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Integrating Ethnoscience in Project-Based Learning: Enhance Critical Thinking and Collaboration with Local Traditional Food

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ABSTRACT Integrating ethnoscience into science learning provides a meaningful and culturally relevant learning experience for students. This study aims to investigate the effectiveness of Ethnoscience-Integrated Project-Based Learning (PjBL) using Cenil, a traditional Indonesian snack, in enhancing students' critical thinking and collaboration skills in science learning. The integration of ethnoscience is intended to create a culturally relevant and meaningful learning experience. The research employed a quasi-experimental design with a pre-test and post-test control group. Participants were eighth-grade students from a junior high school in Magelang, Indonesia, selected through convenience sampling. The experimental group was taught using Ethnoscience-Integrated PjBL, while the control group received Direct Instruction. Data were gathered through critical thinking and collaboration assessments, observation sheets, and peer evaluations. Multivariate Analysis of Variance (MANOVA) and effect size (partial eta squared) were used for analysis. The results demonstrated a statistically significant improvement in the experimental group's critical thinking and collaboration skills compared to the control group ($p < 0.05$, partial eta squared = 0.996). Students in the experimental group showed better performance in analyzing scientific problems, proposing solutions, and engaging in teamwork throughout the learning project. The integration of ethnoscience into PjBL, particularly through the context of traditional food, enhances students' critical thinking and collaborative abilities. This study highlights the potential of combining cultural knowledge with innovative learning strategies to bridge scientific understanding and local wisdom. The findings support the incorporation of ethnoscience into science education as an effective means to promote higher-order thinking and social interaction in real-world contexts.

Keywords collaboration, critical thinking, ethnoscience, project-based learning, traditional food

1. INTRODUCTION

Critical thinking is part of higher-order thinking as one of the skills that must be prepared by students in producing quality human resources (Agnafia, 2019). Meanwhile, collaboration skills are essential, as learners need to learn to work in teams, share ideas, listen to others' views, and work together to achieve common goals (Lubis et al., 2023). Critical thinking skills enable students to have good literacy skills (Hasan et al., 2022). but various study results show that Indonesian students at the junior high school level still face challenges in developing these skills (A. C. Lestari & Annizar, 2020). Critical thinking skills can improve students' skills in dealing with real-life problems (Suci et al., 2019), but there are still misconceptions in the way students build knowledge from the surrounding environment, so many of them are less accustomed to facing and analyzing real problems systematically (Astuti, 2019). In addition, students' low understanding of high-level thinking concepts is also influenced by the limitations of learning models that demand in-depth analysis and lack of practice in solving problems based on complex problem solving (Simanjutak & Sudibjo, 2019).

Collaboration skills affect students' critical thinking skills, because through collaboration, students can discuss problem-solving strategies and develop deeper understanding (Betaviana et al., 2024). However, in practice, collaboration skills are still not optimally applied

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in the school environment, especially in group work which should be a forum for cooperative learning (Dhitasarifa et al., 2023). Learners still have difficulty in explaining the reasons for the answers they choose (Suryani & Saparuddin, 2022). Collaboration skills equip students to be responsible for their duties in the group by having the ability to work together and socialize to achieve learning goals (Fitriyani et al., 2019). This is in line with (Sari & Atiningsih, 2023) opinion that learning that involves group work can improve collaboration and teamwork skills. Unfortunately, there is still a gap between task sharing and active involvement in group work, where some learners tend to be passive and do not have the same sense of responsibility in completing joint projects (Mansur et al., 2022).

Low ability of critical thinking and collaboration of students caused by learning strategies that are less appropriate and monotonous (Gunawardena & Wilson, 2021). Currently, the learning method that is widely used is still teacher-centered learning, where students consider the teacher as the only source of learning without getting active experience in finding and solving problems (Purwasila et al., 2024). In Indonesia, various studies have shown that students' critical thinking skills remain at a low level. For example, the results of the PISA (Programme for International Student Assessment) 2022 revealed that Indonesian students ranked among the lowest in science and reading literacy, which are closely related to critical thinking (Arda et al., 2024). Research also found that students in several provinces were unable to analyze, evaluate, and make reasoned judgments when faced with complex problems (Rasyid et al., 2024).

To overcome this challenge, innovative learning models are needed that can encourage students to be actively involved in the learning process, explore information independently, and work together in completing a learning project. One model that is effective in improving critical thinking and collaboration is Project-Based Learning (PjBL). This model allows learners to participate in problem-solving-based projects, thus improving critical thinking skills and teamwork (Sutamrin & Khadijah, 2021). However, the effectiveness of PjBL is often limited if it is not linked to a context close to learners' lives (Fallas Gabuardi, 2021). Project-based learning can be less effective if learners feel the project, they are working on has no relevance to their real-life experiences (Nurhamidah & Nurachadijat, 2023). In addition, learners' motivation in PjBL can be reduced when the project given has no connection to their culture or daily practice (Dwiantoro & Basuki, 2021). Therefore, it is necessary to integrate approaches that can connect science concepts with the cultural realities they experience.

An approach that can optimize the effectiveness of PjBL is ethnoscience integration. Ethnoscience not only serves as a medium for cultural recognition in learning but can also bridge the gap between scientific concepts and their application in everyday life (Fahrozy et al., 2022). In addition, the integration of ethnoscience in science learning allows learners to understand scientific concepts through the perspective of their familiar culture, thus improving conceptual understanding and engagement in learning (Badriah & Sukati, 2021). Furthermore, this approach also contributes to honing collaboration skills, as learners are invited to explore local knowledge together and discuss it in groups (Wilujeng et al., 2024). However, despite its potential, previous research has not extensively explored how ethnoscience integration can be effectively applied through Project-Based Learning in a structured and measurable way (Sutamrin & Khadijah, 2021), (Sarkingobir & Bello, 2024). Moreover, there is still a lack of studies focusing on the use of specific cultural contexts, such as traditional food, to enhance both critical thinking and collaboration skills in science learning (Tyas et al., 2020).

Figure 1. *Cenil*, an Indonesian Traditional Food

This study aims to analyze the effect of an ethnoscience-based PjBL model using traditional Cenil food on students' critical thinking and collaboration skills. Cenil is a traditional Indonesian snack made from cassava starch, shaped into small colorful balls, and typically served with grated coconut and palm sugar syrup. As a widely consumed traditional food, Cenil is relevant to the topic of food additives in the science curriculum, as it often contains artificial coloring and preservatives (Tamara & Febriantika, 2023). This makes Cenil an ideal ethnoscience context for learning, allowing students to analyze the role of food additives while connecting scientific concepts with their daily lives. By applying ethnoscience Project-Based Learning, learners are expected to be able to conduct scientific investigations, work collaboratively, and understand science concepts more deeply. Through this approach, learners not only gain a stronger conceptual understanding but are also actively involved in a more contextual, collaborative, and meaningful learning experience, fostering both critical thinking and teamwork skills essential for 21st-century education.

Given these considerations, it is essential to examine whether the integration of ethnoscience Project-Based Learning using Cenil as a contextual medium significantly influences students' critical thinking and collaboration

skills. Therefore, this study formulates the following research hypotheses:

H_0: There is no significant difference in students' critical thinking and collaboration skills between those taught using the ethnoscience Project-Based Learning (PjBL) model with Cenil and those taught using the Direct Instruction model in the topic of food additives.

H_1: There is a significant difference in students' critical thinking and collaboration skills between those taught using the ethnoscience Project-Based Learning (PjBL) model with Cenil and those taught using the Direct Instruction model in the topic of food additives.

H_0: The use of the ethnoscience Project-Based Learning (PjBL) model with Cenil has no significant effect on students' critical thinking and collaboration skills in learning about food additives.

H_1: The use of the ethnoscience Project-Based Learning (PjBL) model with Cenil has a significant effect on students' critical thinking and collaboration skills in learning about food additives.

2. METHOD

2.1 Research Design

This research was quantitative research approach, and the type of research uses quasi-experimental design research with a Control Group Pretest-Posttest Design research design. This design was chosen to allow analysis of differences in results between experimental and control groups before and after treatment.

Table 1. Pre-test-Post-test Control Group Design

Class	Before	Treatment	After
Experiment	O1	X	O2
Control	O3	Y	04

Treatment X with the Ethnoscience-Infused Project-Based Learning model using traditional Cenil food, while treatment Y with the Direct Instruction (DI) learning model. The independent variable in this study is the learning model used, while the dependent variable is the critical thinking ability and collaboration skills of students. Control variables include the equality of learning time, teaching materials, and evaluation instruments used in both groups.

2.2 Participants

This study was conducted in one of the public junior high schools located in Magelang City from August to November 2024. Sampling was conducted using a convenience sampling technique, which involves selecting participants based on accessibility and availability. The sample consisted of 62 eighth-grade students (31 in the experimental group and 31 in the control group), with an age range of 13–14 years. Both groups included a mix of male and female students, with a slightly higher proportion of female participants. The selection criteria were based on similar average academic performance and recommendations from science teachers regarding students' engagement and ability in learning. Prior to this study, students had been following the Indonesian national curriculum (Kurikulum Merdeka), which emphasizes inquiry-based learning and competency development in science education.

2.3 Measures

Three tests were used as data collection instruments in this study to measure students' critical thinking and collaboration skills. The first test was a critical thinking skills test, which initially consisted of 40 multiple-choice items. Based on an empirical analysis, 7 items were classified as moderately good, while 1 item was deemed unsuitable. To ensure measurement validity, the test was refined to 30 selected items, with excessively difficult or too easy questions removed based on threshold values reflecting item difficulty levels. The second test was a collaboration skills observation sheet, which consisted of 12 indicators assessing students' ability to work in groups, share responsibilities, and communicate effectively. The third test was a peer assessment, in which students evaluated their group members' contributions based on a structured rubric. The instruments used in this study include:

Pre-Test and Post-Test

The test consisted of 30 multiple choice questions that measured four aspects of critical thinking, namely analyzing facts, formulating the main problem, classifying logical arguments, and drawing conclusions. Instrument validation was conducted by three experts in science education and learning assessment and tested with Aiken's V for content validity and QUEST for empirical validity. The reliability test using QUEST showed a reliability of estimate value of 0.96, which was categorized as very high.

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Summary of item Estimates
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Mean                      .00
SD                       1.85
SD (adjusted)            1.82
Reliability of estimate   .96
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Figure 2. Reliability of Item Estimates

Collaboration Skills Observation Sheet

Using 12 indicators with measured aspects including: working together in groups, shared responsibility, respecting members' opinions, and adaptability in groups. The observation instrument was completed by two independent observers to ensure the objectivity of the assessment.

Peer-to-Peer Assessment Questionnaire

Using a Likert scale of 1-5 to assess individual contribution in discussion, activeness in the project, and collaborative attitude.

2.4 Material

The learning materials used in this study consist of a structured teaching package designed to integrate ethnoscience into science learning through the Project-Based Learning model. The materials include a handout and student worksheets, all of which focus on the topic of food additives. The handout provides comprehensive content on food additives, covering their definitions, classifications, functions, and potential health impacts. Additionally, it introduces Cenil, a traditional Indonesian snack, as a contextualized example of ethnoscience. The materials guide students in analyzing food additives in Cenil, distinguishing between natural and artificial additives, and conducting experiments to create natural food additives as alternatives. These materials aim to enhance students' critical thinking and collaboration skills by engaging them in real-world scientific inquiry linked to their cultural background.

2.5 Procedure

The data collection process in this study began with a pre-test to assess students' initial critical thinking and collaboration skills before the intervention. The learning process was conducted over three sessions, following the structured phases of the Project-Based Learning model integrated with ethnoscience. Each session focused on different stages of project development, from analyzing food additives in Cenil through experimentation to designing natural alternatives. In Session 1, students conducted a literature review and tested Cenil to determine whether it contained artificial food additives. In Session 2, students planned and carried out an experiment to create natural food additives. Finally, in Session 3, they presented their findings and reflected on the learning process. At the end of the intervention, a post-test was administered to measure students' improvement in critical thinking and collaboration skills.

Table 3. Learning Phases and Activities in the Three Sessions

No	Phase & Step	Activity
1	Pre-Test	Assess students' initial critical thinking and collaboration skills.
2	Session 1: Concept Exploration and Testing Cenil	Learners observe a demonstration of testing the content of additives conducted by the teacher, then learners to discuss in groups to make project designs and develop schedules and project completion activities.
3	Session 2: Project Planning and Experimentation	Learners carry out project activities for processing natural additives, as ingredients for making Cenil.
4	Session 3: Evaluation and Presentation	Learners present the Cenil products that have been made, and the teacher directs learners to convey evaluations and reflections during project-based learning
5	Post-Test	Final assessment to measure improvements in students' critical thinking and collaboration skills.

3. RESULT AND DISCUSSION

3.1 Difference of Critical Thinking and Collaboration Skills Between Ethnoscience PjBL and Direct Instruction

Critical Thinking Skill

Based on the research that has been conducted, students' critical thinking skills are analyzed based on four main aspects, namely analyzing facts, formulating the main problem, classifying logical arguments, and drawing conclusions. The data on the results of the pre-test and post-test in the experimental and control classes are presented in Table 3.

Based on Table 3 it is known that the gain score of the critical thinking ability of the experimental class is higher than that of the control class. The experimental class obtained a gain score of 0.55 in the medium category, while

Table 2. Critical Thinking Skills of Experiment and Control Class

No	Aspect	Experiment		Control	
		Pre-Score	*Post-Score*	*Pre-Score*	*Post-Score*
1.	Analyzing Facts	51,71	88,09	57,56	74,31
2.	Formulating The Main Problem	74,56	77,65	73,34	75,40
3.	Classifying Logical Arguments	78,37	92,37	71,15	83,34
4.	Drawing Conclusions	58,90	77,75	56,59	71,00
Sum		263,54	335,86	256,64	304,05
Average		65,88	83,96	64,66	76,01
Min Score		46	76	46	66
Max Score		83	96	80	86
SD		8.64	5.19	6.90	5.61
N-Gain		0,55		0,31	
Category		Moderate		Moderate	

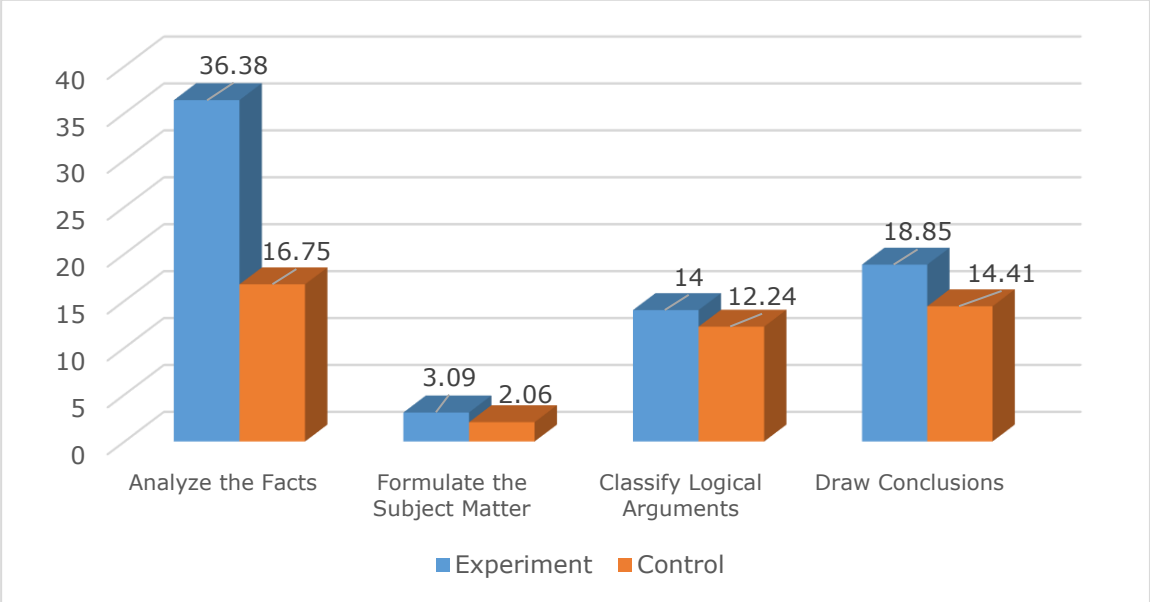

Figure 3. Comparison Graph of Average Improvement from Each Aspect of Critical Thinking Ability

the control class obtained a gain score of 0.31 in the medium category. This shows that the application of the ethnoscience-Project-Based Learning model is more effective in improving critical thinking skills compared to Direct Instruction learning (Hanum* et al., 2023), (Rahman et al., 2023).

Furthermore, a more detailed analysis is carried out based on each aspect of critical thinking ability. A comparison of the average improvement of each aspect in the experimental and control classes is presented in Figure 3.

Based on Figure 3, in the experimental class, the aspect with the highest increase was analyzing facts, with an increase difference of 36.38%. The ability to analyze facts is the highest aspect compared to other aspects because students are more skilled in identifying and analyzing a problem systematically. During the learning process, especially at the stage of determining basic questions and monitoring project progress, students showed good abilities in testing ideas, sorting relevant information, and analyzing data obtained from the projects they were working on. (Setiana & Purwoko, 2020), stated that students with good critical thinking skills can identify relevant information correctly and sort essential data from additional information that is less necessary. In addition, (Ulandari et al., 2025), added that students who can sort relevant information will be more successful in solving problems effectively. (Firdaus et al., 2019), also stated that the aspect of analyzing facts in critical thinking is very important to shape students' mindsets so that they do not only receive information passively but are also able to evaluate cause and effect and seek logical and rational evidence in every problem.

The improvement in students' critical thinking skills in the experimental class is also closely related to the structured teaching materials used in the learning process. The handout and student worksheets were designed to provide students with a systematic guide to exploring food additives through scientific inquiry (Hastuti & Putri, 2022). The materials emphasized conceptual understanding through literature reviews, experimental activities, and guided discussions. This aligns with the constructivist learning theory, which suggests that students develop deeper conceptual understanding when they are actively involved in knowledge construction (Piaget, 1971), (Amineh & Asl, 2015). Through ethnoscience integration, students were able to relate scientific concepts to real-life experiences, such as investigating food additives in Cenil, which helped them develop a more critical approach to analyzing information (Rahman et al., 2023), (Wilujeng et al., 2018).

The aspect of drawing conclusions ranks second in increasing average scores, both in the experimental and control classes. However, in the experimental class, the increase in scores was higher compared to the control class, with a difference in increase of 4.44 points. This shows that students who learn with the ethnoscience-PjBL model are more skilled at summarizing information and drawing conclusions based on the data they obtain during the project. According to (Ridho et al., 2020), the skill of drawing conclusions can be developed through a learning process that emphasizes exploration and problem solving based on real experiences. Research conducted by (Ritonga & Zulkarnain, 2021) also shows that there is a significant increase in the aspect of drawing conclusions after students are given project-based learning, because they are invited

to connect the concepts they have learned with real solutions in their projects.

The aspect of classifying logical arguments also experienced a higher increase in the experimental class compared to the control class. This can happen because in ethnoscience-PjBL, students are involved in more active group discussions, so they can exchange ideas, consider various perspectives, and construct more logical arguments based on scientific understanding. Research conducted by (Ridho et al., 2020) also shows that students involved in discussion-based learning have better skills in classifying relevant arguments and providing more systematic explanations of a problem.

The aspect of formulating the main problem is the aspect with the lowest increase compared to other aspects, both in the experimental and control classes. In the experimental class, the increase was 3.09 points, while in the control class it only increased by 2.06 points. These results indicate that although ethnoscience-PjBL contributes to improving critical thinking skills, students still face difficulties in formulating problems systematically. Research by (Susilawati et al., 2020) also found that the aspect of formulating problems often has a lower score than other aspects because students tend to interpret "problem formulation" literally without understanding the structure and purpose of formulating problems scientifically. In addition, (Hasanah et al., 2023) also reported that students often have difficulty in identifying the core of the problem due to lack of practice in formulating exploratory and analytical questions.

The improvement in this aspect can also be attributed to the problem-solving structure embedded in the student worksheets through Project-Based Learning (Singha & Singha, 2024), (Kokotsaki et al., 2016). The student worksheet encouraged students to analyze experimental data, compare results with theoretical expectations, and synthesize their findings into meaningful conclusions. By engaging in inquiry-based discussions and collaborative data analysis, students developed a stronger ability to draw logical and evidence-based conclusions (Hussein, 2021), (Hairida et al., 2021).

Based on the results of this study, it can be concluded that the application of the ethnoscience-based PjBL model contributes to improving students' critical thinking skills, especially in the aspects of analyzing facts, drawing conclusions, and classifying logical arguments. Although the aspect of formulating the main problem experienced a lower increase, the use of ethnoscience-Project Based Learning model still had a positive impact compared to Direct Instruction learning. Thus, the ethnoscience-based PjBL model not only encourages students to think more critically through real experiences in projects but also helps them connect scientific concepts with local cultural contexts, so that learning becomes more meaningful and applicable.

Collaboration Skills

This study also measured four aspects of collaboration skills, namely working together actively in groups, shared responsibility in groups, respecting opinions and group work results, and being able to adapt to the group environment. Collaboration skills are very important in 21st century learning, especially in the PjBL model, which requires students to work together in groups to complete complex projects (Loyens et al., 2023).

Table 4. The results of the collaboration skills assessment at each meeting

No	Meeting	Experiment	Class
1.	1st Meeting	87,30	72,63
2.	2nd Meeting	87,07	78,90
3.	3rd Meeting	86,65	74,72
Sum		261,02	226,25
Average		87	75,41
Category		Very Good	Good

Based on Table 4, it is known that the collaborative skills of students in the experimental class are higher compared to the control class at each meeting. The experimental class showed a consistent increase in collaboration skills with an average of 87 in the very good category, while the control class had an average of 75.41 in the good category. This difference indicates that the implementation of the ethnoscience-based PjBL model has a positive impact on improving student cooperation compared to the Direct Instruction learning model. Furthermore, a more detailed analysis was carried out on each aspect of collaboration skills. The results of the calculation of the collaboration skill value for each aspect are presented in Table 5.

Table 5. The results of the calculation of the collaboration skill

No	Aspect	Experiment	Class
1.	Working together actively in groups	89,55	72,85
2.	Shared responsibility in groups	82,45	75,60
3.	Respecting opinions and group work results	87,50	75,78
4.	Being able to adapt to the group environment	88,81	77,42
Sum		348,31	301,65
Average		87	75,41
Min Score		61	46
Max Score		100	100
SD		10.64	13.79
Category		Very Good	Good

Based on Table 5, it is known that each aspect of collaboration skills in the experimental class showed a higher score compared to the control class. The average difference between the experimental and control classes of 11.59 points shows a positive impact of the implementation of ethnoscience- PjBL in improving

students' collaboration skills. The analysis graph of students' collaboration skills is shown in Figure 4.

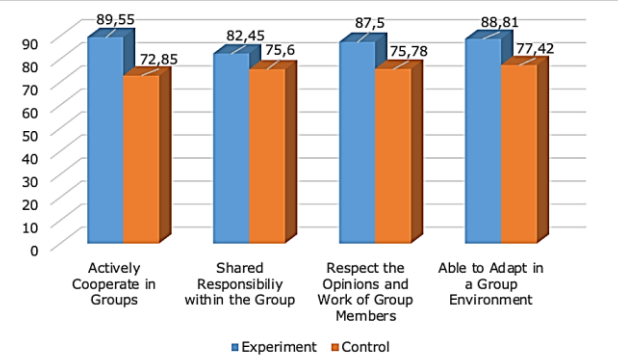

Figure 4. Average Comparison Graph of Each Aspect of Collaboration Skills

Based on Figure 4, all aspects of collaboration skills in the experimental class have higher scores compared to the control class. The aspect with the highest score is working together actively in groups, with a score of 89.55 in the experimental class and 72.85 in the control class, which shows a difference of 16.7 points. This shows that students who learn with the ethnoscience-based PjBL model are more active in working together and involved in group assignments compared to students who learn with the Direct Instruction method. During the learning process, students in the experimental group showed better communication, helped each other in completing projects, and were active in contributing to the tasks given. This is in line with research by (Loyens et al., 2023). which states that PjBL can improve students' collaboration skills through project-based activities that require interaction and collaboration between group members. (Greenstein, 2012) also emphasized that collaboration skills are essential skills in project-based learning, because they enable students to work together effectively, share responsibilities, and make decisions to achieve common goals.

The improvement in collaboration skills can be attributed to the learning activities structured in the PjBL model, which emphasized group-based problem solving, joint project development, and peer feedback (Hussein, 2021), (Hairida et al., 2021). The ethnoscience component further reinforced collaboration by encouraging students to explore local cultural knowledge together, discuss traditional practices, and integrate them into scientific inquiry (Tyas et al., 2020). This aligns with social learning theory, which states that students learn more effectively when they actively interact with peers and engage in shared learning experiences (Vygotsky, n.d.).

The aspect of being able to adapt to the group environment is the aspect with the second highest value, with a score of 88.81 in the experimental class and 77.42 in the control class, with a difference of 11.39 points. This aspect has a high score because during the learning process, students can work together quickly and adapt in a team, especially at the stage of designing projects and monitoring project progress. This is supported by research by (Pratiwi et al., 2020) which shows that students' flexibility in working together with peers reaches a high category, with a percentage of 33.68%. In addition, research by (Sufajar & Qosyim, 2022) shows that 91% of students can accept predetermined group members, thus indicating that social adaptation skills in group-based learning can develop optimally.

The aspect of respecting the opinions and work results of group members also experienced a high increase. In the experimental class, this aspect had a value of 87.50, higher than the control class which had a value of 75.78. This shows that students in the experimental class are more open to various ideas and appreciate the contributions of group members in completing the project. The results of this study are reinforced by the findings of (Sarifah & Nurita, 2023), which stated that compromise skills in groups are still a challenge for some students, especially in accepting the opinions of other members objectively.

The aspect of shared responsibility in the group has the lowest value compared to other aspects, both in the experimental class (82.45) and the control class (75.60), with a difference of 6.85 points. However, this aspect remains higher in the experimental class compared to the control class, which shows that the ethnoscience-based PjBL model still has a positive impact on increasing student responsibility in the group. Research by (Pratiwi et al., 2020) shows that in group discussion activities, students tend to divide tasks individually to speed up the completion of tasks, but do not share knowledge evenly with other group members, so that the aspect of shared responsibility has not developed optimally.

The structured learning materials played a crucial role in supporting this collaboration. The worksheets and discussion guidelines facilitated structured peer interactions, ensuring that each student contributed actively to problem-solving and decision-making (N. Lestari et al., 2024). Additionally, the project-based tasks required students to delegate responsibilities and coordinate efforts, reinforcing teamwork and accountability (Maros et al., 2023). These findings are consistent with research suggesting that well-structured collaborative tasks enhance students' ability to engage in meaningful social interactions and cooperative learning.

Based on the results of this study, it can be concluded that the implementation of the ethnoscience-based PjBL model has a positive effect on improving students' collaboration skills. Students in the experimental class showed higher involvement in working together actively, adapting in groups, and respecting the opinions of group members compared to students in the control class. Although the aspect of shared responsibility is still a challenge, the ethnoscience-based PjBL model still

provides greater benefits in training cooperation and social interaction in learning.

3.2 The Influence on Critical Thinking and Collaboration Skills

The prerequisite test is the Shapiro-Wilk normality test with the results on the critical thinking variable Asymp. Sig. (2-tailed) experimental class 0.652 & control class 0.058, on the collaboration variable Asymp. Sig. (2-tailed) experimental class 0.056 & control class 0.571, all these results > 0.05 so it shows that the data in each variable is normally distributed. Furthermore, in the homogeneity test on the critical thinking variable, the Asymp. Sig. (2-tailed) 0.545 and on the collaboration variable the Asymp. Sig. (2-tailed) 0.100, this result > 0.05 so it shows that the data in each variable has the same variance. Finally, the correlation test analysis was carried out with a Sig value. (2-tailed) 0.001 which means <0.05 so it shows that there is a relationship between the dependent variables, with these results it is known that the prerequisite test assumptions are met, and the hypothesis test can be carried out.

Based on the data obtained and the prerequisite tests that have been carried out, the analysis of the results of the different tests was carried out to test the simultaneous differences between critical thinking skills and collaboration skills in the two treatment classes. The test used was the Multivariate Hotelling's Trace Test, which is presented in Table 6.

Table 6. Differences between critical thinking skills and collaboration skills in the two treatment classes

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Etta Square
Intercept	Pillai's Trace	0.996	7110.843[b]	2.000	59.000	0.000	0.996
	Wilks' Lambda	0.004	7110.843[b]	2.000	59.000	0.000	0.996
	Hotelling's Trace	241.046	7110.843[b]	2.000	59.000	0.000	0.996
	Roy's Largest Root	241.046	7110.843[b]	2.000	59.000	0.000	0.996
Class	Pillai's Trace	0.416	20.972[b]	2.000	59.000	0.000	0.416
	Wilks' Lambda	0.584	20.972[b]	2.000	59.000	0.000	0.416
	Hotelling's Trace	0.711	20.972[b]	2.000	59.000	0.000	0.416
	Roy's Largest Root	0.711	20.972[b]	2.000	59.000	0.000	0.416

Based on the results of the Multivariate Hotelling's Trace Test, the Significance (Sig) value is 0.000. In accordance with the decision-making rules in this test, if the Sig value (2-tailed) <0.05, then H0 is rejected and H1 is accepted. Thus, it can be concluded that there is a significant difference in critical thinking skills and collaboration skills between students who take part in learning using the Project-Based Learning model based on the ethnoscience of the local food "Cenil" and students who learn using the Direct Instruction model. In addition, the Effect Size test was conducted to measure how much influence the Project-Based Learning model based on ethnoscience has on the two dependent variables (critical thinking skills and collaboration skills) simultaneously. The results of the Multivariate Test in the Partial Etta Square column show a value of 0.996, which is categorized as a very strong effect (Cohen, 1988). This indicates that the application of the ethnoscience-based PjBL model has a significant effect in improving students' critical thinking skills and collaboration skills. This very strong effect shows that the ethnoscience-based PjBL model is not only effective in developing students' cognitive skills, but also in building the social skills needed in 21st century learning.

Critical thinking skills and collaboration skills are closely related in the context of education, where both support each other in creating a holistic and effective learning environment. The better the critical thinking skills of students, the better their collaboration skills. This is in line with the opinion of (Betaviana et al., 2024), which states that students with good critical thinking skills will ask more questions when they encounter problems and have a high curiosity in solving problems (Thornhill-Miller et al., 2023). Conversely, students who cannot solve problems themselves will try to find solutions through discussions with peers, which ultimately improves their collaboration skills. This finding is also supported by research by (Diana & Saputri, 2021), which shows that through project activities, students can develop their critical thinking skills. Students are given basic questions or challenging problems, which require them to make project plans, conduct investigations, make decisions, and discuss with group members (Aktamiş & Yenice, 2010). During this process, students are accustomed to analyzing information, evaluating various alternative solutions, and defending their arguments logically, which ultimately improves their critical thinking skills.

In addition, research by (Sholeh et al., 2024) showed that the implementation of PjBL has proven effective in improving collaborative skills and teamwork skills. Students not only learn to think critically and creatively but are also trained to work together to solve complex problem (Hairida et al., 2021). During the learning process, students in the experimental group showed a high level of involvement in group discussions, information gathering, and strategy development to complete the project. This indicates that in addition to improving conceptual understanding, the ethnoscience-based PjBL model also contributes to the development of social skills, such as communication, responsibility, and cooperation in groups. Thus, it can be concluded that the implementation of the ethnoscience-based PjBL model of the local traditional food "Cenil" has a significant impact on improving students' critical thinking skills and collaboration skills. Project-based learning allows students to not only analyze problems in depth, but also to interact, adapt, and work together actively in groups. The effectiveness of this model is further strengthened by the integration of ethnoscience, which makes learning more contextual, relevant, and meaningful for students.

4. CONCLUSION

Based on the results of the research that has been conducted, it can be concluded that the implementation of the Project-Based Learning (PjBL) model based on ethnoscience with the context of the local food "*Cenil*" has a significant influence on improving critical thinking skills and collaborative skills of students. Overall, the results of this study prove that the ethnoscience-based PjBL model can be an alternative effective learning strategy in improving students' critical thinking and collaboration skills, especially in science learning that requires an inquiry-based and exploration approach. The results of this study have implications for the world of education, especially in science learning. For teachers, the ethnoscience-based PjBL model can be used as an innovative learning strategy to improve students' critical thinking and collaboration skills. The integration of local culture in learning also makes science concepts more contextual and relevant to everyday life. In terms of curriculum, this approach is in line with the Merdeka Curriculum which emphasizes project-based learning and exploration of concepts in a local context. Meanwhile, for further research, further exploration is needed regarding the effectiveness of ethnoscience-based PjBL in other subjects as well as the development of more comprehensive collaboration skills assessment instruments.

For the implementation of the ethnoscience-based PjBL model to be more optimal, teachers are advised to apply it gradually and integrate interactive learning media to increase student involvement. The development of PjBL-based teaching modules that accommodate various local cultures is also needed to enrich the learning experience. In addition, future research can expand the scope of the sample and analyze the factors that influence the effectiveness of ethnoscience-based learning to deepen understanding of this model. This study proves that Project-Based Learning based on ethnoscience can be an effective learning approach in improving critical thinking skills and student collaboration. By connecting scientific concepts with local culture, this model not only makes learning more meaningful but also prepares students to face the challenges of the 21st century. Therefore, the integration of ethnoscience in science learning can be an innovative alternative in improving the quality of education that is more contextual, explorative, and collaborative.

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