)	2018
2	M.E. Beier	The effect of authentic project-based learning on attitudes and career aspirations in STEM (Beier et al., 2019)	2019
3	R. Anazifa	Project- based learning and problem- based learning: Are they effective to improve student's thinking skills (Anazifa & Djukri, 2017)	2017
4	S. Mitchell	The Negotiated Project Approach: Project-Based Learning without Leaving the Standards behind (Mitchell et al., 2009)	2009
5	C. Lee	Internet project-based learning environment: The effects of thinking styles on learning transfer (Lee & Tsai, 2004)	2004
6	J.A. Martinich	Preparing students for conservation careers	2006

Rank	Authors	Title	Year
		through project-based learning (Martinich et al., 2006)	
7	M. Ayaz	The effect of the project-based learning approach on the academic achievements of the students in science classes in Turkey: A meta-analysis study (Ayaz & Söylemez, 2015)	2015
8	Y. Cho	Project-based learning in education: Integrating business needs and student learning (Cho & Brown, 2013)	2013
9	Adriyawati	Steam-project-based learning integration to improve elementary school students' scientific literacy on alternative energy learning (Adriyawati et al., 2020)	2020
10	B.A. Younker	Inquiry-Based Learning Through Birdsong: An Interdisciplinary Project-Based Experience (Younker & Bracken, 2015)	2015

Not only identifying the top ten Scopus-indexed publication rankings, here are the ten best world publication rankings on project-based learning with the natural science keyword based on the Google Scholar database:

Tabel 2. The top 10 rankings for project-based learning publications with the keywords natural science database google scholar

Rank	Authors	Title	Year
1	NLU Fauzia, JB Kelana	Natural Science Problem Solving in Elementary School Students Using the Project Based Learning (PjBL) (Latifah et al., 2020)	2020
2	I Rahmania	Model Project based learning (PjBL) learning model with STEM approach in natural science learning for the 21st century (Rahmania, 2021)	2021
3	S Hanipah, TS Florentinus, AR RC	The effectiveness of problem based learning and project based learning model to improve natural science study outcomes (Hanipah et al., 2018)	2018
4	NW Parwati, NK Suarni, IW Suastra	The effect of project based learning and authentic assessment on students' natural science learning outcome by controlling critical thinking skill (Parwati et al., 2019)	2019
5	RD Anazifa, D Djukri	Project-based learning and problem-based learning: Are they effective to improve student's thinking skills? (Anazifa & Djukri, 2017)	2017
6	D Mustika, SQ Ain	The Understanding Improvement of Natural Science Concept of Primary School Teacher (Mustika & Ain, 2020) Education Department Students Using Project-B ased Learning Model	2020
7	R Holubova	Effective Teaching Methods--Project-based Learning in Physics (Holubova, 2008)	2008
8	CI Lee, FY Tsai	Internet project-based learning environment: the effects of thinking styles on learning transfer	2004
9	N Santamaría-Cárdaba	Families, experiments, and nature: Learning science through project-based learning (Cárdaba, 2020)	2020
10	EN Malyuga, GO Petrosyan	Effective Integration of Distance Courses Through Project-Based Learning (Malyuga & Petrosyan, 2022)	2022

The top ten rankings in project-based learning research with natural science keywords based on the Scopus and Google Scholar databases above were determined based on a search on the Publish or Perish (PoP) software. The data ranking can be used as a reference, making it easier to choose research topics or develop existing research.

After obtaining the Scopus and Google Scholar databases, data obtained from the results of a bibliometric analysis is based on a combination using the VOSviewer application. The results of the bibliometric analysis in the VOSviewer application are divided into three types of mapping visualizations in order to facilitate the process of identifying relevant research topics. The three types of visualization are network visualization, overlay visualization, and density visualization (Effendi et al., 2021).

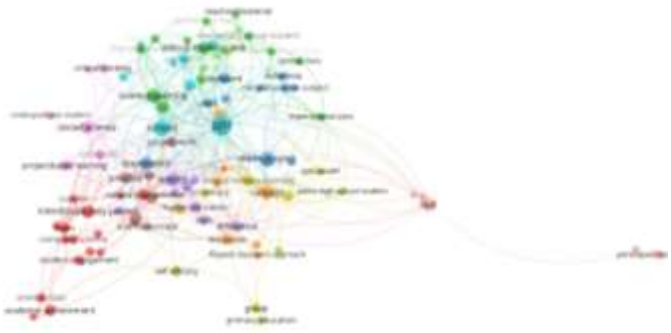

Figure 1. Network Visualization of Project-Based Learning Topic Area

The results of the analysis above show that several topics are divided into ten clusters with different colors (light blue, dark blue, dark green, light green, dark purple, light purple, red, yellow, orange, and brown). All topics from each existing cluster are closely related to each other and centered on one dominant keyword, namely "pjbl". So it can be concluded that since 2003–2023, there have been many studies discussing the project-based learning model.

Based on the picture above, it can also be seen that there have been various research topics related to project-based learning over a period of 20 years, while several keywords are interrelated, such as science learning, stem projects, social science, critical thinking skills, self-efficacy, computer science, etc. Keywords that have little to do with the topic of project-based learning are an opportunity for future researchers to create new and more innovative research topics.

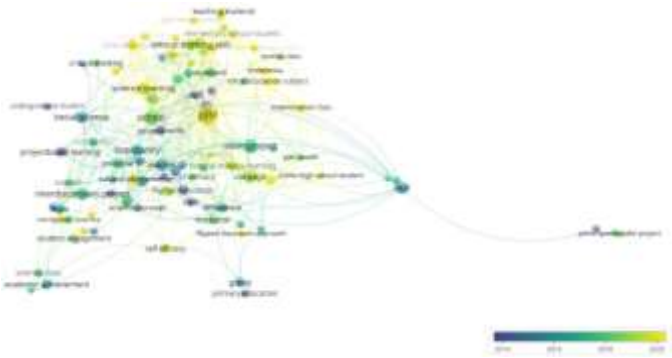

Figure 2. Overlay Visualization of Project-Based Learning All Topic Area

The results of the overlay visualization are differentiated based on the renewal of publications from year to year; the more keywords are symbolized by a bright color, the more keywords are included in the latest research topics, and vice versa. The figure above shows that the research topic related to the project-based learning model is not only the center of many other research keywords but also a research topic that is always updated.

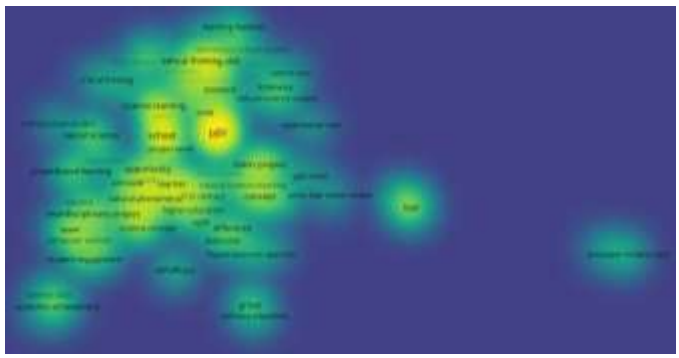

Figure 3. Overlay Visualization of Project-Based Learning All Topic Area

The most frequently conducted research related to the absed learning project model can be seen in the overlay visualization results above. The yellow color density in each of the keywords above explains that these keywords are the most frequently conducted topics of research discussion. If researchers are looking for research topic ideas related to project based learning models with discussions that are still rare, then it is better to choose research topics based on keywords whose color density is still faded. The references for future research topics based on the keywords in the image above are self-efficacy, critical thinking, natural science subjects, etc.

Conclusion

The results of the bibliometric analysis during the 2003–2023 period show that the project-based learning

model research topic is the research topic that most often becomes a scientific discussion, especially in the field of science. However, based on the results of a bibliometric analysis, this project-based learning research model will be discussed more in 2020. This provides a great opportunity for future researchers to find new research topics and develop discussions according to the current conditions of science education.

Author Contributions

Intan Andhika Fitri conceptualized the research idea, designed of methodology, management and coordination responsibility, analyzed data, conducted a research and investigation process; Sri Susilogati Sumarti and Sungkowo Edy Mulyono conducted literature review and provided critical feedback on the manuscript.

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper

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