

Review Article

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Implementation of Project-Based Learning Model in Vocational High Schools: A Bibliometric Analysis

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Abstract

Background/purpose. This analysis aims to determine the mapping of the application of the project-based learning (PjBL) model to design learning needs according to the learning environment in vocational high schools (VHS). Research trends of PjBL in vocational schools, subject mapping of PjBL, opportunities for appropriate PjBL studies, and recommendations for future implementation of PjBL in vocational schools.

Materials/methods. The study used bibliometric analysis through searching the Scopus database. Data analysis was conducted using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) 2020 method, assisted by VOS viewer display. There were 337 articles according to the categories in the Scopus data, only 44 articles were analyzed based on the PRISMA method.

Results. The findings state that the application of PjBL in the education sectors of physical science, information systems, automotive and machinery. VHS has competencies in other fields such as maritime, tourism, agriculture, and others. Competency integration applying PjBL is dominant in the higher education, training, academy and research sectors. Vocational high schools have not yet implemented subject integration. Expertise competencies in VHS have not been fully supported as graduate competency outcomes by general subjects.

Conclusion. It is necessary to disseminate and study PjBL in competencies in other fields, along with the application of PjBL integrated with two or three subjects in VHS. Examples of integration of subjects to achieve full competence are skills, English and math. Encourage vocational schools to integrate subjects in the learning process. Integration of learning in the form of product projects by subject teachers collaboratively.



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1. Introduction

This analysis aims to determine the mapping of the application of the project-based learning (PjBL) model to design learning model needs according to the learning environment in vocational schools. PjBL Model is an instructional strategy that provides students with the autonomy to learn, explore, and investigate throughout the learning process by encouraging them to do projects (Suparmi et al., 2024). Most vocational schools have implemented PjBL. However, it tends to be dominant in certain fields. Project-based learning can significantly improve student learning outcomes, such as academics, motivation, and higher-order thinking skills (Karpudewan et al., 2016). The Education 4.0 framework aims to support the skills needs of Industry 4.0, including soft skills development and lifelong learning (Venkatraman et al., 2022). The digital era has pushed the learning process to promote critical thinking, communication, collaboration, and creative thinking skills in students (Nurlaela & Amiruddin, 2023). The preparations are in the form of a curriculum (Erstad & Voogt, 2018), programs (McMahon, 2009), learning models (Isnaeni et al., 2021), or media (Stolaki & Economides, 2018).

Vocational education is an educational program designed to provide students with competencies that align with the workforce's needs (UNESCO, 2011). Vocational education provides learning on how to work effectively, preparing individuals to become professional workers (Billett, 2011). Various learning models for vocational education have been developed, such as project-based learning (PjBL), problem-based learning, case study, contextual instruction, and inquiry (Jalinus et al., 2023). Learning in vocational education should be more dominant towards practical learning and directing students' practicum topics towards creating real-world products or service (Jalinus et al., 2019).

Three-subject integration project: Creative Products and Entrepreneurship (CPE), Software Applications (SA), and Construction Cost Estimation (ECC) in a simple house design project. The interdisciplinary aspect is seen from the collaboration of technical knowledge (building design, cost calculation), digital skills (AutoCAD software application), and entrepreneurship (market analysis, business planning). The practical implication of this interdisciplinary PjBL is the preparation of adaptive vocational graduates, both as skilled workers and prospective entrepreneurs. (Hariyanto et al., 2023). The research was conducted at SMK Negeri 2 Depok and SMK Negeri 1 Seyegan, Sleman Regency, Special Region of Yogyakarta, Indonesia.

A stochastic modeling project for traffic optimization and hospital logistics, involving students from three disciplines: Applied Mathematics, Civil Engineering, and Engineering & Industrial Management. The interdisciplinary aspect is reflected by the integration of technical knowledge such as queuing theory (Engineering Management), traffic modeling (Civil Engineering), and dynamic programming (Applied Mathematics). The structured approach facilitates collaborative learning relevant to real-world challenges (MacLeod & van der Veen, 2020). Research at the University of Twente Enschede, Netherlands to prepare graduates to work in complex interdisciplinary teams.

Interdisciplinary Project-Based Learning (PjBL) is becoming a critical approach in preparing a workforce that is adaptive to the demands of Industry 4.0. Interdisciplinary PjBL allows students to combine engineering, business, and computing perspectives to solve complex industrial problems, such as supply chain optimization or autonomous system design (S. Bell, 2010). This is in line with Education 4.0 which emphasizes global citizenship skills, collaborative problem-based learning, and technological literacy (Vadim Grinshkun & Elizaveta Osipovskaya, 2020). Education 4.0 also encourages curriculum flexibility, allowing students to access online materials and micro-credentials to update skills in line with technological developments (Zawacki-Richter et al., 2019). Moreover, lifelong learning includes not only the acquisition of technical knowledge, but also critical thinking and collaboration skills which are intrinsically embedded in PjBL (Delors & Al Mufti, 1996).

This research addresses the pressing issue of the application of PjBL models in vocational schools. The purpose of this study is to look at the mapping of PjBL implementation in vocational schools, aiming to explain the mapping of subjects, study programs, and design recommendations of PjBL models according to the learning environment of vocational schools as well as contribute valuable insights for agencies and vocational teachers. To guide our investigation, the following research questions will be explored:

- What are the research trends of project-based learning in vocational schools?
- What is the subject mapping of PjBL application in vocational schools?
- What are the opportunities for appropriate PjBL studies in vocational schools?
- What are the recommendations for future implementation of PjBL in vocational schools?

By answering these questions, we aim to achieve certain goals or outcomes, which ultimately advance our understanding of the application of PjBL in vocational school.

2. Literature Review

Vocational schools have gained increasing attention in the past decade as critical institutions for addressing global skills gaps and unemployment. Emphasize the importance of integrating vocational training into secondary and tertiary education systems to meet labor market demands (Pavlova & Huang, 2013). Similarly, (Paryono, 2017) highlights the challenges and opportunities of vocational education in Southeast Asia, particularly in aligning curricula with industry needs. Recent studies, such as (Avis, 2018), argue for the inclusion of critical thinking and digital skills in vocational curricula to prepare students for the Fourth Industrial Revolution. Emphasizes the importance of balancing technical expertise with soft skills (Winch, 1972). Discusses the growing importance of work-integrated learning (WIL) in vocational education, highlighting its effectiveness in bridging the gap between theory and practice (Billett, 2011).

Project-Based Learning (PBL) has emerged as a transformative pedagogical approach that fosters critical thinking, collaboration, and real-world problem-solving skills. Highlight the positive impact of PBL on student engagement and motivation, particularly in STEM education (Kokotsaki et al., 2016). Similarly, (J. Bell & Waters, 2018) emphasizes the role of PBL in developing 21st-century skills, such as creativity and communication, by immersing students in authentic, hands-on projects. Explore the effectiveness of PBL in improving academic outcomes, noting its ability to bridge the gap between theoretical knowledge and practical application (Mergendoller, 2018). Finally, Calabrese and Capraro (2022) examine the challenges of scaling PBL in diverse educational contexts, advocating for adaptable models that cater to varying student needs.

Vocational education can be explained by integrating the principles of social constructivism (Vygotsky, 1978) and experiential learning (Kolb, 2015), emphasizing authentic contexts and collaboration. According to the 4C/ID Model (Kirschner & Van Merriënboer, 2018), vocational learning requires four components: (1) learning tasks(real project-based tasks), (2) supportive information (resources for conceptual understanding), (3) procedural information (technical guidance), and (4) part-task practice(specific exercises). PjBL in context adopts situational learning theory (Down, 2001), where students engage in communities of practice to develop competencies through interaction with industry practitioners.

Studies by (Gulikers et al., 2004) added an authentic assessment framework that assesses students' abilities through workplace relevance criteria, such as completion of real projects and feedback from industry experts. Meanwhile, (S. Bell, 2010) emphasized that PBL is effective in improving vocational students' problem-solving skills and technical competencies, especially when projects are designed to simulate industry challenges.

3. Methodology

This study is categorized as Design-Based Research, which aims to design, develop, and validate products as solutions to problems (Plomp, 2013). The difficulty of economics teachers in

Data collection by utilizing article and journal search applications, namely Scopus. Search for articles by following the rules of words that match the subject and meet the conditions. The keywords used are project-based learning and vocational school. The minimum requirements for articles collected were open access, last 10 years, education domain, minimum 1 citation, journal article publication type, high school education, and relevant. There were 171 unqualified documents in the identification phase and 158 unqualified documents in the screening phase. The Scopus search displayed 44 relevant documents. The article analysis search did not limit the country of origin or global search.

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) 2020 is intended for use in systematic reviews that include synthesis (such as pairwise meta-analysis or other statistical synthesis methods) or do not include synthesis (for example, because only one eligible study is identified). PRISMA 2020 can be used for original systematic reviews, updated systematic reviews, or continually updated ("living") systematic reviews (Page et al., 2021). The criteria for the identification stage are not in accordance with the title, the type of study does not match the topic and there is no peer review. The screening stage criteria were double data and did not meet the inclusion and exclusion criteria in the aspects of title, keywords, abstract, place, introduction, conclusion, and full text.

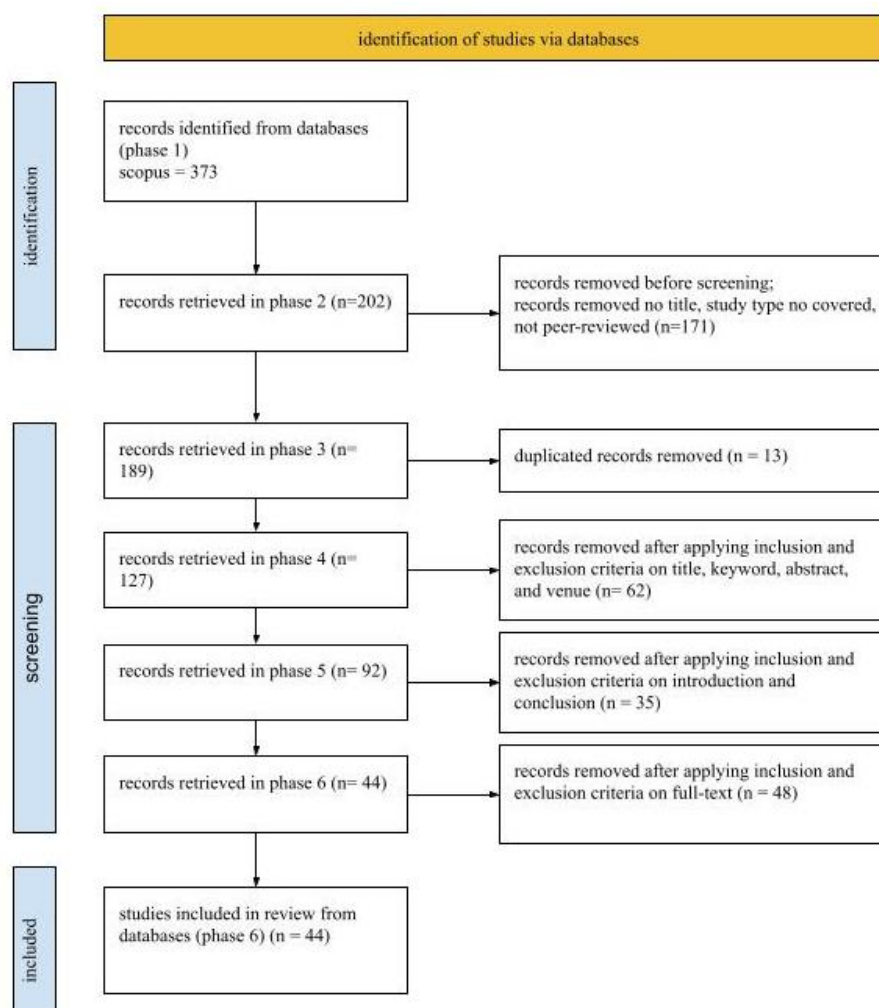


Figure 1. PRISMA flow diagram illustrating the identification and search processes

Bibliometric analysis can reveal research gaps and point to future studies in various emerging fields (Zainuldin & Lui, 2022). Data analysis uses analysis through the Scopus web page and VOSviewer. VOSviewer, a freely available software package used to construct and display bibliometric relationships between a variety of variables (Kirby, 2023). Inclusion and Exclusion criteria are listed in Table 1.

Table 1. Inclusion and Exclusion Criteria

Inclusion criteria	Exclusion criteria
Published from 2014 until 2024	Publish before 2010
Type of publication: journal (research article, conference proceeding, and systematic review)	Type of publication: book chapter and books
Written in English language	Written in other than English language
Conducted in vocational high school	Conducted in other level education than vocational high school
Articles could be accessed. Project-based learning is the model of the instructional	Article couldn't be accessed other Project-based learning is the model of the instructional
Indexed by Scopus	Was not indexed by Scopus

4. Results

4.1. Research Trends of Project-Based Learning (PjBL)

In 2016, there were 2 Scopus documents with the source of AIP conference proceedings and the International Conference on Applied System Innovation (ICASI), IEEE. In 2017, there was only 1 Scopus document with the source AIP conference proceedings. In 2018, there were 2 Scopus documents with the source Journal of Physics: Conference Series and *Obrazovanie i Nauka*. In 2019, Scopus documents rose to 10 with the highest citations in two sources, namely Journal of Physics: Conference Series and International Journal of Emerging Technologies in Learning. The number of documents dropped in 2020, 2021, and 2022, with 7, 5, and 4 documents, respectively. The number of documents rose again in 2023 to 8 documents. However, in 2024 it decreased to 5 documents.

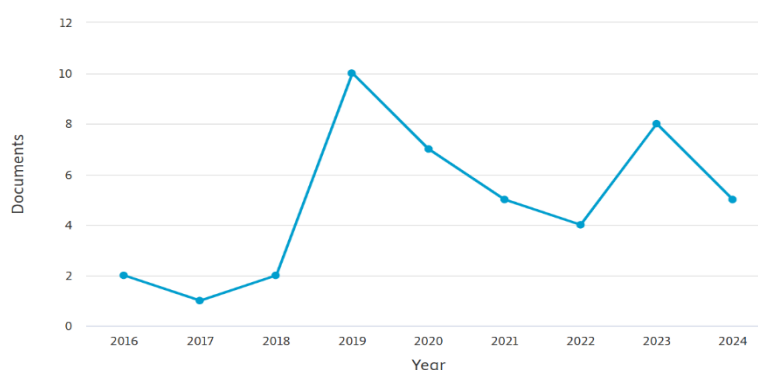


Figure 2. Documents by year

The trend of project-based learning studies reached its highest publication in 2019. Publications in *Journal of Physics: Conference Series* and *International Journal of Emerging Technologies in Learning* with 10 citations each. Likewise, in 2023, the study of the application of project-based learning rose again to 8 documents. *Journal Documents AIP conference proceedings* published 4 articles with 3 citations. Both conferences have the same scope, namely the field of physics and one journal in the field of information systems. This confirms that the application of project-based learning is dominant in the field of physics in 2019 and 2023.

4.2. Subject Mapping of PjBL

The application area of project-based learning in vocational schools is dominant in physics and astronomy as many as 21 documents (30.9%). Furthermore, social sciences have as many as 16 documents (23.5%), and engineering disciplines have 10 documents (14.7%). In addition, computer science is 6 documents (8.8%), and mathematics 3 documents (4.4%). Disciplines that are below 3% are business, management and accounting (2.9%), environmental science (2.9%), and material science (2.9%). Other disciplines below 2% are arts and humanities, energy, psychology, and others.

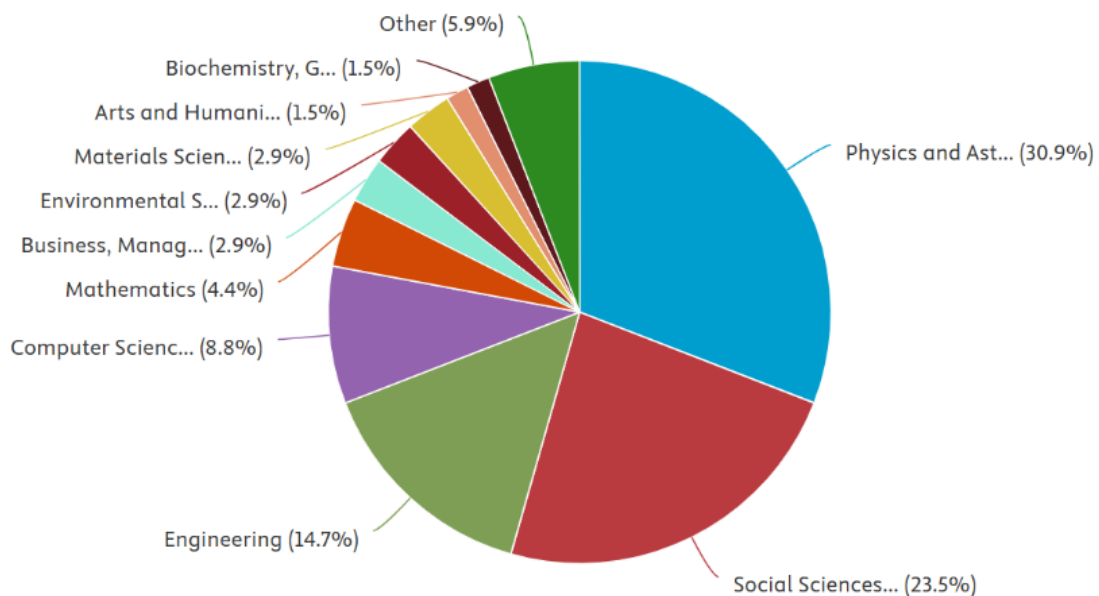


Figure 3. Documents by subject area

Articles on the application of project-based learning in vocational schools in the last 10 years showed the highest research interest in 2019 and 2023. The most journal sources in 2019 were from *Journal of Physics Conference Series* with 5 documents. In 2023, most of them came from *AIP conference proceedings* with 4 documents. The number of article documents decreased in 2017 and 2022. Journals published in 2017 are the *AIP Conference Proceedings* 1 document, and journals published in 2022 are the *International Journal of Evaluation and Research In Education* 1 document and *AIP Conference Proceedings* 3 documents.

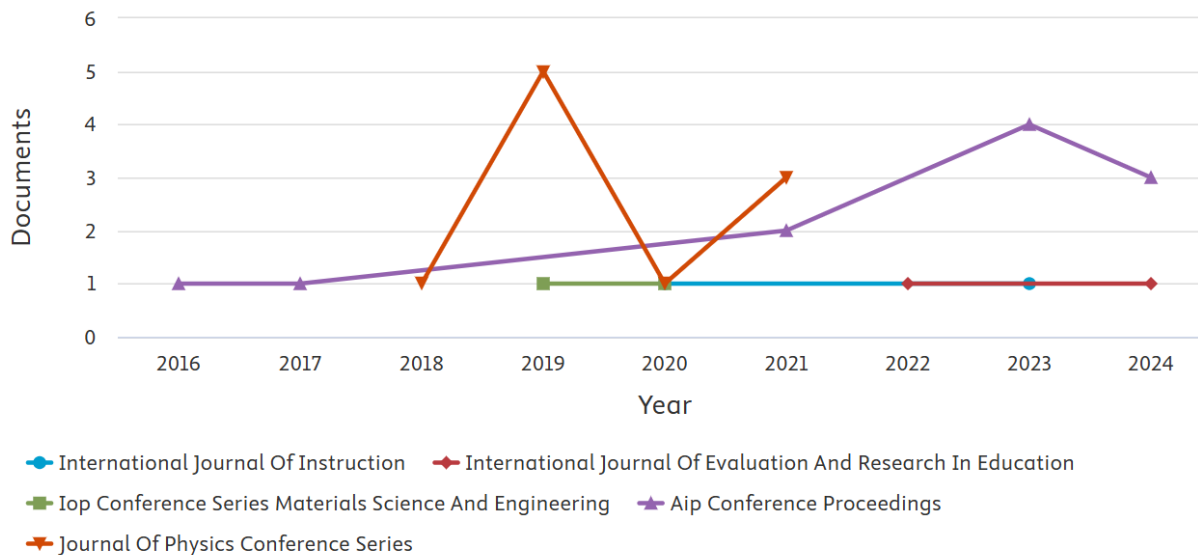


Figure 4. Documents per year by source

There are five journals that have the highest number of documents within 10 years. AIP conference proceedings publication 11 documents, Journal of Physics Conference Series publication 10 documents. International Journal of Evaluation and Research In Education publication 2 documents, International Journal of Instruction 2 documents, and IOP conference series materials science and engineering. AIP conference proceedings' highest publication in 2023, as many as 4 articles. The Journal of Physics Conference Series's highest publication was in 2019, with 5 articles.

4.3. Opportunities for Appropriate PjBL Studies

Review data according to the results of the PRISMA method process is imported into VOSviewer in CSV format. The application settings consider the frequency of occurrence and co-occurrence relationships between terms. VOSviewer then processes the data to identify patterns of relationships between terms, group them by semantic or thematic proximity, and calculate visualization weights such as node size (term frequency) and distance between nodes (degree of relatedness). The display shows 27 items, 4 clusters, 164 links and 295 link strengths.

Cluster 1 consists of 9 items, including computer-aided instruction, students, the mechanical engineering department, student learning, surveys, developing projects, experimental methods, creative thinking, and high school. Cluster 2 consists of 7 items including project-based learning, competence, vocational high school, learning outcomes, cognitive learning, e-learning, and learning outcome. Cluster 3 consists of 6 items including blended learning, learning models, project-based learning models, learning systems, high school students, and education computing. Cluster 4 consists of 5 items including stem, project-based learning, stem (science, technology, engineering, mathematics), engineering education, and apprentices.

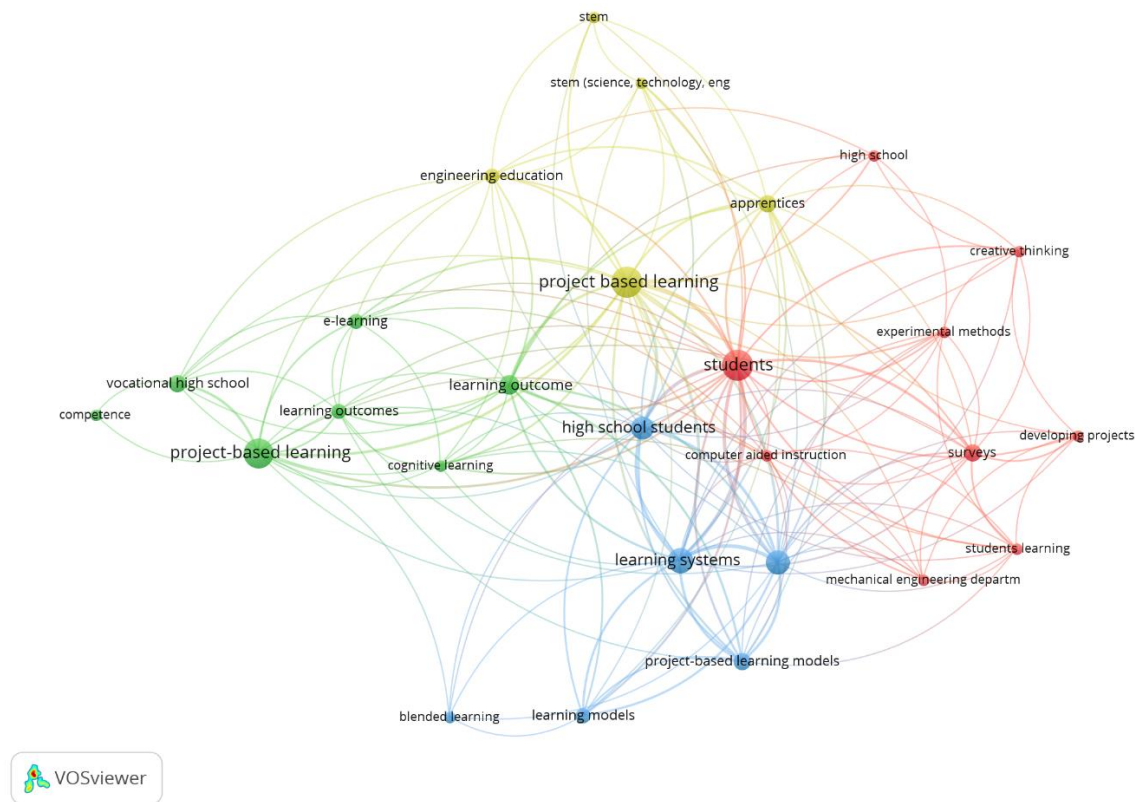


Figure 5. Occurrences PjB

Four clusters were formed: project-based learning, high school students, project-based learning, and students. The project-based learning item includes 2 clusters, 14 links, 24 link strengths, and 12 occurrences. The high school students item includes 3 clusters, 19 links, 42 link strengths, and 7 occurrences. Project-based learning items include 4 clusters, 23 links, 61 link strengths, and 13 occurrences. Student items included 1 cluster, 25 links, 72 link strengths, and 13 occurrences. The total links of project-based learning and project-based learning items are 37 links, 85 link strengths, and 25 occurrences.

Table 2. Citation overview.

Title	Author	Year	Journal	Cited
Creative project-based learning model to increase the creativity of vocational high school students (Usmeldi & Amini, 2022)	Usmeldi, Risda Amini	2022	International Journal of Evaluation and Research in Education	12
Using Instagram to support creative learning and project-based learning (Salehudin et al., 2020)	Sugiyanto, S., Setiawan, A., Hamidah, I., & Ana, A.	2020	International Journal of Advanced Science and Technology	10
Influence of physics problem-solving ability through project-based learning towards vocational high school students	N H D Retno, W Sunarno and A Marzuki	2019	Journal of Physics: Conference Series	10

learning outcomes (Retno et al., 2019)

Project-based learning model practicality on local network devices installation subject (Maulana et al., 2019)	Maulana, I. T., Hary, R. D., Purwasih, R., Firdian, F., Sundara, T., & Na'am, J	2019	International Journal of Emerging Technologies in Learning	9
Development of mathematics e-module with STEM-collaborative project-based learning to improve mathematical literacy ability of vocational high school students (Hadiyanti et al., 2021)	N F D Hadiyanti, Hobri, A C Prihandoko, Susanto, R P Murtikusuma, N Khasanah and P Maharani	2021	Journal of Physics: Conference Series	8
Implementation of Project-Based Learning Model and Workforce Character Development for the 21st Century in Vocational High School (Sudjimat et al., 2020)	Sudjimat, D. A., Nyoto, A., & Romlie, M	2020	International Journal of Instruction	8
Experience of project-based learning: An attempt at objective analysis of results and problems (Trishchenko, 2018)	Trishchenko, D. A	2018	Obrazovanie i Nauka	7
Developing the critical thinking skills of vocational school students in electrochemistry through STEM - Project-based learning (STEM-PjBL) (Rahmawati et al., 2021)	Rahmawati, Y., Hadinugrahanin gsih, T., Ridwan, A., Palimbunga, U. S., & Mardiah, A	2021	AIP Conference Proceedings	6
Using instagram to support creative learning and project-based learning (Salehudin et al., 2020)	Salehudin, M., Sarimin, D. S., & Steven, R. H	2020	International Journal of Advanced Science and Technology	6
Project-based blended learning: The innovation of the pandemic era of learning models in vocational high schools (Setuju et al., 2023)	Setuju, S., Widowati, A., Mariah, S., Suyitno, S., & Setiadi, B. R	2023	AIP Conference Proceedings	3

No documents were published in 2014 and 2015, so there are automatically no citations. In 2016, there were 2 documents published but still no citations. The same thing happened in 2017; there was 1 document published but no citations. In 2018, there were 2 documents published with 1 citation. In 2019, a high number of documents were published, namely 10 documents, but still 1 citation. In 2020, there were 7 documents published with 14 citations. In 2021, there are 5 documents published

with 9 citations. In 2022, 4 documents were published with 14 citations. In 2023, 8 documents were published with 30 citations. In 2024, 5 documents were published with 35 citations.

Article titles with the most citations in “project-based learning model practicality on local network devices installation subject” and “influence of physics problem-solving ability through the project-based learning towards vocational high school students' learning outcomes”. AIP conference proceedings with the title “project-based blended learning: the innovation of the pandemic era of learning models in vocational high schools” (Setuju et al., 2023). Three articles show research trends in the field of science education, especially physics (Retno et al., 2019), information systems (Maulana et al., 2019), mechanical and automotive technology (Setuju et al., 2023).

Based on Figure 3, the application of project-based learning (PjBL) in vocational schools has covered most subject areas. However, there are still some expertise competencies that have not been implemented in PjBL, such as hospitality, fabrication, logistics, and marine fisheries. The temporary assumption is that these competencies have implemented PjBL but there has been no relevant research. In addition, there are still many fields of expertise needed by the industry with PjBL implementation below 3%, including the business, management, and accounting sectors (Chen et al., 2016; Sugiarni et al., 2019) and material science (Aliftika et al., 2021; Nugroho & Sukardi, 2019).

Another concern is the collaboration of fields, subjects, and expertise competencies in implementing PjBL. There are 4 field collaborations, namely Physics and Astronomy (Apriadi et al., 2020), Business, Management and Accounting (Chen et al., 2016), Arts and Humanities (Sukerti et al., 2019), Biochemistry, Genetics and Molecular Biology (Fatimah & Sarbaini, 2022). However, the collaboration still has scientific slices. Figure 2 does not show cross-field collaboration such as between physics and math or physics and English. It is important to pay attention to cross-field collaboration in vocational education to improve cross-field competencies and relationships in product-based applications.

4.4. Recommendations for Future Implementation of PjBL

Studies on the implementation of PjBL in vocational schools were published in 2 journals and 3 conferences. The International Journal of Instruction published 1 document with 11 citations (Sudjimat et al., 2020), and the International Journal of Evaluation and Research in Education 1 document (Usmeldi & Amini, 2022). It is necessary to pay attention to PjBL studies in vocational schools that are published in journals. PjBL studies are not only published in the form of proceedings, but it is also necessary to focus on publishing in vocational journals. Proceedings and journals have different citations, so researchers tend to cite them from indexed journals.

As shown in Figure 5, project-based learning is in clusters 2 and 4. Project-based learning has relevance/occurrence with vocational high school in cluster 2 and high school in cluster 4. Project-based learning and vocational high school are closely related to competence (Apriadi et al., 2020; Sugiyanto et al., 2020), learning outcomes (Arwizet & Saputra, 2019; Herlambang et al., 2023; Rismawati et al., 2019) and cognitive learning (Fatimah & Sarbaini, 2022; Herlambang et al., 2023). Project-based learning dan high school is closely related to engineering education (Ana et al., 2022; Fatimah & Sarbaini, 2022; Widiyanti et al., 2020), apprentices, and stem (Hadiyanti et al., 2021; Rahmawati et al., 2021; Sumarni et al., 2023; Widiyanti et al., 2020; Yusuf et al., 2023).

5. Discussion

Project-based learning and vocational high schools have renewable publication records in 2020 and 2021. The impact factor is in the range of 4 and 5, and the visualization density is in the high school, learning system, and vocational high school (Chen et al., 2016), and education computing (Jäggle et al., 2019; Sugiyanto et al., 2020). The implementation of project-based learning in vocational schools has not increased from 2022 to 2024. The impact factor has increased from 4 to 5

but has not yet reached 6 as the highest point. The achievement of the impact factor shows that citations about project-based learning in vocational schools have increased but have not yet reached the highest point. The study of PjBL in VHS is still limited to learning systems and educational computing, thus encouraging other competencies to be able to implement PjBL.

Research related to Project-Based Learning (PjBL) in vocational schools is still limited to technical aspects such as learning systems and educational computing (Chen et al., 2016; Jäggle et al., 2019). While aspects of industry collaboration, interdisciplinary curriculum, and socio-economic impact have not been explored. The implementation of PjBL in SMK tends to focus on mastering digital tools without strengthening linkages with real industry needs, thus reducing the practical relevance of graduates in the job market (Sugiyanto et al., 2020). This is in line with the findings that the transformation of vocational education in the Industry 4.0 era requires integration with the industrial ecosystem through project-based internship programs (industry-linked PjBL) and measurement of economic impacts such as increased graduate absorption (Lasi et al., 2014).

The impact factor of vocational PjBL research, which has not reached 6 (on the Q1 scale), reflects the limited methodological innovation and expansion of study coverage. Most studies have not utilized mixed-methods or longitudinal analysis to assess the long-term impact of PjBL (Zawacki-Richter et al., 2019). Measuring the success of vocational education does not focus on indicators of increased productivity or reduced unemployment (Bergseng et al., 2019). A holistic approach is needed that integrates soft skills (cross-disciplinary collaboration), entrepreneurship, and adaptation of Industry 4.0 technology (Schwab, 2016). Lifelong learning should include the development of adaptive capacity and creativity, which can be accelerated through interdisciplinary PjBL based on actual industrial problems (Delors & Al Mufti, 1996). Thus, expanding the scope of the research to non-technical and collaborative aspects will encourage the transformative impact of PjBL academically and practically.

The two articles with the highest citations describe aspects of creativity (Salehudin et al., 2020; Usmeldi & Amini, 2022) on the application of PjBL. The third and fourth citations discuss the problem-solving attitude (Retno et al., 2019) and practicality (Maulana et al., 2019) by implementing PjBL. Next, the development of a stem collaboration module (Hadiyanti et al., 2021) and character (Sudjimat et al., 2020) with PjBL. Another paper reviewing critical thinking skills (Rahmawati et al., 2021) and innovation during the pandemic (Setuju et al., 2023) with PjBL. There is no research on the impact of PjBL implementation on vocational students' communication skills, motivation, and learning outcomes. In addition, collaboration is limited to stem and has not been integrated with other subjects such as English in VHS.

6. Conclusion

Publication of PjBL application is still low, only in 2 journals and 3 conferences. Both journals are not in the scope of vocational and training sector expertise. Publications can have a significant impact if they are published in vocational and/or training sector journals. Optimal support is needed so that teachers, lecturers, and researchers can choose relevant journals in publishing articles. Opportunities to study the application of PjBL in VHS in various competencies and expertise programs can produce many findings in order to produce innovations (Joko et al., 2022; Yusuf et al., 2023), achieving learning objectives (Arwizet & Saputra, 2019; Herlambang et al., 2023; Rismawati et al., 2019), improve competence (Apriadi et al., 2020; Sugiyanto et al., 2020), and employment opportunities (Purnomo et al., 2023; Sudjimat et al., 2020) for VHS outputs.

Limitation of research on vocational schools that apply the PjBL learning model. To expand the impact of research, there is a need for deeper exploration of the synergies of PjBL with non-technical subjects (e.g. language or art) as well as measurement of multidimensional impacts, such as improved soft skills, motivation to learn, and relevance of the curriculum to industry needs (Bergseng et al.,

2019; Zawacki-Richter et al., 2019). Thus, future research needs to adopt interdisciplinary and mixed methods approaches to address the complexity of vocational education challenges in the 21st century.

7. Suggestion

The tendency of project-based learning implementation in the aspect of practicality (Maulana et al., 2019) in the field of network installation, problem solving (Retno et al., 2019) in physics, and innovation (Setuju et al., 2023) in vocational schools. The application of PjBL in the education sectors of physical science, information systems, automotive engineering and machinery. VHS has competencies in other fields such as maritime, marine, tourism, social work, agribusiness, animal husbandry, agriculture, and others. It is necessary to disseminate and study PjBL in competencies in other fields, along with the application of PjBL integrated with two or three subjects in VHS.

Declarations

Author Contributions. Muhtar.Suryanti.Bachtiar Sjaiful Bachri: The conception and design of the study. Muhtar.: The first draft of the manuscript and all authors commented on earlier versions of the manuscript. All authors read and approved of the final manuscript. Muhtar.: Idea for the article, Ayil Qoimatul Laili.Isnaini Nur Siyam.: Literature search, Khusnul Mila.Eka Yuliaturosida.: Data analysis, Muhtar.Ayil Qoimatul Laili.Khusnul Mila.: Drafting and/or critically revising the work.

Conflicts of Interest. The authors declare no conflict of interest.

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Ethical Approval. No approval from the ethics committee was required

Data Availability Statement. The data that supports the findings of this study are available from the first and corresponding author upon reasonable request.

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