JPPIPA 12(4) (2026)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

Enhancing Student Learning Interest through Product-Based Learning and Peer Assessment in Sustainable Bakery Practicum Using Watermelon Rind and NTT Palm Sugar

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Received: February 21, 2026
Revised: March 13, 2026
Accepted: April 25, 2026
Published: April 30, 2026

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DOI: 10.29303/jppipa.v12i4.14639

Abstract: This study aims to analyze the implementation of Product-Based Learning (ProdBL) integrated with peer assessment in a bakery practicum and its contribution to student learning interest. The study employed a pre-experimental design with a one-group pretest-posttest approach involving 20 third-semester students of the Culinary Education Study Program. Data were collected using a validated learning interest questionnaire and supported by classroom observations and student reflections. The results of the paired sample t-test showed a significant difference between pretest and posttest scores ($t = -2.816$, $p = 0.011 < 0.05$), indicating an increase in student learning interest. The mean score improved from 31.15 in the pretest to 37.65 in the posttest. Qualitative findings revealed that students became more active, confident, and collaborative during the practicum process. The use of watermelon rind as food waste and local palm sugar contributed to meaningful and contextual learning experiences. These findings suggest that the integration of ProdBL and peer assessment can enhance student learning interest and support sustainability-oriented vocational education.

Keywords: Learning Interest; Peer Assessment; Product-Based Learning; Sustainable Learning; Vocational Education

Introduction

Vocational education in Indonesia continues to develop in response to global challenges and local demands that require not only technical competence but also creativity, innovation, and sustainability awareness. In culinary vocational education, particularly in bakery practicum courses, learning activities are often still limited to the application of standard recipes and repetitive instructional models. This condition tends to reduce student engagement and learning interest, indicating the need for a more contextual, experience-based, and innovation-oriented learning approach.

One relevant approach is Product-Based Learning (ProdBL), which emphasizes the creation of tangible products as the core of the learning process. This approach is grounded in the concept of *learning by doing* introduced by Dewey (1938), which highlights the importance of active student involvement in constructing knowledge through real experiences. In addition, peer assessment plays a crucial role in enhancing student responsibility, reflection, and collaborative skills. Topping (2019) explains that peer assessment improves learning outcomes through structured feedback, dialogue, and evaluative judgment. Recent studies have also shown that product-based and participatory learning approaches can enhance student motivation, creativity, and practical competence (Dewra, 2025; Amri et al., 2024; Mursyida et al., 2024).

However, previous studies generally focus on the implementation of these approaches in conventional learning contexts and rarely explore their application in developing innovative products based on local and non-conventional materials. In practice, the use of alternative ingredients such as watermelon rind, which is

How to Cite:
Karyanto, Y., Asmaul, R., Evawati, D., & Sholikha, K. R. (2026). Enhancing Student Learning Interest through Product-Based Learning and Peer Assessment in Sustainable Bakery Practicum Using Watermelon Rind and NTT Palm Sugar. *Jurnal Penelitian Pendidikan IPA*, *12*(4), 666–672. https://doi.org/10.29303/jppipa.v12i4.14639

commonly considered food waste, and traditional NTT palm sugar, which represents local cultural resources, presents unique challenges in bakery practicum. These materials have complex characteristics, such as high moisture content, unstable texture, and variability in processing, which require experimentation, problem-solving, and collaborative learning process.

Therefore, the complexity of processing non-conventional and locally sourced materials requires an exploratory and product-oriented learning model such as ProdBL, supported by peer assessment to ensure continuous feedback and quality evaluation. In this context, peer assessment enables students to critically evaluate product quality, refine their techniques, and develop a deeper understanding of production standards.

The novelty of this study lies not in the mere integration of ProdBL and peer assessment, which has been widely discussed in previous literature, but in its specific application within a vocational culinary context that utilizes food waste (watermelon rind) and local wisdom (NTT palm sugar) to develop innovative bakery products. This approach not only enhances student learning interest but also integrates sustainability values, promotes the utilization of local resources, and supports real-world problem-solving in vocational education.

Based on these considerations, this study aims to analyze the implementation of Product-Based Learning (ProdBL) integrated with peer assessment in a bakery practicum and to examine its contribution to student learning interest. This research is important as it provides an alternative learning model that supports student engagement, innovation, and sustainability-oriented vocational education.

Method

This study employed a pre-experimental design using a one-group pretest-posttest approach to examine the contribution of Product-Based Learning (ProdBL) integrated with peer assessment to students' learning interest in a bakery practicum. This design was selected because the study involved only one group without a comparison or control group using conventional learning methods.

The research subjects consisted of 20 third-semester students of the Culinary Education Study Program who were enrolled in the Bakery Practicum course. The sampling technique used was total sampling, as all students in the class were included as participants in the study.

This research applied a mixed-methods approach with an explanatory design, in which quantitative data were collected and analyzed first, followed by qualitative data to support and deepen the interpretation of the findings.

Instruments and Data Collection

Quantitative data on students' learning interest were collected using a structured questionnaire consisting of 20 statements measured on a Likert scale. The instrument was developed based on indicators of learning interest, including attention, participation, curiosity, and engagement in practicum activities. The questionnaire was administered twice, as a pretest before the learning intervention and a posttest after the intervention. Prior to its use, the instrument was validated by experts in vocational education and tested for reliability.

In addition, students' perceptions of the implementation of Product-Based Learning (ProdBL) and peer assessment were collected using a response questionnaire administered at the end of the learning process.

Qualitative data were obtained through classroom observations and student reflective notes during the practicum process. These data were used to describe students' participation, collaboration, confidence, and responses when processing watermelon rind and NTT palm sugar in product development.

Learning Procedure

The learning intervention was conducted through the implementation of Product-Based Learning (ProdBL) integrated with peer assessment. The procedure consisted of the following stages:

1. Product planning
   Students identified problems, explored ideas, and designed bakery products using watermelon rind and NTT palm sugar.
2. Material experimentation
   Students explored the characteristics and processing techniques of the local ingredients through trial and error.
3. Production process
   Students produced bakery products collaboratively in groups.
4. Peer assessment
   Students evaluated each other's products using predetermined criteria and provided constructive feedback.
5. Reflection
   Students discussed the results and reflected on their learning experiences and product outcomes.

To provide a clearer overview of the research process, the procedure is illustrated in **Figure 1** (Research Procedure).

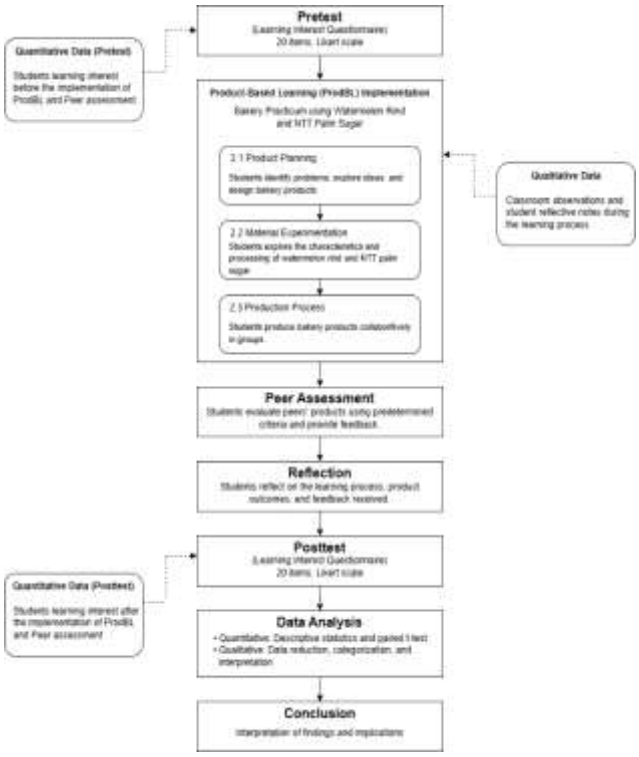

Figure 1. Research Procedure

Data Analysis

Quantitative data were analyzed using descriptive statistics, including mean and standard deviation, to describe students' learning interest and perceptions of the learning model. To determine whether there was a significant difference between pretest and posttest scores, an inferential statistical test was conducted. If the data were normally distributed, a paired sample t-test was used; otherwise, a Wilcoxon signed-rank test was applied. The level of significance was set at 0.05.

Qualitative data from observations and student reflections were analyzed descriptively through data reduction, categorization, and interpretation to support and explain the quantitative findings.

Result and Discussion

This section presents the results of the implementation of Product-Based Learning (ProdBL) integrated with peer assessment in the bakery practicum. The findings are discussed in three main aspects: (1) the profile of learning implementation, (2) the analysis of student learning interest based on pretest and posttest results, and (3) the role of local materials in supporting vocational learning.

Profile of Learning Implementation

The implementation of Product-Based Learning (ProdBL) and peer assessment was perceived positively by students. During the learning process, students were actively involved in designing, experimenting, and producing bakery products, which encouraged active participation and collaboration.

Peer assessment also played a significant role in the learning process, as students were required to evaluate their peers' work using structured criteria. This activity enhanced students' responsibility, reflective thinking, and ability to provide constructive feedback. These findings indicate that the integration of ProdBL and peer assessment created an interactive and participatory learning environment.

Analysis of Student Learning Interest

The results of the normality test using the Shapiro–Wilk method indicate that the data are normally distributed ($p > 0.05$). Therefore, a paired sample t-test was conducted to examine the difference between pretest and posttest scores.

Table 2. Paired Sample t-test Results

Variable	Pretest	Posttest	t	df	Sig.
Learning Interest	31.15	37.65	-2.816	19	0.011

The results of the paired sample t-test show that there is a significant difference between pretest and posttest scores ($t = -2.816$, $df = 19$, $p = 0.011 < 0.05$). The mean score increased from 31.15 in the pretest to 37.65 in the posttest, indicating that the implementation of Product-Based Learning (ProdBL) integrated with peer assessment contributed to a significant increase in student learning interest.

The increase in student learning interest can be explained by the characteristics of the ProdBL approach, which emphasizes active participation through product creation. Students were required to explore ideas, experiment with ingredients, and produce bakery products, making the learning process more meaningful and engaging.

In addition, peer assessment contributed to increased engagement by involving students as both producers and evaluators. This dual role encouraged students to think critically, reflect on their performance, and understand quality standards more deeply. These findings are consistent with previous studies indicating that active learning and peer assessment can improve student engagement and learning outcomes (Topping, 2019; Freeman et al., 2014).

Discussion: The Role of Local Ingredients in Vocational Learning

One of the distinctive contributions of this study is the use of watermelon rind as food waste and traditional NTT palm sugar as local resources in bakery product development. These materials introduced authentic

challenges that required students to engage in experimentation, problem-solving, and collaboration during the practicum process.

The stages of students' activities during the practicum process are illustrated in Figure 2.

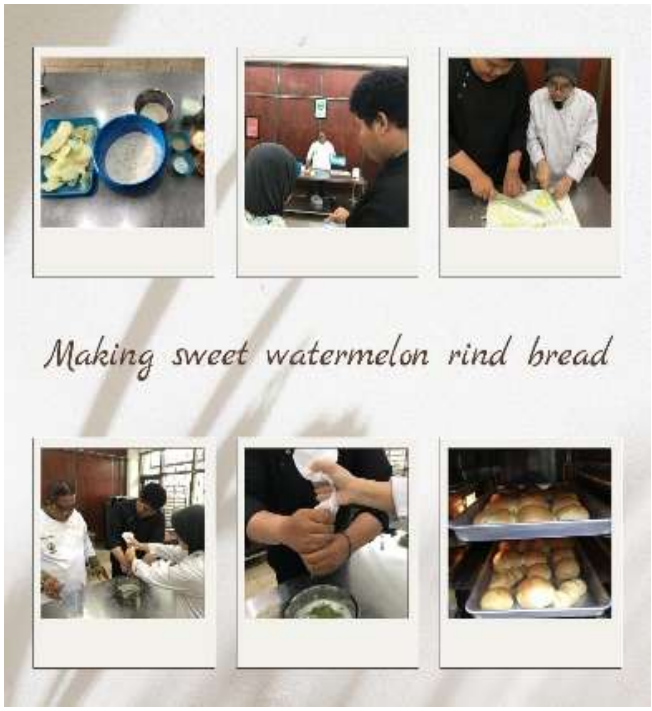

Figure 2. Students' Activities During Bakery Practicum

Figure 2 shows the stages of learning activities, including material preparation, group discussion, dough processing, and baking. Students collaboratively processed watermelon rind and utilized NTT palm sugar as the main ingredients in developing bakery products.

Based on qualitative observations, students initially experienced difficulties in processing watermelon rind due to its unfamiliar characteristics. However, through group discussion and peer feedback, they were able to refine their techniques and improve product quality. This process reflects experiential learning, where knowledge is constructed through direct experience and reflection (Dewey, 1938).

In addition, peer assessment played an important role in enhancing students' confidence and reflective thinking. By evaluating their peers' work, students developed a deeper understanding of quality standards and became more aware of their own strengths and weaknesses (Topping, 2019).

The results of the product development are presented in Figure 3.

Figure 3. Bakery Products Using Watermelon Rind and NTT Palm Sugar

Figure 3 presents the bakery products developed by students using watermelon rind and traditional NTT palm sugar. The products demonstrate variations in texture, appearance, and formulation, reflecting students' creativity and adaptability in processing non-conventional ingredients.

Moreover, the use of local materials adds a sustainability dimension to vocational learning. The transformation of watermelon rind into a valuable product demonstrates the potential for reducing food waste, while the use of traditional palm sugar promotes local cultural identity. This contextual approach makes learning more relevant and meaningful for students.

Therefore, the integration of Product-Based Learning (ProdBL), peer assessment, and local resource utilization not only enhances student engagement but also supports the development of creativity, critical thinking, and sustainability awareness in vocational education.

Conclusion

The implementation of Product-Based Learning (ProdBL) integrated with peer assessment significantly improves student learning interest in bakery practicum, as indicated by a significant difference between pretest and posttest scores. The use of watermelon rind as food waste and traditional NTT palm sugar as local resources provides meaningful and contextual learning

experiences, encouraging students to engage in experimentation, collaboration, and problem-solving, thereby enhancing creativity and reflective thinking. These findings highlight that integrating local material-based product innovation within learning activities not only increases student engagement but also supports sustainability-oriented vocational education. Practically, this approach can be applied by culinary educators to develop more contextual and innovative practicum-based learning. However, this study is limited by the absence of a control group and a relatively small sample size; therefore, future research is recommended to involve larger samples, comparative experimental designs, and the exploration of various local materials to strengthen and expand these findings.

Acknowledgments
The authors would like to express their sincere gratitude to Universitas PGRI Adi Buana Surabaya for supporting this research. The authors also thank the students of the Culinary Education Study Program who participated actively in this study and contributed during the bakery practicum process. The authors are also grateful to all parties who provided valuable assistance and support in completing this research.

Author Contributions
Conceptualization, Y.K. and R.A.; methodology, Y.K., R.A., and D.E.; formal analysis, Y.K. and D.E.; investigation, Y.K., R.A., and K.R.S.; resources, Y.K. and R.A.; data curation, D.E. and K.R.S.; writing—original draft preparation, Y.K.; writing—review and editing, R.A. and D.E.; visualization, K.R.S.; supervision, R.A.; project administration, Y.K. All authors have read and agreed to the published version of the manuscript.

Funding
This research received no external funding

Conflicts of Interest
The authors declare no conflict of interest.

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