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Influence Of *Problem Based Learning* (PBL) Model On Increasing Students' Knowledge Of Functional Food Processing Systems

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Abstrak

This study aims to analyze the effect of the application of the Problem Based Learning (PBL) model on improving students' knowledge on the material of functional food processing systems at SMAN 5 Tangerang Regency. The PBL stages carried out include problem orientation, organization for learning, investigation guidance, presentation of results, evaluation of problem solving carried out in 2 meetings. The research method applied is quantitative through a quasi-experimental design with a nonequivalent control group type. The sample was divided into two class groups, namely the experimental class and the control class through a purposive sampling technique with the basic criteria of classes with the same average academic value. The data collection applied was a test instrument with a multiple choice of 20 questions. Based on the results of the descriptive test, the experimental class's score was higher than the control class. This finding was strengthened by a paired sample t-test statistical test which obtained a sig value <0.05 which stated that PBL learning increased students' knowledge. The results of the independent t-test obtained a sig value of 0.000 <0.05. These results indicate a significant difference between the post-test results of students in the experimental class and the control class. The N-Gain Score calculation also showed an increase of 59.75% in the experimental class and 23.98% in the control class. Based on these results, it can be concluded that the PBL model is moderately effective in improving students' knowledge of functional food processing systems. Therefore, the results of this study can be used as input for educators in efforts to improve student knowledge through the use of the PBL model in classroom learning.

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1. INTRODUCTION

Education in the 21st century emphasizes the development of critical thinking, problem-solving, and creativity. These skills can be developed through classroom learning, including practical work and entrepreneurship. Crafts and Entrepreneurship are compulsory subjects in the 2013 curriculum that cover crafts, technology, cultivation, and processing. Crafts and Entrepreneurship are category B (General) subjects in grade XII with an allocation of 2 hours of lessons per week, in accordance with Permendikbud Number 36 of 2018. Processing emphasizes practical skills-based education, which helps students build basic abilities and entrepreneurial attitudes (Sirait & Oktarina, 2025). These abilities are expected to be beneficial for students in the future.

Conditions in the field show various problems still experienced by students in learning, students are not accustomed to developing creative ideas in learning. Student learning outcomes in this subject also tend to be low. This is reinforced by the results of interviews with Craft and Entrepreneurship teachers at SMAN 5 Tangerang Regency, it was found that Craft and Entrepreneurship learning that focuses on food processing material is still limited to material explanations, especially on functional food material. Teachers still use conventional methods in the form of lectures to explain the process of making functional foods without conducting practical activities. This is because the school does not yet have facilities for practical tools. This causes 9-12 students to have scores below the established minimum completion criteria (KKM), which is 70 (Teacher Documentation, 2024).

The material studied in the craft and entrepreneurship subjects is functional food.(Praptanti et al., 2023)This material discusses functional food systems based on local carrying capacity and incorporates several innovations into its activities. In craft and entrepreneurship lessons, students can explore simple ways to creatively create or process functional foods that are beneficial for health. However, if students' knowledge is limited, achieving a solid understanding will be difficult.

If left untreated, problems will negatively impact learning objectives. The solution to this problem requires a learning model that can develop children's skills in the learning process.Problem Based Learning(PBL) is seen as an appropriate model because it is able to encourage students to actively seek solutions to the problems they face (Hariyani, 2023). In the process of learning the material on functional food processing systems, students need to understand the correct processing techniques and be able to optimize the use of local food ingredients. However, the lecture method still dominates the learning process in schools, leaving little room for students to think critically and contribute to the learning process. Consequently, students' understanding of functional food processing systems remains suboptimal. Therefore, the implementation of PBL can address this issue.

Many previous researchers have conducted research related to PBL, and the results show positive impacts on learning.Dalila et al., (2022) stated that the application of the modelProblem Based Learning(PBL) with differentiated learning can improve students' cognitive learning outcomes, especially in physics lessons in high school. Pradnyadinata et al., (2018) also stated that the application of the modelProblem Based Learning(PBL) can improve the learning outcomes of crafts and entrepreneurship in students. Strengthened by Amirulloh et al., (2025) who stated that the application of the PBL modelProblem Based Learning(PBL) is effective in improving student learning outcomes. Research has shown that PBL is an effective learning strategy that increases student engagement and academic learning outcomes across various disciplines.

Although previous studies have also investigated the influence of PBL on learning, this study still provides a distinct innovation. The scientific innovation in this article lies in the application of the PBL model to the subject of functional food processing systems based on local potential at the high school level, which differs from previous studies that only examined learning outcomes in entrepreneurship without linking it to local potential (Pratnyadinata et al., 2018; Amirulloh et al., 2025). Different from previous studies that were generally conducted in the field of science or natural sciences, this article focuses on the development of food processing knowledge relevant to the context of local wisdom.The problem in this research is related to the impact of using the model.Problem

Based Learningon increasing students' knowledge in the material of functional food processing systems.

Based on the description above, this research was conducted to determine how big the influence of the model is.Problem Based Learning on students' knowledge levels on functional food processing systems at SMAN 5 Tangerang Regency. The PBL model is considered effective if it shows an increase in students' knowledge levels before and after implementation. This model can also be declared effective if it shows a significant difference in results compared to classes that implement conventional learning. The results will be strengthened by the findings of the study.N-GainThe obtained score was >30%. Based on these criteria, the application of the PBL model in this study was declared effective for use in learning, particularly in improving students' knowledge of functional food processing material at SMAN 5 Tangerang Regency.

2. MATERIALS AND METHODS

*Problem Based Learning*Problem-Based Learning (PBL) is a learning approach that emphasizes the presentation of real-world problems to stimulate students' critical thinking (Sofyan et al., 2017). According to Delishe in Fathurrohman (2017), PBL directs students to actively solve problems through the stages of the scientific method. Meanwhile, Sudarman in Siswanti & Indrajit (2023) emphasizes that PBL is based on collaborative processes and builds knowledge through social interaction.

Several relevant previous studies exist, including: Robiyanto's (2021) research shows that PBL can improve student learning achievement by up to 43.6%. Research by Retliza (2020) shows an increase in student learning outcomes in crafts and entrepreneurship from 56% to 88% after implementing PBL. Setyo Budi (2020) confirms that PBL can improve student achievement and learning independence. Asiyah et al. (2021) and Umayrah et al. (2023) also confirm that PBL is effective in improving problem-solving skills and learning outcomes. Research by Indrawan et al. (2022), Mujib et al. (2023), Pasinggi (2023), Astuti (2022), and Trianto et al. (2021) also supports the effectiveness of this model in various subjects.

The research was conducted using a quantitative approach (Sugiyono, 2022) and a quasi-experimental method in the form of a design. Nonequivalent control group. The study involved 12th-grade students at SMAN 5 Tangerang Regency as subjects. The sample was selected using a random sampling technique. *Purposive sampling*. The consideration is that classes that have the same average value. The sample obtained is class XII MIPA 3 which was used as the experimental class and class XII MIPA 4 which was used as the control class. The experimental class received intervention in the form of learning *problem based learning* with functional food processing system material and conventional learning in the control class.

Table 1. Research Design Table

Group	*Pre-test*	Treatment	*Posttest*
Experiment	O1	X1	O2
Control	O3	-	O4

Information:

X1 : class treatment with *problem based learning*

X2 : without treatment
O1 : giving*Pre-test*
O2 : results *post-test*
O3 : giving*pre-test*
O4 : results *post-test*

The PBL learning process was implemented in the experimental class over a two-week period, consisting of two meetings. Learning was conducted through problem-oriented syntax, organizing learning, guiding investigations, presenting results, and evaluating problem-solving (Ministry of Education and Culture, 2020). Data collection techniques included tests, student response questionnaires, and observations. Before the learning was implemented, *pre-test* and after learning *post-test.* The questionnaire consisted of 20 multiple-choice questions to measure student knowledge as a result of the PBL model. Prior to implementation, the questionnaire instrument underwent testing for item validity, reliability, difficulty level, and discriminatory power. The results of the questionnaire validity test can be seen in Table 2.

Table 2. Results of Instrument Validity Test

Question number	R count	R table	Information
1	.476**	0,329	V
2	0,045	0,329	TV
3	.557**	0,329	V
4	0,270	0,329	TV
5	.443**	0,329	V
6	.627**	0,329	V
7	.643**	0,329	V
8	0,228	0,329	TV
9	.502**	0,329	V
10	0,219	0,329	TV
11	.469**	0,329	V
12	0,296	0,329	TV
13	.469**	0,329	V
14	0,219	0,329	TV
15	.476**	0,329	V
16	-.406*	0,329	TV
17	.393*	0,329	V
18	.480**	0,329	V
19	.393*	0,329	V
20	.452**	0,329	V
21	0,084	0,329	TV
22	.334*	0,329	V
23	.378*	0,329	V
24	.378*	0,329	V
25	.443**	0,329	V
26	.334*	0,329	V
27	0,219	0,329	TV
28	-0,066	0,329	TV
29	.380*	0,329	V

30	.350*	0,329	V

Assessment using instruments through *Pre-test* And *post-test* with a total of 30 multiple choice questions. Validity testing was conducted involving 36 students to assess the quality of each question item. A question was declared valid if it met the criteria. R count> r table. Based on the trial results, 20 valid questions were obtained. Next, a reliability test was conducted. The reliability test results for this research instrument showed a score of 0.753. Based on reliability standards, this score falls into the high category. The reliability test results can be seen in Table 3.

Table 3. Reliability Test

Cronbach's Alpha	*N of Items*
.753	*30*

After the instrument was valid and reliable, a difficulty level test was carried out. The results of the difficulty level test can be seen in Table 4.

Table 4. Results of the Difficulty Level Test

No. Question	**Index of difficulty**	**Interpretation**
1	0,78	Easy
3	0,44	Currently
5	0,42	Currently
6	0,42	Currently
7	0,67	Easy
9	0,47	Currently
11	0,53	Currently
13	0,53	Currently
15	0,78	Easy
17	0,58	Currently
18	0,56	Currently
19	0,58	Currently
20	0,39	Difficult
22	0,28	Difficult
23	0,75	Easy
24	0,75	Easy
25	0,56	Currently
26	0,28	Difficult
29	0,47	Currently
30	0,25	Difficult

Of the 20 questions analyzed, 5 were easy, 11 were moderate, and 4 were difficult. This distribution of difficulty levels was deemed to meet the criteria for good test construction, with a predominance of moderate-difficulty questions and a balanced distribution of easy and difficult questions to accommodate the varying abilities of students. Difficult items were still used in the test because they have good discriminating power and serve to measure the abilities of students with a higher level of mastery of the material.

The final Feasibility Test, namely the discriminatory power test, was analyzed to assess the level of each question item in determining the difference between high-ability and low-ability students. The results of the analysis of 20 questions showed that 55% had moderate discriminatory power, 40% with good results, and 5% with very good results. There were no questions with low discriminatory power (≤ 0.20), so all questions met the accepted standards. Thus, the instrument can be used to measure the level of knowledge of students in this study.

The data obtained from the study were analyzed descriptively and inferentially. Descriptive analysis was conducted to describe the initial and final test scores in both research classes. Inferential calculations to determine the extent of the PBL model's influence on the study, the data were calculated using several statistical tests, such as the normality test using the Shapiro-Wilk test and the homogeneity test using the t-test. *Levene's test*, *uji paired t test*, test-independent *sample t test*, as well as calculations *N-Gain Score in* assessing learning outcomes. The N-Gain value can be seen in Table 5.

Table 5. Criteria *N-Gain*

Range	Criteria
< 40	Ineffective
40-55	Less Effective
56-75	Quite Effective
> 76	Effective

3. RESULTS

Based on the research that has been conducted, the average obtained is*pre-test* and *post-test*each class through descriptive analysis, the following are the results obtained which can be seen in Table 6.

Table 6. Data Results *Pre-test* and *Post-test*

Group	*N*	*MIN (0)*	*MAX (100)*	*MEAN*	*ST.DEV*
Pre-Test Experiment	35	45	80	61.57	9.297
Post-Test Experiment	35	70	100	84.86	7.325
Pre-Test Control	35	45	80	64.29	9.560
Post-Test Control	35	60	85	73.14	6.975

This study shows that there was a more significant increase in knowledge in classes that applied the model. *Problem Based Learning* (PBL) compared to conventional learning. Comparison of average *pre-test* and *post-test* strengthens the findings. In the experimental group, the average score *pre-test* by 61.57 increasing to 84.86 in *post-test.* Meanwhile in the control group, the average score *pre-test.* From 64.29, it only increased to 73.14. For more details, see the following graph.

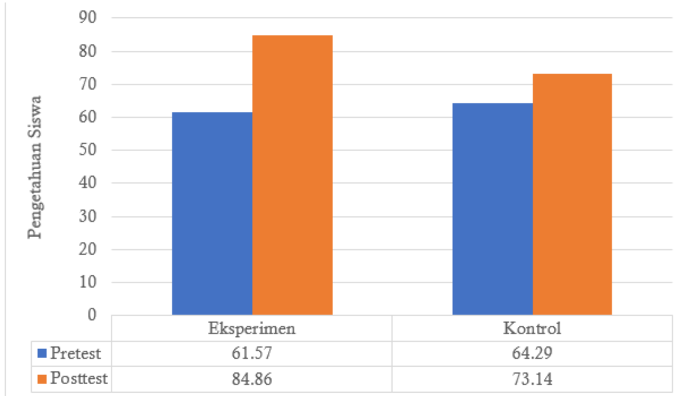

Figure 1. Graph of Student Knowledge Improvement

After conducting descriptive analysis, the next step is inferential analysis. *Paired t-test* proves that there is a significant increase in the value *Pré-test* the *post-test in* both experimental and control classes ($p < 0.05$), which means the learning model in both classes was able to improve knowledge. Thus, the improvement that occurred in the experimental class was higher. Before conducting the inter-class difference test, the data were tested for normality and homogeneity. Based on the prerequisite tests, the data were declared to meet the requirements for analysis with the next test, namely *independent sample t-test* Before testing the differences in post-test results between the two classes, normality and homogeneity tests were first conducted as prerequisites for parametric analysis. The results of the normality test using the Shapiro-Wilk test are presented in Table 7.

Table 7. Normality test results

Class	Shapiro-Wilk Sig
Pre-Test Experiment	0.73
Post-Test Experiment	0.152
Pre-Test Control	0.115
Post-Test Control	0.55

Based on Table 7, all significance values are greater than 0.05. Thus, the data*pre-test* And *post-testing* both classes were declared normally distributed. Next, a homogeneity of variance test was carried out using *Levene's Test*, which is presented in Table 8.

Table 8. Results of Homogeneity Test

Calculation Basis	*Levene Statistic*	df1	df2	Say.
Mean	0.15	1	68	0.904
Median	0.000	1	68	1.000
Trimmed Mean	0.07	1	68	0.936

Referring to Table 8, all significance values (Sig.) > 0.05, which indicates that the data between groups have *homogeneous* variance. Thus, the homogeneity assumption is met and the data is suitable for analysis using parametric tests. *Independent Sample t-Test*. To strengthen the results of the analysis, Table 9 is presented below, which contains the test results. *Paired Sample t-Test*in each class.

Table 9.*Uji Paired T Test*

Partner	Mean Difference	T	Say. (*2-tailed*)
Pre-Test Experiment *Post-Test* Experiment	-23.286	-12,951	<0.001
Pre-Test Control *Post-Test* Control	-8.857	-10,160	<0.001

Both groups showed significant improvement from*pre-test* the *post-test*(p < 0.001). However, the mean difference (*mean difference*) in the experimental class is higher than in the control class, which indicates that the model *Problem Based Learning* (PBL) has a greater influence on increasing students' knowledge. To see the difference in results *post-test* between the two classes, a test was conducted *Independent Sample t-Test*, as presented in Table 10.

Table 10 Test Results *Independent Sample T-Test*

Variables	Mean
Post-test experiment	84.86
Post-test control	73.14

Based on the test results/independent *sample t-test*,a significance value of 0.000 (<0.05) was obtained Mark *post-test.* The experimental class obtained an average of 84.86, while the control class obtained an average of 73.14. This shows that students in the experimental class were higher than students in the control class. Therefore, because the significance value is below 0.05, H_0 is rejected and H_a is accepted. This means that there is a significant difference between the results of *post-test of* students in the experimental class and the control class. These findings indicate that the application of the model *Problem Based Learning* (PBL) has a significant influence on improving student learning outcomes compared to conventional learning, especially on the material on functional food processing systems. To determine the effectiveness of using the PBL model in improving students' knowledge, calculations were analyzed using scores *N-Gain* which is presented in Table 11.

Table 11. Calculation Data*N-Gain*

Class	*N-Gain* (%)	Category*N-Gain*
Experiment	59.74	Currently
Control	23.98	Low

From the data in Table 11, the score *N-Gain,* The experimental class achieved 59.74%, which was categorized as "moderate," while the control class achieved 23.98%, which was categorized as "low." These data indicate that the use of the PBL model is quite effective in increasing students' knowledge of functional food processing systems. Furthermore, observations during the learning process showed that the experimental class was more active in discussions, asking questions, and providing responses. Student questionnaire data also supported this finding, with 80% of students stating that the PBL model contributed to optimal understanding of the material, with 80% of students reporting increased motivation to learn.

Research findings demonstrate that the use of the PBL model has a positive impact on improving students' knowledge of functional food processing systems. Scientifically, this can be explained because the PBL model provides space for students to be active subjects in learning activities. This model encourages the development of critical thinking skills, problem-solving skills, and links theory to practice (Sofyan et al., 2017). In this model, students are not merely passive recipients of information, but actively participate in the process of exploring information and solving problems related to the processing of functional foods based on local ingredients.

Active participation of students encourages deeper cognitive processes, As a result, students acquire knowledge that is not only relevant but also more easily remembered in the long term. This finding aligns with the constructivist learning theory proposed by Trianto et al. (2021), which states that active problem-based learning can support students' conceptual understanding. This research also aligns with the findings ofRetliza (2020) proved that PBL improves the results of practical work and entrepreneurship knowledge in high school students. Thus, this study strengthens the evidence that PBL is quite effective when applied in various subjects, including in teaching functional food processing.

The improvement in learning outcomes in the experimental class is also consistent with research by Dalila et al. (2022) and Pradnyadinata et al., (2018), which suggests that the PBL model contributes to improving academic achievement and critical thinking skills. This model facilitates active engagement through collaboration, investigation, and real-world problem-solving. Furthermore, questionnaire response data from the experimental class demonstrated that the majority of students felt helped in understanding the material and were encouraged to actively participate in discussions. Observations during the learning process also indicated increased participation and engagement. This further strengthens the conclusion that the implementation of PBL not only increases knowledge but also helps build students' motivation to learn.This study had limitations in terms of time, practical facilities, and the scope of the variables studied. Furthermore, non-test instruments such as questionnaires and observations were only used in the experimental class and were adapted from previous research without revalidation. Therefore, non-test data were used only as supplementary information and were not the primary basis for quantitative analysis. These limitations led to a greater focus on improving student knowledge.

4. THE KNOT

Based on the research that has been carried out, the research results obtained show that the use of the model *Problem Based Learning* (PBL) is quite effective in improving students' knowledge in the material of functional food processing systems. Statistical analysis using the t-test proved that there was a higher difference between the increase in scores of *post-test* in both class groups ($p < 0.05$). Comparison of the experimental class through the t-test of *independent* also showed significantly different results. The calculation results were strengthened by*N-Gain* obtained in the "medium" category of 59.74% in the experimental class and low of 23.98% in the control class. Observation data and questionnaire responses during the learning process also showed that students in the experimental class demonstrated active participation, increased motivation to learn, and a comprehensive understanding of the material. Therefore, it can be concluded that the PBL model is worthy of consideration as an alternative, effective and aligned learning pattern to support student learning outcomes, particularly in the Crafts and Entrepreneurship subjects. This study recommends that teachers of craft and entrepreneurship subjects implement the PBL model by integrating local potential into the lesson plans for functional foods. For future researchers, because this study is still limited to craft and entrepreneurship lessons, specifically functional foods, it can be developed more broadly to other subjects and other local potentials to test and provide a broader positive impact of the PBL model in learning.

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