

Implementation of Project Based Learning Model in Vocational High School: A systematic Literature Review

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Abstract: This research aims to provide a comprehensive overview of the implementation of project-based learning in Vocational High Schools (VHS). The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) was used as the method. The research results show that first, PjBL in Indonesia vocational high schools and abroad has an impact on student interest and motivation also students' learning outcomes in various aspects; second, the flexibility of the model consists of time in the classroom and time outside the classroom; third, teacher's main roles are design the instruction, media selected, and facilitate students in learning with measuring the extent of students' understanding; fourth, model, media, and strategies, there are various activities can be integrated into Project Based Learning; Fifth, Model can be applied in various vocational fields. Benefits, challenges, and recommendations for further research are also provided.

Keywords: Project-Based Learning; Systematic Literature Review; Vocational High Schools.

Introduction

The flexibility of PjBL to improve the quality of learning can be integrated with other methods. Application of project-based learning and discovery learning (Puti et al., 2024), integrated stem and project-based learning (Andriani et al., 2023; Pan, Lai & Kuo, 2023; Prajoko et al., 2023; Zahirah et al., 2024). Integrated problem-based learning and project-based learning (Hudha, et al., 2023; Loyens et al., 2023), and integrated Gpt chat in project-based learning (Purnama et al., 2023). The opportunity to apply PjBL with other innovations are still open

Project-based learning (PjBL) has emerged as a pivotal educational approach in vocational education, promoting active learning, students are actively involved in project problem-solving and practical skills essential for the modern workforce such as analytical thinking (Puti et al., 2024), In the preparing students for real-world challenges, PjBL offers a dynamic and

interactive alternative that aligns with contemporary educational goals and industry demands. This introduction synthesizes the insights from several key studies on PBL in vocational education, highlighting its impact on student learning outcomes, vocational competence, and the development of essential skills.

Vocational High Schools are formal schools in the vocational field that prepare students to be ready and able to work immediately after graduating. However, the low energy absorption of vocational schools in the world of work and industry is still low due to poor attitudes (Kurniawan et al., 2021), low mastery of skills, attitudes and knowledge was also reported by (Nuryanto & Eryandi, 2020). For this reason, effective learning methods are needed to improve learning practices (Dewangga & Ahmad, 2023). School partnerships with the industrial world can improve the quality of learning and students' readiness for work (Susilowati, 2023). Jollands et al., (2012) claim that model is a suitable approach for developing work-ready skills

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for engineering graduates. The negative impact of the industry is also felt by vocational education and training. The efforts made are to increase students' competence to work sustainably in the fields of tourism, society and culture (Riswano & Widiaty, 2023; Thunqvist et al., 2023). Based on the results of the research above, it is necessary to implement Student-Centered Learning (SCL), and be able to support work readiness and influence competency and/or learning outcomes.

The implementation of an independent curriculum further strengthens the implementation of SCL. Learning that allow students to actively increase learning independence and teachers as a facilitators. (O'Neill & McMahon, 2005) describe student-centered learning as focusing on the students' learning and 'what students do to achieve this, rather than what the teachers do'. PjBL originates from the progressive era of (Dewey, 1902), who advocated an educational approach that centered students to be active participants in learning experiences, thereby promoting interest and motivation (Weiss & Belland, 2016). Various methods are used to facilitate SCL, including model. PjBL Model is an instructional strategy that provides students the autonomy to learn, explore, and investigate throughout the learning process by encouraging them to do projects. As a method, model is a SCL pedagogy, the instructors act like knowledge facilitators (Chiu, 2020). There are six characteristics of PBL: first driving question, second learning goals, third scientific practices, fourth collaboration, fifth using technological tools, and sixth creating an artefact (Markula & Aksela, 2022).

PjBL has emerged as a learning approach in vocational education, promoting active learning and practical skills essential for the modern workforce. Meanwhile traditional teaching methods often fail to preparing students for real-world challenges. PjBL offers a dynamic and interactive alternative that aligns with contemporary educational goals and industry demands. Several studies of model in vocational education highlighting its impact on student learning outcomes, vocational competence, and skills development. One view is that project-based learning can significantly improve student learning outcomes, such as academics, motivation, and higher-order thinking skills. (Karpudewan et al., 2016) reported that implementing model approach can had better performance on energy-related knowledge, attitudes, behaviours, and beliefs. Model showed that there were significant differences in students' interest, autonomy, and competence before and after which influence of intrinsic motivation to learn (Zhang, 2021; Pamenang et al., 2024). Biazus & Mahtari (2022) conducted a quasi-experiment using model and direct instructional learning models and found that a significant impact on the enhancement of creative

thinking skills, and supported by research from (Deria et al., 2023; Kiraga, 2023; Yanti et al., 2023; Amalia et al., 2024; Anwar et al., 2024; Ilafi et al., 2024; Khafah et al., 2023; Setyani et al., 2024). An innovative approach used in various countries, namely learning that facilitates 21st century skills and is still a trend in research, software development and for educators (Matahari et al., 2023; Dewi & Arifin, 2024). Indonesia has conducted the most research on model to help students improve skills in problem solving (Hudha et al., 2023).

In the education domain, PjBL can be applied at all levels of education units from elementary school to high school/vocational school (Yanti & Novaliyosi, 2023). The success of PjBL has also been proven increasing learning outcome (Diarini et al., 2020; Nestiyarum & Widjajanti, 2023; Setiawan et al., 2024; Tuaputty et al., 2023). Implementing model can improve critical thinking skills (Diarini et al., 2020; Kiraga, 2023; Loyens et al., 2023; Tuaputty et al., 2023), improved visual literacy (Andriani et al., 2023), to improve students' conceptual understanding and creativity (Pan & Kuo, 2023; Prajoko et al., 2023), character of national integration (Sa'ida, 2022), collaborative skills (Nestiyarum & Widjajanti, 2023; Yanti et al., 2023), motivation and interest in learning (Deria et al., 2023), professional skills (Taneja, 2020), and improve life skills (Wurdinger & Qureshi, 2015; Hizqiyah et al., 2023). Further, (Purnama et al., 2023) reported that the integration of CPT with PjBL can improve the quality of learning.

Based on the explanation above, the literature review shows that the research finding and teaching effectiveness of PjBL teaching are still mixed. A few studies have been analyzed and evaluated optimal group measures, class size, curriculum type, and field of study. Therefore, this research aims to provide evidence of the best implementation of project-based learning in vocational high schools by selecting relevant articles and reviewing them using the PRISMA method. This article addresses four key research questions: first, it examines the effectiveness of Project-based Learning (PjBL) in vocational high schools; second, it explores the positive impacts of PjBL on student skills, engagement, and motivation; third, it identifies the challenges of implementing PjBL, such as time and resource constraints; and fourth, it considers whether PjBL can be applied across various educational domains. These questions aim to evaluate the feasibility and benefits of PjBL in vocational education.

Method

A systematic review is a method for providing a comprehensive and unbiased synthesis of many relevant research in a single document. This research attempts to

uncover evidence relevant to a question and focuses on research that reports data. The systematic review was conducted through the following steps: first, clearly defining the objectives and research questions; second, establishing inclusion and exclusion criteria; third, conducting a comprehensive search to identify all relevant published and unpublished studies; fourth, assessing the quality and validity of the studies and reporting based on research quality; fifth, analyzing the data; sixth, presenting and synthesizing the findings; and seventh, transparently reporting the methodology and methods used in the review.

This research was conducted using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) method introduced by (Liberati et al., 2009) and developed specifically for scoping reviews by (Tricco et al., 2018). PRISMA can be used as the foundation for reporting a systematic review (Moher et al., 2009). At the stage of the eligibility criteria, Literature review to needs to be included Inclusion and Exclusion (Table 1). Furthermore, all databases and other sources searched and the date of the last search for each source.

Table 1. Inclusion and Exclusion Criteria

Inclusion criteria	Exclusion criteria
Published from 2010 till June 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
Article could be accessed	Article couldn't be accessed
Project based learning is the model of the instructional	Other project-based learning is the model of the instructional
Indexed by scopus	Was not indexed by scopus

The next step is searching and collecting a number of articles published from 2010 to June 2024 by using the keywords "Poject Based Learning" And "Vocational High School" in a searchable database of scholarly literature, Scopus with assisted Publish or Perish (PoP). Even though the request was for 200 articles, 151 records were detected. Identification is carried out completely to find out whether article meets the criteria or not. The data collection process, including searching, screening, and selecting qualified articles for inclusion. The 49 studies were included for further consideration in the eligibility phase. Author re-read the literature based on the inclusion and exclusion criteria. Finally, a total of 32

studies satisfied the inclusion criteria. The author uses a flow diagram using a citation search because the article comes from Scopus. The results obtained were 32 articles as study material in this research (Figure 1).

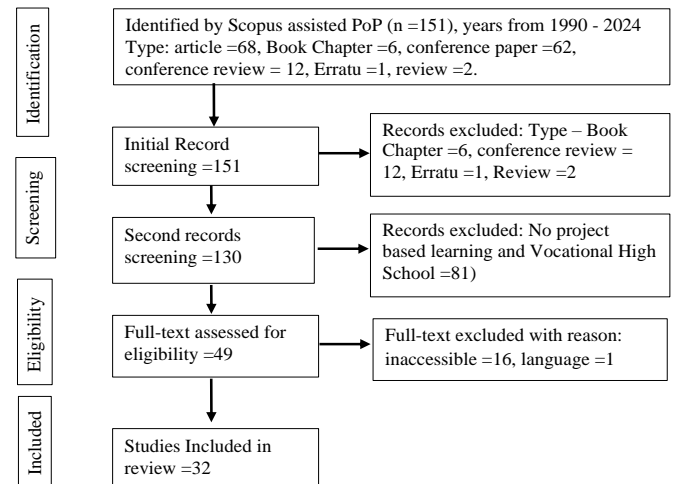


Figure 1. Flow Diagram of PRISMA (Liberati et al., 2009).

Result and Discussion

Based on the flow diagram in figure above, there are 32 suitable articles and the types consist of 15 articles and 17 conference papers. As can be seen in Figure 2, these-article were published the over last decade. Furthermore, a general overview of Project based Learning research in vocational high schools can be seen in Table 2.

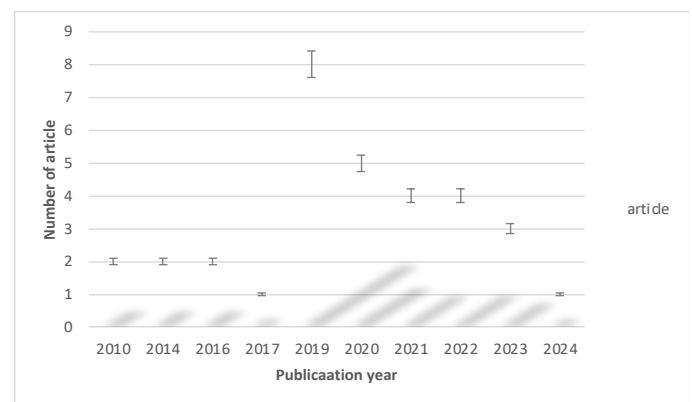


Figure 2. Year of publication of the selected articles

Figure 2 explains that articles were published from 2010 to May 2024. The lowest frequency of one article in 2017 and the highest occurred in 2019 with eight articles. Then the trend began to decline in the following years. This means that the use of the PjBL model in vocational high schools has shifted to other models which are not discussed in this research.

Table 2. Summary of Selected Article

Authors (Publication Year)	Subject	Research Area	Research Methods	Country
Fjellström (2014)	construction	work practices	qualitative	Sweden
Liao et al., (2016).	core capability indices	the students' satisfaction	survey	Taiwan
Maulana et al., (2019).	local network devices installation subject	practical and helpful learning	instructional development institute (IDI)	Indonesia
Lubis et al., (2019).	entrepreneurship	learning outcome and motivation	experiment	Indonesia
Sukerti et al., (2019).	culinary	formation of entrepreneurship mindset with Tri kaya parisudha concept	quasi-experiment	Indonesia
Salehudin, et al., (2020).	basic graphic design	conceptual understanding	quasi -experiment	Indonesia
Sudjimat et al., (2021).	the mechanical engineering expertise	21st-century workforce character development	mixed method	Indonesia
Sugiyanto, et al., (2020)	computer assembly and basic network	validity instrument and affective, cognitive, psychomotor domain	R & D and experiment	Indonesia
Usmeldi & Amini, (2022).	electric motor installation	skills in making creative product	R & D and quantitative	Indonesia
Joko et al., (2022).	human-machine interface	validity & behaviour, and skills	R & D and quantitative experiment	Indonesia
Ana et al., (2020).	bakery and pastry practical	practical skills	experiment	Indonesia
Fatimah and Sarbaini, (2022)	-	cognitive skills and creativity	experiment	Indonesia
Hariyanto et al., (2023).	entrepreneurship learning	students' achievement and final product quality	quasi -experiment	Indonesia
Abdurrahman & Mahmudah (2023)	digital-preneurship	validity and measurement	R & D	Indonesia
Maknun & Herman, (2024).	physics	critical thinking skills	quasi-experiment	Indonesia
Köse, (2010).	web design and programming	skills and attitude	descriptive	Turkey
Louet al., (2010).	cup speaker	academic performance	descriptive	Taiwan
Susilowati, (2014).	engineering and electrical installation	Practical skills	descriptive	Indonesia
Sudjimat, (2016).	mechanical machining skills package	soft and hard skills	survey	Indonesia
Sugandi, (2017).	prakerin, construction industry services	employment skill readiness	descriptive	Indonesia
Nugroho & Sukardi, (2019).	CNC milling mechanical technique	validity and learning outcome	R & D	Indonesia
Sudjimat et al., (2019).	practicum	skills	descriptive	Indonesia
Arwizet & Saputra, (2019)	auxiliary machine	learning outcomes	quasi- experiment	Indonesia
Saputra & Wagiran, (2019).	mechanical engineering	validity	R & D	Indonesia
Rismawati et al., (2019).	automotive	learning environment and learning outcomes	quasi- experiment	Indonesia
Jailungka, et al., (2020).	physics simulation	Motivation	descriptive	Thailand
Astarina et al., (2020).	building design and information design	transferable skills	experiment	Indonesia
Rahmawati et al., (2021).	multimedia	critical thinking skills	qualitative	Indonesia
Hadiyanti et al., (2021).	math	literacy ability	R & D	Indonesia
Aliftika et al., (2021)	-	critical thinking skills	quasi- experiment	Indonesia
Wibowo et al., (2021).	waste treatment materials	creative thinking	experiment	Indonesia
Purnomo et al., (2023).	bench work practice	bench work practice activities and skills	action research	Indonesia

The articles obtained represent three types of subjects in vocational school, namely normative, adaptive and productive. These findings indicate that project-based learning has been developed and implemented in vocational high schools. The results of the research revealed that project-based learning influences students' skills, work readiness, interest and motivation, affective, cognitive and psychomotor competencies, as well as critical thinking and creative thinking. The trend of research being carried out is not only in the field of technology, but also in other fields.

The implementation of Project Based Learning

Vocational education aims to equip students with specific skills and knowledge tailored to future careers. The implementation of PjBL can be integrated with digital technology, social media, learning strategies, and local knowledge to support vocational students' learning outcomes (Arwizet & Saputra, 2019; Lubis et al., 2019), and work readiness skills (Rismawati et al., 2019). (Fjellström, 2014) emphasizes the need to create a learning environment that fosters vocational competence through teacher guidance and project-based activities. This approach is in line with the principles of active learning, where students are encouraged to apply theoretical knowledge in practical contexts. (Liao et al., 2016) further underscored the importance of integrating scientific inquiry into PjBL courses to enhance core capabilities. This integration can improve academic performance, foster critical thinking and problem solving skills. Sugiyanto et al., (2020) integrated mobile learning with PjBL, demonstrating increased competency and making learning accessible and flexible. Usmeldi & Amini, (2022) focus on significantly increasing creativity, creative thinking and problem solving abilities. Joko et al., (2022) developed an IoT-based PBL model to increase innovative behaviour and skills relevant to Industry 4.0 and Society 5.0.

The implementation of PBL varies in each educational environment, tailored to fulfil certain goals. Maulana et al, (2019) focus on the practicality of PBL in teaching local network device installation, to prepare for industry-specific tasks. Meanwhile Lubis et al., (2019), Abdurrahman & Mahmudah, (2023), Hariyanto et al., (2023) introduced it to foster entrepreneurial skills, innovate, adapt and made final product quality to market changes. On the other hand Sukerti et al., (2019) integrates the Tri Kaya Parisudha concept which can develop students' entrepreneurial mindset. This holistic approach combines cognitive, affective, and psychomotor domains, to ensure a well-rounded educational experience. At this time, exploration of media technology is needed. Salehudin et al., (2020) explored the use of social media Instagram, to support creative learning, and integrated mobile learning to

enhance cognitive skills (Fatimah & Sarbaini, 2022). Meanwhile, Ana et al., (2022) developed an integrated PjBL and blended learning guide during the Covid-19 pandemic. Arwizet & Saputra (2019) emphasize the importance of collaborative learning in overcoming these challenges, advocating for a think-pair-share model to enhance student learning outcomes.

The research results show that the project-based learning model has been used in vocational high schools. The Model are applied in two types of time, namely in class (synchronous) and outside class (asynchronous). The model as a transformative pedagogical approach in vocational high schools, influences student engagement and learning outcomes. Integration of practical work with academic content, allowing students to be ready for the real world. The effectiveness of PjBL can be assessed through various parameters including skill mastery, critical thinking, and student motivation. Sudjimat's research, shows a marked increase in hard and soft skills (Sudjimat, 2016). Student involvement in projects, collaborating, solving problems, and managing projects, are important skills in the modern world of work.

Quantitative evidence supports increased test scores and practical competence, as proven by (Sudjimat et al., 2019), that the application in mechanical engineering studies has resulted in increased student learning outcomes and involvement in learning can increase motivation. However, the effectiveness needs to be supported by other factors, such as teacher training and availability of resources. (Sudjimat et al., 2020), noted that teachers expressed the need for support and professional development for successful implementation of PjBL strategies. In conclusion, the effectiveness of implementing PjBL in vocational high schools can be seen through increasing student performance, engagement, and developing skills for employability. However, maximizing its effectiveness requires systemic support, including teacher training and adequate resources.

Benefits of Project Based Learning

Project Based Learning provides many benefits in vocational high schools, for students of educational institutions and industry partners. The main advantages are the ability to develop practical skills and an engaging learning environment. One of the most significant benefits is alignment with labour market demands. By involving students in real-world projects, narrows the gap between theoretical and practical application. Increasing students' readiness to face the world of work, relevance to research results (Sudjimat, 2016; Sugandi, 2017). In addition, PjBL encourages the development of soft skills, attitude (Köse, 2010), practical skills (Susilawati, 2014) and academic performance (Lou et al., 2010) such as teamwork, communication, critical

thinking skills and problem solving abilities. working on projects by collaborating in teams, communicating effectively, negotiating roles in groups can foster the interpersonal skills necessary for a future career. (Rahmawati et al., 2021; Maknun & Herman, 2024; Aliftika et al., 2021).

Another important benefit of PjBL is the promotion of independent learning, foster a sense of responsibility and initiative during project development, by researching, planning, and executing tasks independently, cultivating critical thinking and decision-making skills. The positive impact of PjBL extends to student motivation and engagement (Jailungka et al., 2020). Research shows that this increased engagement results in higher student retention (Purnomo et al., 2023). In short, the benefits of using Project Based Learning in vocational high schools are that it enriches student experience, increases employability, practical skills, and encourages collaboration and motivation. In meaningful Partnerships between educational institutions and industry stakeholders. Alignment of projects with industry needs, internship programs and real-world applications that benefit students and the business world, as well as building a cooperative approach to education.

Challenges in implementation Project Based Learning

Implementing PjBL in vocational high schools provides benefits as well as challenges. Challenges for educators and administrators. Challenges can hinder the effectiveness and sustainability of PjBL approaches. The first challenge is the lack of adequate teacher training. Teachers are not ready to implement PjBL methodology effectively. Sudjimat et al., (2020) stated that many vocational educators have not received adequate professional development to understand the complexities of managing project-based learning environments. The second challenge is the availability of resources such as materials, tools and technology which may not be easily accessible in all vocational institutions. Sudjimat et al., (2019), highlighted the limitations of laboratory equipment and project materials, and this was exacerbated by limited funding. Third, time constraints limit their ability to engage students in in-depth project work. The pressure of standardized tests makes things more complicated, because educators prioritize test preparation over experiential learning (Nugroho & Sukardi, 2019).

The last involves students in diverse classrooms, where students demonstrate varying levels of motivation and competence. Some students struggle with autonomy and prefer a more structured learning environment. This difference requires educators to apply effective strategies and students to be actively

involved in the project process (Hadiyanti, N.F.D., et al., 2021). Although the challenges of implementing Project Based Learning in Vocational Schools are quite large, these challenges can be overcome through targeted teacher training, adequate resource allocation, innovative assessment strategies, and effective classroom management techniques.

Project Based Learning can be applied to all educational domains

Project Based Learning (PjBL) is a pedagogical approach that can be applied in various areas of vocational education study. Its flexibility and relevance lend itself to science, technology, engineering, arts, mathematics (STEAM), humanities and social sciences disciplines. In science education, PjBL allows students to engage in hands-on experiments and investigations, thereby enhancing in-depth understanding of scientific concepts. This learning approach fosters critical thinking and inquiry skills, addressing complex issues in environmental science and sustainability (Nugroho & Sukardi, 2019). The fields of technology and engineering significantly emphasize PjBL on problem solving and innovation. Students can start projects starting from designing and prototyping, such as robotics or computer applications. Projects that apply theoretical knowledge in a practical context, thereby bridging the gap between classroom learning and industry demands. (Liao et al. 2016) highlight how to integrate inquiry-based and project-based learning to enhance core competencies in engineering, demonstrating the widespread applicability of PjBL.

Furthermore, PjBL can enrich the arts by encouraging creativity and self-expression. Students may work on community arts projects or multimedia presentations that explore cultural themes, integrating various artistic disciplines. By collaborating in artistic endeavors, students develop teamwork skills while cultivating creative abilities (Wibowo et al., 2021; Saputra & Wagiran, 2019). This approach has been proven to foster greater engagement and motivation among students in the arts (Astarina et al., 2020).

In the humanities and social sciences, PBL facilitates critical engagement in social issues, business education, enabling students to develop practical skills in entrepreneurship and management. By engaging in projects that require market research, social communication, product development, and business planning, students gain insight and increase their readiness to enter the world of work. Ability to encourage skills development, foster critical thinking, and engage students deeply with subjects and ensure their relevance in modern education, whether in vocational, scientific, artistic, or humanities fields. The successful integration of PjBL across fields signals a shift

toward more collaborative, experiential, and meaningful learning experiences that prepare students for the challenges of the 21st century.

Conclusion

The various studies and models discussed here illustrate the multifaceted nature of model in vocational education. With active learning, critical thinking, and practical skills, model prepares students to face the dynamic and complex demands of the modern world of work. As vocational education develops, the integration of innovative teaching methods such as model can create competent, adaptable and resilient professionals. PjBL can improve students' vocational competencies in disciplines such as construction, engineering and entrepreneurship. Model effectively aligns students' skills with industry demands. This study also highlights the importance of teacher support and the challenges posed by high task complexity, which can limit student initiative and motivation. The integration of model with mobile learning, a STEM approach, and an entrepreneurial mindset, shows its potential in developing skills for career readiness in today's job market. Implementation found: first, the PjBL model in vocational schools throughout Indonesia and aboard has an impact on student interest, motivation and learning outcomes in several aspects; second, flexible in implementation over time, inside and outside the classroom; third, the teachers' still roles the main of planning, selecting media, facilitating students in learning by measuring and evaluating the extent of students' understanding; fourth, the model can be integrated with various methods, media and strategies; fifth, the model can be applied in various subjects in vocational schools.

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Conceptualization, Suparmi, Fatma S.; Budi T. C.; Eka B.S.; Relly P.; Ratna J.; methodology, Suparmi, Fatma S, Budi T. C.; Eka B.S.; Relly P.; Ratna J.; formal analysis, Suparmi; investigation, Suparmi; resources, Suparmi, Fatma S, Budi T. C.; Eka B.S.; Relly P.; Ratna J.; data curation, Suparmi; writing – original draft preparation, Suparmi; writing – review and editing, Suparmi; visualization, Suparmi; project administration, Suparmi; All authors have read and approved the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest in this research.

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