ASEAN Journal of
Agriculture and Food Engineering

Optimizing Psychomotor Skills through Project-Based Learning in Seaweed Dodol Processing

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A B S T R A C T

This study investigates the impact of implementing the Project-Based Learning (PjBL) model on students' psychomotor skills in diversifying dodol seaweed products. Using a quantitative approach and a quasi-experimental design with pretest-posttest measurements, the study involved the Agribusiness Processing of Fishery Products class. The main focus was on enhancing creativity, activity levels, and response to the learning process. Results revealed positive outcomes from applying the PjBL model, with students showing strong interest and self-efficacy, scoring 81.15% in the good category. Moreover, the use of PjBL significantly improved students' psychomotor skills, as indicated by the t-test results ($p < 0.05$). Consequently, the null hypothesis was rejected, and the alternative hypothesis was accepted. In conclusion, the PjBL model is highly effective in improving students' psychomotor abilities and can be implemented in the Agribusiness Processing of Fishery Products class, providing a valuable approach to the learning process.

A R T I C L E I N F O

1. INTRODUCTION

Product diversification encompasses the diversity of products involving preparation, capital, promotion, creativity, and innovation. Recommendations for product diversification have often been proposed to optimize the utilization of fisheries resources (Klein *et al.*, 2019). By diversifying, processed products become more varied and not limited to a single type (Purwanto, 2022). Vocational High Schools play an important role in producing human resources with competence and skills for the workforce (Fajra, 2020). Psychomotor skills play a significant role in learning. Developing the psychomotor aspect not only provides practical opportunities for students but also encourages their motivation to be creative and innovative. Considering the importance of the psychomotor aspect in learning, it needs proper attention and improvement (Tibrani, 2017). Seaweed is a raw material that can be processed into various high-nutrition foods and has the potential for development as a food product (Erniati *et al.*, 2016). Processed seaweed dodol is one of the local food products with high economic potential and has become a flagship product in the fisheries and marine sector (Andjani, 2021).

However, the processing of seaweed dodol requires complex psychomotor skills, including the processing, shaping, and packaging of the product. The success of learning is determined by the preparation and selection of learning devices by teachers, using appropriate strategies, methods, and innovative learning models to meet the needs of students to understand the material, feel engaged, and be active in learning (Sari, 2021). One proven effective learning method for developing students' skills is Project-Based Learning (PBL). The project-based learning (PBL) model is a learning method that actively involves students and places them at the center of learning. PBL is characterized by giving autonomy to students, using an inquiry-based approach to construct knowledge, setting learning goals, fostering collaboration among students, communicating, and reflecting on real-world learning experiences (Kokotsaki *et al.*, 2016). However, in the context of seaweed dodol processing, there is still a lack of research specifically examining the use of PBL to optimize students' psychomotor skills. Therefore, this study aims to fill this gap and optimize students' psychomotor skills through project-based learning in the processing of seaweed dodol.

Based on the background provided, two research questions need to be answered: 1) How is the implementation of the PBL learning model in the processing of diversified seaweed dodol products? 2) What is the influence of the PBL learning model on students' psychomotor skills in the processing of diversified seaweed dodol products?

This study has two objectives: to describe the implementation of the PBL model in the processing of diversified seaweed dodol products and to analyze the influence of the PBL model on students' psychomotor skills in the processing of diversified seaweed dodol products. It is expected that this research can provide a positive contribution to the development of effective and innovative teaching methods in seaweed dodol processing. Additionally, this study is also expected to enrich the understanding of the potential of PBL in enhancing students' skills, particularly their psychomotor skills, and provide guidance for educators in designing contextually relevant learning focused on students' skill outcomes. The relevance of this research is crucial for the development of education and the local processed food industry.

2. METHODS

This research employs a quantitative approach to develop the diversification processing of seaweed dodol and enhance students' creativity outcomes. The quasi-experimental method

and research design with pretest and posttest systems were utilized in this study. The quasi-experimental method was chosen to ensure that the learning process occurs naturally and to avoid students from being experimental subjects. The research design used was the One Group Pretest-Posttest Design, where only one group was utilized as the experimental class. Before the learning process, the students were given a pretest, and then during the learning process, they implemented the Project Based Learning (PjBL) instructional model. Subsequently, a posttest was conducted to measure the influence of PjBL implementation on students' psychomotor skills in the processing of diversified seaweed dodol. This research was conducted at vocational school (i.e. SMK Negeri 1 Warunggunung, Indonesia), involving teachers and students from the 10th grade of Fisheries Processing Agribusiness. Data collection was carried out through tests, observations, questionnaires, and documentation. The collected data included skill tests, laboratory observation sheets, self-efficacy questionnaires, as well as data from literature research. Data analysis was conducted using tests for normality, homogeneity, and hypothesis testing (see **Table 1**).

Table 1. One Group design *Pretest Posttest*.

Pretest	Treatment	Posttest
O_1	X	O_2

Note: O_1 is the Pretest to assess the understanding of concepts before receiving the treatment, X is the treatment provided in the form of PjBL instruction, and O_2 is the Posttest to measure the level of concept comprehension after receiving the treatment.

3. RESULTS AND DISCUSSION
3.1. Research Results and Discussion of Student Learning Activity Analysis

The observation results of student learning activities indicate that students exhibit higher enthusiasm in learning when using the PjBL instructional model in the processing of diversified seaweed dodol. Throughout the learning process, students actively engage in processing activities and practice them independently. With opportunities to seek materials and discuss with groupmates, students can broaden their understanding and develop their creativity. These results demonstrate that the use of the PjBL model can enhance students' independence, creativity, and comprehension.

In learning theory, project-based learning is a teaching method that utilizes projects or activities as a medium (Fivia *et al.*, 2019). This method provides opportunities for students to work independently and develop problem-solving and critical-thinking skills (Eliza *et al.,* 2019). The design of PjBL emphasizes the importance of positioning projects as a central element in the teaching process and students as active participants in constructing knowledge. The results of this study support this theory by demonstrating an improvement in students' learning outcomes when engaged in learning with the PjBL model.

3.2. Research Results and Discussion of Student Response Analysis

The student's response to the use of the PjBL model in the learning of diversified seaweed dodol processing indicates a high level of confidence (see **Figures 1 and 2**). The students show enthusiasm and a strong interest in this learning approach. The results of the self-efficacy questionnaire indicate that the majority of students agree with the use of the PjBL model and feel confident in their abilities. Therefore, the use of the PjBL model can assist students in developing knowledge and skills while enhancing their self-confidence. The use of questionnaires is effective in obtaining good responses and enhancing understanding (Odenfusho 2023).
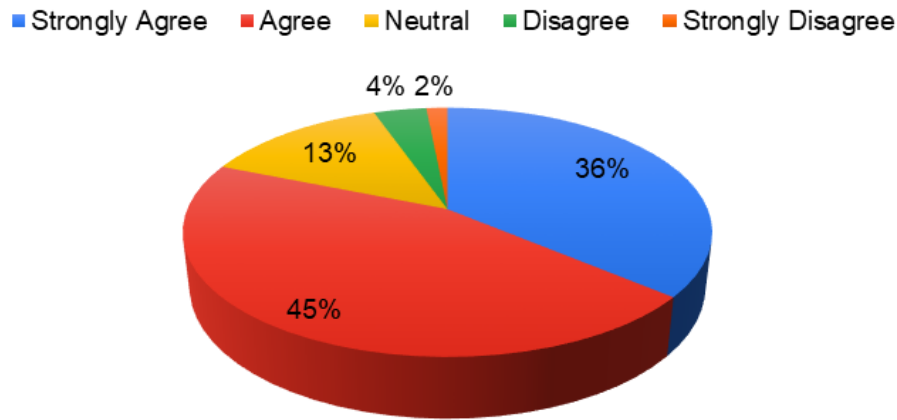
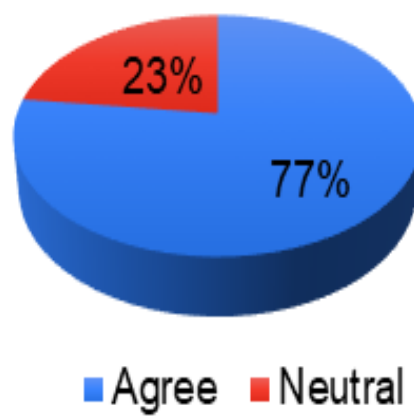**Figure 1.** Percentage of Self-Efficacy Questionnaire Responses

Figure 2. Percentage of Students' Confidence Level Results

The theory of PjBL learning also suggests that this method can motivate students to think critically and generate new ideas or creativity (Fitria, 2017). The results of this study support this theory by showing that students engaged in learning with the PjBL model become more courageous in expressing their opinions, have a high level of self-confidence, and are more active and interactive concerning the learning materials.

Furthermore, the analysis of student responses to the PjBL instructional model shows that the majority of students agree with its use. Students' feedback indicates that they feel this instructional model helps them develop knowledge, skills, enthusiasm, and confidence in learning. This learning model also provides students with opportunities to express their opinions, share ideas, and actively interact with the learning materials. This aligns with the goals of using the PjBL instructional model, which aims to increase student engagement, provide opportunities for collaborative work, and enhance their abilities. Students can support each other, share explanations, develop creative thinking, and demonstrate patience in their interactions with one another (Tsybulsky & Muchnik-Rozanov, 2019).

3.3. Research results and discussion of student learning outcomes analysis

The student learning outcomes in the processing of diversified seaweed dodol using the PjBL model show a significant improvement (See **Figures 3 and 4**). There is a significant difference between the pretest and posttest scores of the students. The final posttest results of the students demonstrate a considerable increase compared to the pretest results. This also applies to the student's skills in processing activities. The PjBL theory posits that the PjBL

instructional model has a significant and effective impact on students' learning outcomes (Triana, 2022). The normality test and homogeneity test results indicate that the data used in this study have a normal distribution.
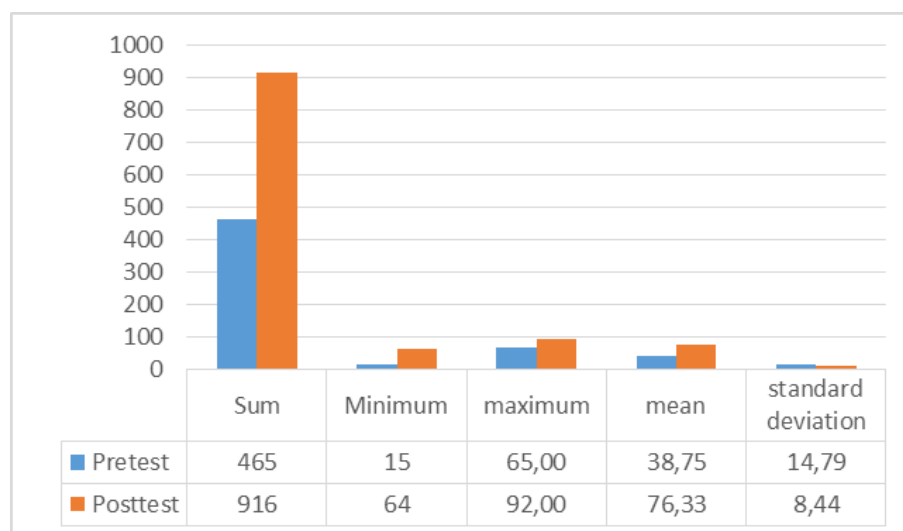

	Sum	Minimum	maximum	mean	standard deviation
■ Pretest	465	15	65,00	38,75	14,79
■ Posttest	916	64	92,00	76,33	8,44

Figure 3. Percentage of Student Learning Outcomes

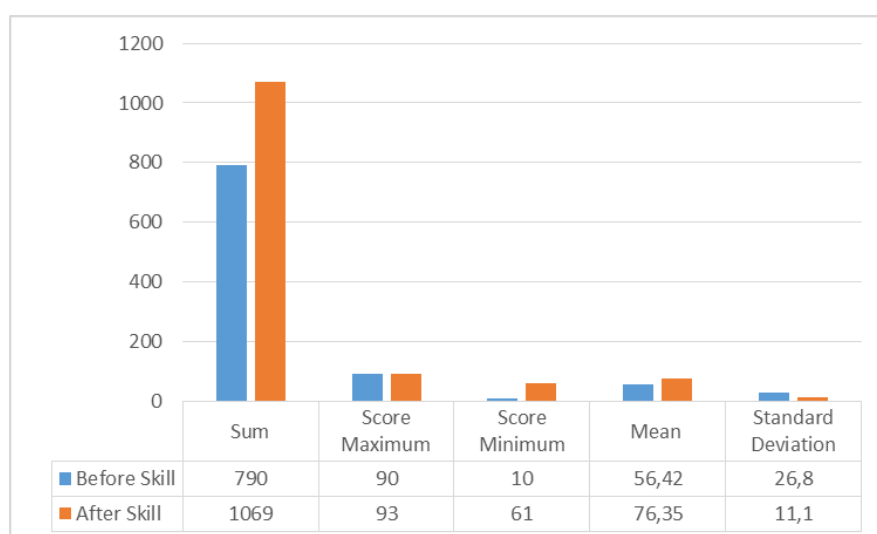|	Sum	Score Maximum	Score Minimum	Mean	Standard Deviation
■ Before Skill	790	90	10	56,42	26,8
■ After Skill	1069	93	61	76,35	11,1

Figure 4. Percentage of Student Skills Outcomes

3.4. Analysis of the effectiveness of the Project-Based Learning (PjBL) instructional model

In this study, the use of the PjBL instructional model in the processing of diversified seaweed dodol successfully improved students' learning activities, their response to the learning process, and their learning outcomes in the affective, psychomotor, and cognitive domains. From the analysis of students' learning activities, it is evident that students exhibited high enthusiasm in engaging with the learning process through the processing of diversified seaweed dodol using the PjBL instructional model. This can be attributed to the opportunities given to students to actively participate in the learning process, seek additional materials, engage in discussions, and generate new ideas and innovations. This instructional model provides students with the freedom to comprehend the materials and develop their creativity, enabling them to become more independent and proficient in understanding and applying their knowledge.

Furthermore, the analysis of student learning outcomes indicates that the use of the PjBL instructional model in the processing of diversified seaweed dodol has successfully improved students' learning outcomes in the cognitive, affective, and psychomotor domains. The pretest and posttest results show a significant difference, with higher scores obtained in the posttest compared to the pretest. Additionally, an improvement in student skill scores is also observed from the scores obtained before and after the learning process. The statistical test results demonstrate that these differences are statistically significant, with a significance value smaller than 0.05 (see **Table 2**).

Table 2. Paired-sample t-test results.

		Paired Differences				t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 Pretest - Posttest	-37.583	10.867	3.137	-44.488	-30.679	-11.981	11	0.000

Table 3 displays the t-test results for Skill 1, which represents the skill before the implementation of the PjBL instructional model, and Skill 2, which represents the skill attained after the implementation of the PjBL instructional model.

Table 3. Paired-sample t-test results.

		Paired Differences				t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 First Skill – Second Skill	-19.929	19.952	5.332	-31.448	-8.409	-3.737	13	0.002

This research demonstrates that the utilization of the PjBL instructional model is effective in enhancing students' learning outcomes in the affective, psychomotor, and cognitive domains. Project-based learning (PBL) instructional model can enhance students' process skills and creative thinking (Lestari, 2018). Through the processing of diversified seaweed dodol, students are encouraged to analyze information, identify problems, formulate solutions, and evaluate their work. This process engages students' critical thinking and creativity, enabling them to develop logical, analytical, and innovative thinking abilities (Eliza *et al.*, 2019).

Furthermore, the PjBL instructional model also helps improve collaboration and teamwork among students (Handayani, 2020). In the project of processing diversified seaweed dodol, students work in groups or teams. They learn to communicate, divide tasks, support each other, and achieve common goals. This collaboration not only enhances students' social skills but also prepares them for future teamwork.

However, this research also identifies several challenges that may arise in implementing the PjBL instructional model. One major challenge is the time required to complete the project. Complex projects take a considerable amount of time to complete all stages. Therefore, careful planning and appropriate time allocation need to be considered to avoid disrupting other learning schedules.

It is found that some students may face difficulties in managing time and independently managing the project. They may require more intensive guidance and support from teachers. Therefore, teachers need to provide clear instructions, establish regular schedules, and offer necessary support to students throughout the learning process.

Overall, the results of this research indicate that the PjBL instructional model is effective in enhancing learning activities, student responses, and learning outcomes in the affective, psychomotor, and cognitive domains. PjBL has advantages such as learning through problem-solving, facilitating idea debates, involving planning and communication, shaping learning experiences, clarifying the main project questions, providing task instructions, developing project plans through brainstorming ideas, and involving data collection, role division, and organization of thoughts (Choi *et al.*, 2019). This model also can develop students' critical thinking skills, collaboration, and social skills. However, it should be noted that the implementation of this model requires careful planning and strong support from teachers.

4. CONCLUSION

Based on the research conducted on the influence of PjBL on the psychomotor skills of students in processing diversified products of seaweed dodol at SMKN 1 Warunggunung, it was found that the implementation of the PjBL model in the teaching and learning process has a positive impact. The analysis results indicate that students show high interest in the learning activities of processing through PjBL. This can be seen from the students' responses in the self-efficacy questionnaire, which reached a percentage of 81.15%, falling into the good category with scores between 61% and 90%. Furthermore, there is a significant influence of using the PjBL model in processing diversified products of seaweed dodol on the psychomotor skills of students in the 10th grade of Agribusiness Processing of Fisheries Products (APHPi) during the learning process, as evidenced by the t-test results showing a significant value (2-tailed) < 0.05. Therefore, it can be concluded that the use of the PjBL model is highly effective and can be applied in the teaching and learning process in the 10th grade of APHPi at SMKN 1 Warunggunung.

5. ACKNOWLEDGMENT

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