

## *Study on The Implementation of PjBL-STEM Learning Model for Science*

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**Abstract:** *An independent curriculum provides space for educators and students to be more flexible in developing learning. In this latest curriculum, learning is no longer carried out conventionally using the lecture method. Instead, it uses a learning model that stimulates student activity. The times that require students to have 4C skills to be able to adapt to global competition. For this reason, teachers can carry out learning using the PjBL-STEM model. This research was carried out using descriptive analysis methods in journals in the database of Google Scholars, Mendeley, ERIC, Elsevier, and Sinta. The data was used in the form of journals published in the period 2010-2022. The results obtained are 81 journals that research designing and implementing PjBL-STEM in learning. The application of this model provides many benefits such as increasing 4C skills, independence, problem-solving, processing data, and creating the latest technology-based innovations. The application of the PjBL-STEM model by teachers in the form of worksheets, LKPD, modules, textbooks equipped with learning videos, flipbooks, and UKBM as well as the use of syntax in the learning process. Based on the data obtained, the application is mostly carried out by teachers in the learning process using the PjBL-STEM model syntax.*

**Keywords:** *PjBL-STEM, Science Education*

**Abstrak:** Kurikulum merdeka menyediakan ruang bagi pendidik dan peserta didik untuk lebih leluasa dalam mengembangkan pembelajaran. Dalam kurikulum terbaru ini, pembelajaran tidak lagi dilaksanakan secara konvensional menggunakan metode ceramah. Melainkan menggunakan model pembelajaran yang merangsang keaktifan siswa. Perkembangan zaman yang menuntut siswa memiliki keterampilan 4C agar mampu beradaptasi pada persaingan global. Untuk itu guru bisa melaksanakan pembelajaran menggunakan model PjBL-STEM. Penelitian ini dilaksanakan menggunakan metode analisis deskriptif pada jurnal yang ada pada database google schoolars, mendeley, ERIC, Elsevier, dan sinta. Data yang digunakan berupa jurnal yang terbit dalam kurun waktu 2010-2022. Hasil yang diperoleh terdapat 81 jurnal yang meneliti tentang merancang dan menerapkan PjBL-STEM dalam pembelajaran. Penerapan model ini memberikan banyak manfaat seperti meningkatkan kemampuan 4C, kemandirian, problem solving, mengolah data dan menciptakan inovasi terkini berbasis teknologi. Penerapan model PjBL-STEM oleh guru berupa LKS, LKPD, modul, buku ajar yang dilengkapi video pembelajaran, flipbook dan UKBM serta penggunaan sintaks dalam proses pembelajaran. Berdasarkan data yang didapatkan, penerapan lebih banyak dilaksanakan guru pada proses pembelajaran dengan menggunakan sintaks model PjBL-STEM.

**Kata kunci:** PjBL-STEM, Pembelajaran Sains

### **1. INTRODUCTION**

Information technology is growing rapidly in all aspects of life, including the world of work. Ironically, many job seekers do not find work due to their inability to maximize their technology-related abilities. The proof is that in 2021 there will be 5.98% of openly unemployed university graduates (BPS, 2021). For this reason, there needs to be a change in the world of education by integrating technology. So that when you graduate, you can maximize the resources it has.

The integration of technology in the world of education can be done in various ways, for example inserting it in a learning model, using technology-based media, and using learning resources that utilize digital technology. The insertion of technology in the world of education demands a change in the mindset. Where previously the pattern of teacher-centered education is now starting to shift to student-centered. This shift also trains the skills that students must have to adapt, namely 21<sup>st</sup>-century skills or commonly known as 4C skills. (Tuan Soh et al., 2010). These skills include critical thinking, creative thinking, communication, and collaboration (Erdoğan, 2019).

In recent years, education around the world has begun to try to equip students to have cognitive skills and professional skills (Vogler et al., 2018). Current learning focuses on preparing students who can adapt to fast-paced changes in all aspects of life. In conventional learning, learning is centered on the teacher and students as recipients of the information. But the demands are now starting to change those students who have to be active to get their knowledge (Guo et al., 2020). An independent curriculum provides space for educators and students to be more flexible in developing learning. In this latest curriculum, learning is no longer carried out conventionally using the lecture method. Instead, it uses a learning model that stimulates student activity. Teachers can provide space for students to learn through learning models such as Project Based Learning (PjBL) and STEM.

Project Based Learning provides opportunities for students to learn actively through projects so that they get a meaningful experience. Project-based science learning is based on constructivist learning theory (Krajcik et al., 1994). Providing opportunities for an active learning environment through student activities constructs prior knowledge with newly acquired knowledge. Through project-based learning students practice finding solutions to real problems that exist in everyday life through activities asking questions, designing and carrying out investigations, researching problems, gathering information, drawing conclusions, and reporting findings...

In classroom application, teachers usually apply the Project Based Learning (PjBL) learning model with a combination of STEM. It is based on a characteristic equation that emphasizes the systematic design process as a problem-solving effort (Lee et al., 2019). The merger of PjBL-STEM is one of the ways that teachers take in increasing the effectiveness of the learning process (Tseng et al., 2013). STEM-based learning trains students' concepts through procedural activities in finding solutions to real problems in everyday life (Putri et al., 2021). So that STEM learning is trusted in training 21<sup>st</sup> century (Hernandez et al., 2014). The integration of STEM in education has an ally in 2007 but has only developed rapidly since 2016 (Gil-Doménech et al., 2020).

Previous research has provided an overview of the implementation of PjBL and STEM in the world of science, administration, management, and computing (Hallinger & Kovačević, 2019). The main purpose of this research is to know the implementation of PjBL-STEM in the world of education today. So that it can answer several main questions such as (1) How are publications on the topic of PjBL-STEM in the 2016-2022 range? (2) What is the distribution pattern of PjBL-STEM publications? (3) Who is the author of the most research on PjBL-STEM?

## **2. METHOD**

### **2.1. Search**

We used Google Scholar, Mendeley, ERIC, Elsevier, and Sinta search services to identify relevant studies. The search term used is using the keywords "PjBL-STEM and IPA". Data collection was carried out in October 2022. The results were 81 articles and proceedings published in 2016-2022. Most of the results use English and Indonesian.

### **2.2. Selection**

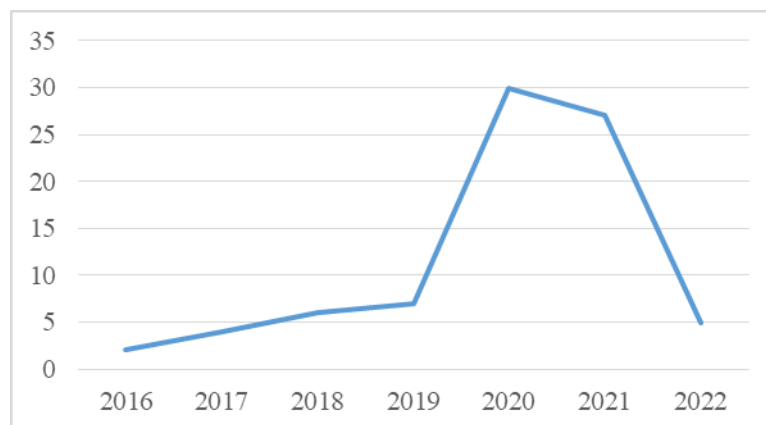
Article selection is done manually with several criteria. Selection using criteria:

- Relevant studies with original data
- Focus on PjBL-STEM
- PjBL-STEM Impact
- Minimum contains abstracts, introductions, methods, results, conclusions, and bibliography

The data were analyzed using Microsoft excel software so that the PjBL-STEM research trend was obtained.

## **3. RESULT AND DISCUSSION**

The following is the number of research publications on PjBL-STEM from 2016 to 2022.



**Figure 1** Number of publications per year

Based on the search results obtained as many as 81 documents. The search focuses on the publications of the main Indonesian journals that have been recognized by Sinta. However, it does not rule out the possibility of foreign journals being registered. From the graph it can be seen that the number of publications increases every year, this is following previous research.(Triwahyuningtyas et al., 2021)(Vuong et al., 2021). However, the graph in 2022 has decreased, this is due to the search for journals carried out in October 2022. So there may be still many journals that have not been published. The data obtained are from 4 proceedings and 78 journals.

The pattern of dissemination of journal publications is very diverse, ranging from publications in national and international journals. Because the focus of the search for journals is more directed at national journals, the distribution pattern is more in national journals. Journal publications are mostly carried out in Jurnal Pasca Sarjana Universitas Negeri Malang, Journal of Turkish Science Education, Jurnal Pendidikan Indonesia, Jurnal of Physics, Quagga, and Jurnal Penelitian Pendidikan IPA.

The authors of most journal publications are Parno, Toto, Ade Fitriyani, Eny Triastuti, and Afni Nur Afifah. All of these authors have published in at least 2 PjBL-STEM-related journals. Based on the quality data, the journals obtained are very diverse, ranging from indexed by sinta to indexed by Scopus. The following is the journal index data:

**Tabel 1** Journal based on quality data

	Indeks	Jumlah
Sinta	S1	3
	S2	16
	S3	7
	S4	6
	S5	2
	S6	0
Scopus	Q1	0
	Q2	4
	Q3	1
	Q4	0
Jumlah		39
Tidak terdefinisi		42

Based on the table, it can be seen that most publications are indexed by Sinta 2. While the publications are the least indexed by Scopus with Q3. However, 42 journals have not been indexed by Sinta or Scopus.

Based on the data, the top affiliation in PjBL-STEM journal publications from 2016-2022 is dominated by Indonesia, this is to previous research. (Putri et al., 2021). Based on the mapping, most universities that research PjBL-STEM are Universitas Negeri Malang. This is reinforced by research

conducted by Putri(2021) that Universitas Negeri Malang contributed 27 research documents, Universitas Pendidikan Indonesia contributed 50 documents, Universitas Sebelas Maret 22 documents, and Universitas Negeri Semarang 20 documents(Putri et al., 2021).

The implementation of PjBL STEM in science learning has the main objective of training students' 4C skills so that they can adapt to the 21st century. The superior skills that students get when using PjBL-STEM-based learning are problem-solving skills and the use of technology(Purwaningsih et al., 2020). However, it turns out that many other skills are also trained when using the PjBL-STEM model such as scientific argumentation skills, scientific literacy, and increasing understanding of concepts. (Laforce et al., 2017), increase interest in learning (Putri et al., 2021), improve mathematical thinking skills (Indriani, 2020), analytical thinking (Tipani, Anita., 2019), independence, data processing skills, and increase students' creativity in their work (Siew & Ambo, 2018). Even PjBL-STEM-based learning can reduce gender stereotypes in learning because all students mix in their groups to express ideas to produce work. (Tam et al., 2020). The assessment carried out by the teacher after using the PjBL-STEM model has a positive impact on the cognitive aspects, attitudes, and skills of students (Diana et al., 2021).

The implementation of PjBL-STEM in learning by teachers is carried out in various forms according to the needs of the class. Teachers implement PjBL-STEM in the syntax of the learning process and digital books. Digital books are developed by teachers in the form of worksheets, worksheets, and modules that can make it easier for students to carry out work procedures(Astuti et al., 2019). Implementation is also carried out in the form of textbooks equipped with learning videos (Widarti et al., 2020). Teachers also develop modules on specific learning concerning the desired skills (Widiyanto et al., 2021). The teacher also implements PjBL-STEM in the form of a flipbook, making it more interesting for students to learn (Rokhim et al., 2020). Another form used is the form of UKBM which is equipped with formative assessment (Alifiyah et al., 2020). Based on the data obtained, the application is mostly carried out by teachers in the learning process using the PjBL-STEM model syntax. Before applying the PjBL-STEM model, the teacher should make observations on the characteristics of students. Because it turns out that PjBL-STEM depends on aspects of gender, race, and self-efficacy(Geng et al., 2019). In addition to having advantages, it turns out that the implementation of PjBL-STEM is also considered to have disadvantages, namely it takes a long time. However, with more advantages, the shortcomings can be ignored with the innovations made by the teacher.

#### **4. Conclusion**

The trend of PjBL-STEM research in 2016-2022 continues to increase. Publications are mostly done in the form of journals. The integration of the two models has a positive impact on learning, mainly training 4C skills. PjBL-STEM is implemented in learning through the syntax of the learning process and in the form of teaching materials. Based on the positive impact generated, the implementation of PjBL-STEM needs to be intensified as an innovative product that can help students practice 4C skills through science learning.

#### **5. Suggestion**

This research can be used as an initial study to provide research direction on PjBL-STEM which is dominated by national publications. Suggestions for further research are to study more deeply related to the implementation of PjBL-STEM based on education level, and focus on certain countries. So that it can compare implementations from various countries.

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