Integration of Project Based Learning (PjBL) and Ethnobameti Models on Critical Thinking and Innovative Works Through Marine Biodiversity Materials

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ABSTRACT:
A major challenge in learning biology (marine biodiversity) is how to convey it contextually and relevantly, and how to utilize it effectively for the lives of the people in this region. One solution is the implementation of the integrated learning model of PjBL and Etnobameti, which is the local wisdom of the Maluku community. Based on the results of the implementation of this learning tool by fifth-semester students of the Biology Education study program, FKIP, Patimura University, the results of the syntax mastery assessment were 70.8% with very good and good criteria, only 29.2% with a score of less than or poor. The assessment of students' critical thinking skills was 87.5% with very good and good criteria, only 12.5% with less criteria. The assessment of students' innovative work (products) was 95.8% with very good criteria and only 4.2% with less criteria. The results of the correlation analysis showed a significant relationship between syntax and critical thinking with an R2 value of 0.707, or 70.9% of the syntax of the PjBL and Etnobameti learning integration model correlated with students' critical thinking, and only 29.3% with other factors.The assessment results also show a correlation between syntax and innovative work (products) with correlation values of R2 = 0.438 or 43.8% influenced by syntax while 56.2% is influenced by other factors, especially student knowledge that has been obtained from generations through the Bameti culture which is seen in the form of critical thinking intelligence in recognizing and obtaining various types of marine biota. Based on the results of the analysis, it can be seen that there is an influence of the syntax of the Etnobameti integrated PjBL model on critical thinking intelligence with a df value = 23-22 = 1 with an F value = 53.022 where the significance level is 000, < p 0.05, indicating a significant influence and also a significant influence between the syntax of the PjBL and Etnobameti integration models on students' innovative work according to the df value = 23-22 = 1

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with an F value = 17,886 with a significance level of 000 < p 0.05, indicating a significant influence between the syntax of the project based learning (PjBL) integration learning model and Etnobameti. The development of students' thinking in understanding the integrated model of project based learning (PjBL) and Etnobameti, as the local wisdom of the Maluku community in the process of learning biology on marine biodiversity material is a form of building intelligent and innovative constructivism of thinking to develop the potential of natural resources for the welfare of society in the future through the biology learning process.

Keywords: PjBL, ethnobameti, critical thinking, innovative work.

INTRODUCTION

The development of students' potential as teachers must be prepared by lecturers so that students are able to design innovative learning through the integration of new elements in learning in the 0.4 technology era, increasing thinking skills, innovative work skills, complex thinking in describing material, making conclusions. The implementation of teacher professional development (PPG) courses must be in accordance with this competency, namely equipping students as prospective teachers in their duties, leading students to master teacher professional development materials during the lecture process. According to Griet Helenaa Laihad, et al., 2023, learning development is a process that is carried out in a directed, measurable manner, improving, and increasing optimal learning outcomes. This is in line with Law No. 14 of 2005 which requires lecturers to be familiar with the characteristics and potential of students and how to develop their thinking intelligence and innovative work designed in a topic of developing innovative learning tools.

Developing student potential, to actualize the various potentials they have, this competence is demonstrated by lecturers by providing various ideas for developing learning tools to encourage students to achieve optimal learning achievements, as well as providing various learning models to actualize student potential, especially thinking intelligence and creativity as well as innovation in integrating various learning models based on the use of the natural environment and local culture. Sudiati, et al 2025, that teachers' ability to integrate local cultural elements and the natural environment in biology lessons is needed in learning to create a learning experience that is both fun and meaningful and has been proven to be effective in training thinking intelligence and innovative work which in the end can be applied as a professional teacher.

The implementation of the teacher professional development course for prospective biology teachers requires an understanding of ethnobiology, an interdisciplinary scientific study of how living organisms in nature are used for various human needs and cultures. As prospective biology teachers, it is necessary to study and explore various cultures and traditions carried out by communities as local wisdom in the form of interactions between humans, understanding living organisms and their environment, in other words, studying ethnobiology, namely traditions and community culture related to living organisms and the environment. According to Imam Taufik et al. (2025), teachers must be able to integrate local cultural elements with science, technology, and engineering to create innovative, enjoyable, and meaningful learning. One of the major challenges in teaching biology (marine biodiversity) is how to convey it contextually and relevantly, and how to apply it effectively to future human life.

Developing the professional skills of teachers in Maluku Province is a necessity in developing learning models that integrate local cultural values as local wisdom into the learning process, thus making learning more relevant and meaningful. Megarivera et al, 2023, that the culture and

tradition of "bameti" is a local wisdom activity of the Maluku community that is very important in the learning process, because it can provide students with an understanding of biological concepts and maintain the sustainability of the natural coastal and marine environment.

The activity of "bameti" as a local wisdom of the community has steps that can be applied in learning. Amkieltiela 2014 explains that the activity of bameti has steps such as the implementation process, including: (1) Preparation, tools and materials for bameti activities, (2) Implementation, observation, search, capture (capture), collection, identification, (3) End, communication, production, conclusion. The term "Ethnobameti" has the meaning of the activity of local communities observing, searching, collecting various marine organisms to be used for the needs of life, food sources and various crafts as well as protecting the coast from damage to coastal and marine ecosystems from waste and garbage. Considering that the culture of "bameti" has steps, it can be used in the learning process with the term Etnobameti.

The development of innovative learning tools through the integration of the project Based learning (PjBL) model and Etnobameti as the local wisdom of the Maluku community in the lecture process of the teacher professional development course for students of the biology education study program is very necessary for mastering marine biodiversity material. The development of culturally integrated learning tools is a form of building intelligent and innovative student constructivism to carry out the biology learning process. According to Liswijaya et al, 2025, that culture as local wisdom can be used as an innovative learning model approach in the world of education, because local wisdom reflects culture, values, and traditions that are relevant to the natural environment to be studied can create meaningful and contextual student learning experiences. Surlialy Ramon. 2025 that the tradition and culture of "bameti" as the local wisdom of the Maluku community can be used as an effective contextual learning model to improve students' understanding of the local wisdom approach integrated with learning models such as project Based learning (PjBL).

The activity of "bameti" as a culture and local wisdom of the Maluku people. Jimmy Pattiasina (2009) stated that bameti has a scientific process in utilizing coastal and marine water resources. The ability to integrate bameti culture as local wisdom can enrich the learning experience of students, including university students, strengthen the identity of the local wisdom of "bameti" in the context of cultural values in learning and make marine biodiversity learning materials more relevant and meaningful. The objectives of developing learning tools for the integration model of Project Based Learning (PjBL) and Etnobameti as local cultural wisdom of the Maluku people include: (1) want to know the intelligence of students' thinking in compiling the syntax of integrated PjBL and Etnobameti learning, (2) want to know the intelligence of students' thinking about the concept of marine biodiversity through the concept of bamieti, (3) want to know the various innovative works of students from marine biodiversity materials, (4) want to know the relationship between syntax and students' critical thinking intelligence, (5) want to know the relationship between syntax and students' innovative works (products). The application of the Etnobameti integrated PjBL model by students is to create innovative, fun, contextual learning that is oriented towards project-based scientific studies. Tio Gusti Satria, et al, 2025, that the development of a project based learning (PjBL) model connected with local wisdom (culture) improves critical thinking skills, because it makes learning more contextual and meaningful and increases innovative work, serves to increase student motivation, facilitates understanding of the material, which is taught and supports student professionalism as a teacher. The development of an integrated learning model of project based learning (PjBL) and Etnobameti as local wisdom is used as contextual, interesting, effective, creative learning that can improve critical thinking and innovative work as a student learning experience in completing teacher professional development courses.

METHODOLOGY

This type of research uses the Research and Development (R&D) model with the integration of Project-Based Learning (PjBL) and Etnobameti's 4D model (Define, Design, Develop, Disseminate). This integration aims to produce student-created learning tools to enhance critical thinking skills and innovative work based on local wisdom regarding marine biodiversity. The research method with the development of the PjBL and Etnobameti integration model with 4D includes: (1) Define, namely students analyze the needs of local wisdom in biology (marine biodiversity) according to the curriculum), (2) Design, namely students design the learning process according to the syntax of project based learning (PjBL) and Etnobameti integration with critical thinking instruments and innovative work, (3), Develop, namely students validate Etnobameti activities regarding marine biodiversity material with the lecturer in charge of the teacher professional development course to see its practicality, (4) Disseminate, namely students prove that innovative work (final products) are made from marine biodiversity material which is carried out through the implementation of microtching in the form of simulations in class.

The research subjects involved 24 fifth semester students of the Biology Education Study Program, FKIP, Pattimura University, which offers teacher professional development courses. Using the Integrated Project-Based Learning (PjBL) and Etnobameti Syntax, The student-created learning tools are based on the learning steps (syntax) of the integrated project-based learning (PjBL) and Etnobameti models designed by students as prospective teachers. This is to understand the professionalism of teachers in the technological era, to enhance creativity, critical thinking, innovative work, and communication skills. The learning syntax of the integrated project-based learning (PjBL) and Etnobameti models is explained in Table 1.

Table 1. The learning syntax of the integrated project based learning (PjBL) and Etnobameti models

Syntaks Project Based Learning (PjBL)	Ethnobameti Syntax	Syntaks Integrasi PjBL-Ethnobameti
Determine the Essential Question (Start with the Essential Question)	Determining the observation area based on the question of where marine biota (biodiversity) live for Bameti activities	Determine the Fundamental Question (Start with Essential Question): Questions rooted in local wisdom about the habitat of marine biota (biodiversity) and its utilization
Design a Plan for the Project	Get to know various types of marine biota based on their ecological characteristics and functions in coastal and marine water habitats.	Developing a Project Plan (Design Plan): students develop knowledge about marine biodiversity as local knowledge (ethnobameti)
Create a Schedule Create a timeline for project completion.	Determine the time of Bameti activities based on groups when the sea water recedes (morning, afternoon, evening)	Create a Schedule: students determine the time for bameti activities as a local community custom and interviews with local community leaders and experiments.
Monitor the Students and the Progress of the Project	Identifying collected marine biota (results of Bameti activities)	Project Monitoring and Progress: Lecturers monitor the project, especially on the aspect of scientific validity of local knowledge (connecting empirical data).
Assess the Outcome	The group held a discussion on the types of marine biota that had been collected during the Bameti activity for follow-up.	Testing Results: students present the results of the product (videos, processed food products, crafts from marine biota).
Evaluate the Experience	Creating innovative works (products) in various forms (food menus and crafts from various types of marine biota)	Experience Evaluation: Lecturers/teachers reflect on and assess the syntax, critical thinking, innovative work (learning videos, brochures, flyers, food menus) created by each individual or group of students related to the concept of marine biodiversity.

Critical Thinking and Innovative Work Questions. To assess students' thinking skills and innovative work during the development process of the project-based learning (PjBL) and Etnobameti integrated learning model, the questionnaire is formulated into 10 questions: 6 critical thinking questions and 4 innovative work questions. These questions are explained as follows:

Critical Thinking Questions

1. How can the integrated PjBL and Ethnobameti syntax model bridge the gap between biological knowledge (marine biodiversity) and local community knowledge (traditional wisdom) without distinguishing between them?
2. In the context of marine biodiversity conservation (marine biodiversity), how can students critically evaluate sustainable and unsustainable local community ethnobameti practices?
3. To what extent can the ethnobameti data obtained in student projects be scientifically validated (marine biodiversity and its ecosystem) without losing the sociocultural context?
4. What are the criteria for the most valuable "original product" in the integrated PjBL learning model of Ethnobameti, and what form should it take: physical products (functional foods, handicrafts) or documentation (learning videos, brochures, flyers, posters)?
5. How does the integrated PjBL and Ethnobameti learning model change students' mindsets about marine biodiversity and its role in local communities' conservation?
6. Is it necessary for teacher professional development courses to raise fundamental questions and problem formulations related to the strengths and weaknesses of the PjBL and Etnobameti integration learning model related to biology material (marine biodiversity) with local cultural wisdom of the community?

Innovative Work Questions

1. How can traditional foods made from various types of marine life be innovated into functional food products with nutritional value and health through the application of the integrated PjBL and Etnobameti models?
2. Investigate and reformulate local knowledge "bameti" regarding types of marine life as a source of nutritious and healthy food (nutrition with omega-3 content) into food products that can improve students' intellectual intelligence?
3. Create handicrafts in the form of chain toys and colorful bracelets made from various types of marine life (shellfish).
4. Create learning media in the form of learning videos, posters, placards, herbariums, and seashell crafts.

The research data obtained included: (a) The ability to compile learning steps (syntax) using the integrated project-based learning (PjBL) and Etnobameti model, created by students and implemented in simulations. Assessment was based on achievement criteria scores (85-100 / very good), (75-84 / good), (65-74 / sufficient), (0 < 64 / inadequate), (b) Student answers to critical thinking questions and innovative work were assessed using achievement criteria scores (85-100 / very good), (75-84 / good), (65-74 / sufficient), (0 < 64 / inadequate), (c) Student answers based on their innovative work were assessed using achievement criteria scores (85-100 / very good), (75-84 / good), (65-74 / sufficient), (0 < 64 / inadequate). The data obtained were analyzed according to the problems proposed using descriptive and inferential statistics using the SPSS 25 program.

RESULTS

The data obtained from the assessment of the development of learning tools developed by 24 students on the integrated project-based learning (PjBL) and Etnobameti models, as well as the assessment of students' critical thinking on the marine biodiversity material being implemented, as well as the assessment of critical thinking and innovative work or learning outcomes created by students, are described in Table 2.

Assessment Results of Learning Tools, Syntax, Critical Thinking, and Student Innovative Work

Table 2. Scores for the Assessment Results of Syntax, Critical Thinking, and Student Innovative Work

Score	Syntaks PjBL-Ethnobameti		Critical Thinking		Innovative Work		Criteria
	F	%	F	%	F	%	
85 - 100	5	20,8	14	58.3	15	62,5	Very Good
75 - 84	12	50	7	29,2	8	33,3	Good
65 - 74	5	20,8	3	12,5	1	4,2	Sufficient
0 < 64	2	8,4	0	0	0	0	Poor
∑	24	100	24	100	24	100	

Based on the data in Table 2 above, it shows that there are differences in scores for the assessment criteria, namely: (a) very good criteria 20.8%, for critical thinking activities with good criteria 58.3%, for innovative work with good criteria 62.5%. (b) syntax assessment with good criteria 50%, for critical thinking with good criteria 29.2%, for innovative work with good criteria 33.3%. (c) syntax assessment with sufficient criteria 20.8%, for critical thinking activities with sufficient criteria 12.5%, for innovative work with sufficient criteria 4.17%. Syntax assessment with less criteria is 8.4%, critical thinking 0%, innovative work or learning product 0%.

Regression Correlation Analysis Between Syntax and Critical Thinking

Based on the syntax assessment scores of the project-based learning (PjBL) and Etnobameti integration models in applying marine biodiversity material to students' critical thinking, regression analysis and ANOVA analysis are used, as explained in Table 3.

Table 3. Regression analysis and ANOVA analysis of syntactic assessment of the project-based learning (PjBL) model and Etnobameti integration in applying marine biodiversity material to students' critical thinking

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.841	.707	.693	.069

The independent variable is Berpikir.

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	.252	1	.252	53.022	.000
Residual	.105	22	.005		
Total	.357	23			

The independent variable is think

Table 3 above shows a significant correlation between the learning syntax of the PjBL and Etnobameti integration models and students' critical thinking skills regarding the implementation of marine biodiversity learning concepts. This is evident from the results of the correlation analysis, which shows an R2 value of 0.707, indicating a significant correlation between the learning syntax of the PjBL and Etnobameti integration models and students' critical thinking skills regarding the implementation of marine biodiversity learning materials. The existence of this significant correlation according to the value of R2 = 0.707, then the linear correlation between the syntax of the PjBL and Etnobameti integration model learning on students' critical thinking on the application of marine biodiversity material is 70.7%. and only 29.3% of other factors. Based on

the analysis data in Table 3, it is also seen that there is an influence of the PjBL and Etnobameti integration model learning syntax on students' critical thinking skills in the implementation of marine biodiversity material. This is in accordance with the analysis results which show a df value = 23-22 = 1 with an F value = 53.022 with a significance level of 000, <p 0.05, this indicates a significant influence between the syntax of the PjBL and Etnobameti integration model on students' critical thinking intelligence on mastering marine biodiversity material.

Based on the regression coefficient value between the learning syntax of the PjBL and Etnobameti integration models on critical thinking in the implementation of marine biodiversity material in learning, biodiversity, is explained in Table 4.

Table 4. The Regression Coefficient Value Between the Learning Syntax of the PjBL and Etnobameti Integration Models on Critical Thinking in the Application of Marine Biodiversity Material in Learning, Biodiversity.

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
1 / Berpikir	-84.624	11.622	-.841	-7.282	.000
(Constant)	5.336	.135		39.541	.000

The dependent variable is ln(syntaks).

Based on the data in Table 4, it shows that there is a coefficient value that can explain the existence of a linear correlation based on the formula y = a + bx = -84.624 + 5.336 between the learning syntax values of the PjBL and Etnobameti integration models on students' critical thinking in implementing marine biodiversity material. There is a regression coefficient relationship as seen in Figure 1.

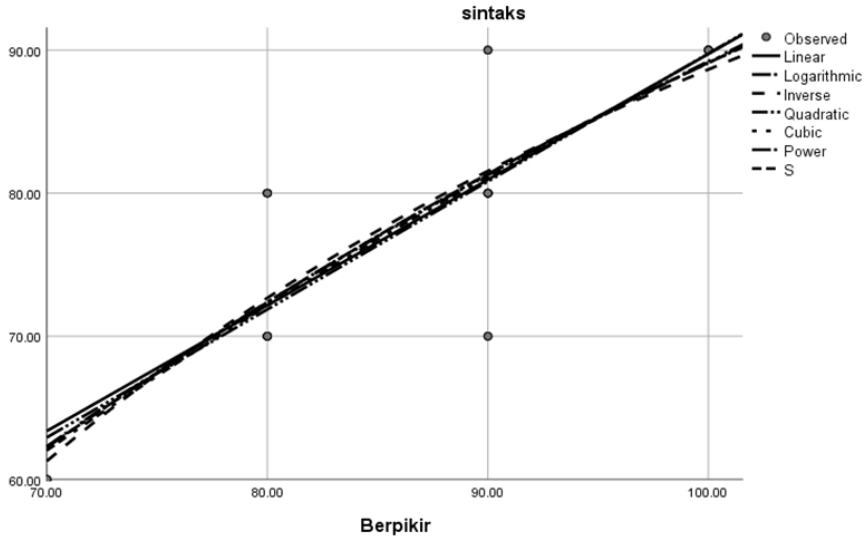

Figure 1. The relationship between the regression coefficient between the syntactic value of the PjBL and Etnobameti integration model of learning and students' critical thinking skills in implementing marine biodiversity material

Figure 1. above shows a significant regression correlation between the learning syntax of the PjBL and Etnobameti integration models on students' thinking in implementing marine biodiversity material, this can be seen from the linear correlation line, there are observation points and inverse lines as well as logarithmic lines, quadratic lines that are close to the linear correlation line.

Regression Correlation Analysis Between Syntax and Innovative Work (Product Results)

Based on the assessment scores for the syntax of the project-based learning (PjBL) and Etnobameti integration models, the application of marine biodiversity material to students' innovative work, as described in Table 5 below, is shown in the regression and Anova analyses.egression Correlation Analysis Between Syntax and Innovative Work (Product Results)

Table 5. Regression Analysis and ANOVA Based on the Syntactic Assessment Scores of the Project-Based Learning (PjBL) Model and the Integration of Etnobameti, the Application of Marine Biodiversity Material to Students' Innovative Work

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.661	.438	.412	5.974

The independent variable is innovative work

ANOVA

	Sum of Square	df	Mean Square	F	Sig.
Regression	625.926	1	625.926	17.886	.000
Residual	769.907	22	34.996		
Total	1395.833	23			

The independent variable is innovative work

Table 5 above shows a correlation between the learning syntax of the PjBL and Etnobameti integration models and students' innovative work (learning products) related to marine biodiversity material. This is evident from the results of the correlation analysis which shows an R2 value of 0.438, which means there is a correlation between the learning syntax of the project-based learning (PjBL) and Etnobameti integration models and students' innovative work through the implementation of marine biodiversity material. The existence of a linear correlation between the learning syntax of the project based learning (PjBL) and Etnobameti integration model on students' innovative work through the application of marine biodiversity material is 43.8%. and only 56.2% of other factors are due to the knowledge received by students from their parents from the previous generation in recognizing various types of marine biota (marine biodiversity) on how to carry out bameti activities. In addition, table 3.3 above also shows the influence of the learning syntax of project based learning (PjBL) and Etnobameti integration on innovative work (learning product) on marine biodiversity material, based on the df value = 23-22 = 1 with an F value = 17.886 where the significance level is 000, <p 0.05, this means that there is a significant influence between the learning syntax of project based learning (PjBL) and Etnobameti on students' innovative work on marine biodiversity material.

According to the results of the linear regression analysis with the regression coefficient value between the learning syntax of the project based learning (PjBL) integration model and Etnobameti on critical thinking in the application of marine biodiversity material, it can be explained in Table 6.

Table 6. Linear regression analysis with regression coefficient values between the learning syntax of the project-based learning (PjBL) integration model and Etnobameti on critical thinking in the application of marine biodiversity materials

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
1 / KARYA	-6066.667	1434.487	-.670	-4.229	.000
(Constant)	148.935	16.836		8.846	.000

Based on the data in Table 6 above, it shows that there is a coefficient value that can explain the existence of a linear correlation based on the formula y = a + bx = -6066.667 + 148.935 between the learning syntax value of the PjBL and Etnobameti integration model towards students' innovative work in the application of marine biodiversity material. In addition, there is a regression coefficient relationship between the learning syntax of the PjBL and Etnobameti integration model and students' innovative work as seen in Figure 2.

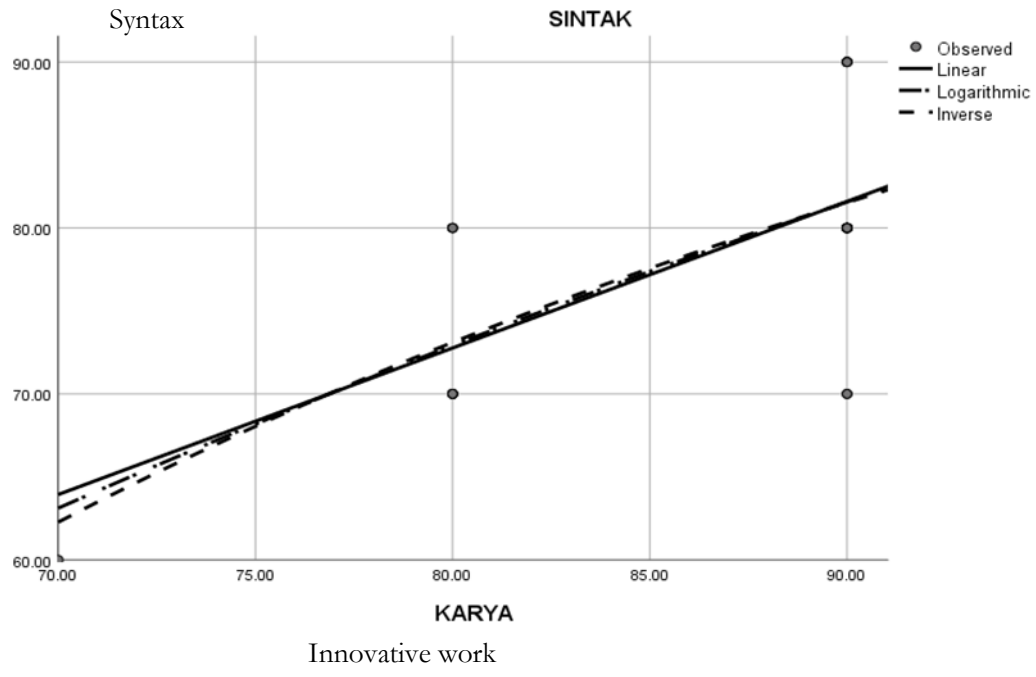

Figure 2. Regression Coefficient Relationship Between the Learning Syntax of the PjBL and Etnobameti Integration Model and Students' Innovative

Figure 2. above shows a significant regression correlation between the learning syntax of the project based learning (PjBL) integration model and Etnobameti towards the innovative work (learning product results) of students in the application of marine biodiversity material, this can be seen in the graph which shows a linear correlation line flanked by observation points and inverse lines and logarithmic lines, which are close to the linear correlation line.

DISCUSSION

The development of the project based learning (PjBL) and Etnobameti integration model is the development of a combination of two syntactic models of project based learning (PjBL) integration and Etnobameti syntax. The development of both syntactic models focuses on critical thinking intelligence and innovative work or student learning outcomes. The collaboration of these two syntax models is an innovative project-based learning, emphasizing real and complex contextual learning, while by combining PjBL and Etnobameti which is local wisdom from the culture of the Maluku people and is referred to from the word "bameti" can be used in the learning process. These two learning models place more emphasis on the innovative work of students. According to Surlialy Ramon (2025), "ethnobiology" has a syntax (steps in the learning implementation process) that can build learning motivation and direct student involvement. The collaboration of the two syntax models of project-based learning (PjBL) integration and Etnobameti allows students (prospective teachers) to master how to study marine biodiversity and be able to summarize all lesson materials, as well as be able to evaluate and reflect on the entire learning process. Dina Aulial Husna, et al., 2024, that ethnobiology can be integrated with the PjBL model and it is hoped that students can build a more contextual and meaningful understanding of biology, as well as develop the biology knowledge needed to face future challenges.

According to Tri Emy Handayani, et al, 2025 that through project-based learning integrated with culture as local wisdom can increase students' learning motivation and facilitate understanding of the material being studied. Learning outcomes in the form of projects are a form of student thinking intelligence through the use of biological science materials by utilizing local wisdom of bameti activities to fulfill problems in real life by the community through the process of education and learning. The development of an integrated model of project based learning (PjBL) and Etnobameti for marine biodiversity material is very important, because the combination of the two syntaxes has a function as a guide for the flow of systematic and structured steps, starting from the introduction to the closing of learning. Ensuring that teaching and learning activities run effectively, directed, and efficiently.

The combination of the two PjBL and Etnobameti integration model syntax creates a clear learning step-by-step structure for student (prospective) teachers in developing learning tools and also for classroom management. Griet Helenaa Laihad et al, 2023, that active teacher capability development is needed to shape the mastery of teaching skills of students as prospective teachers so that they themselves become the center of learning, which can increase intrinsic motivation and activeness, so that the objectives of the teacher professional development course are achieved optimally.

The results of the assessment of syntax in the development of learning devices for the project based learning (PjBL) and Etnobameti integration model compiled by students showed good to very good criteria of 70.8% and 20.8% of students had sufficient criteria for understanding syntax 20.8% and students had less criteria only 8.4%. Jean Marie, et al, 2020 that the importance of a teacher mastering learning syntax, because, (1) structured steps (operational guidelines), with syntax providing a clear sequence of what students or learners must do, ensuring the learning process is not random and consistent, (2) Syntax can increase effectiveness, students (prospective teachers) understand the material well, because the learning steps are conveyed systematically, so that it is easy for students (prospective teachers) to understand, increasing critical thinking intelligence and innovative work, (3) Syntax can create meaningful learning for students, different and relevant learning experiences, so that students (prospective teachers) find it easier to develop innovative learning devices based on the knowledge they have

The development of professional skills of students as prospective teachers in formulating learning steps (syntax) is a must that students must have, able to develop integrated learning models of community cultural values as local wisdom into the learning process, one of which is "bameti culture" as local wisdom of the community, because it has

syntax, namely the steps of the learning process. Nila Maharotunnisa, et al, 2025 that the development of learning tools based on local wisdom is one of the innovative approaches in increasing learning motivation according to learning steps. Thus the development of integrated learning tools PJBL and Etnobameti compiled by students is an innovative and enjoyable learning according to the success of learning outcomes in the form of innovative products or works, all of these are more meaningful and contextual student learning experiences, although the development of learning through integration based on local wisdom is still limited, especially in the lecture environment.

Based on the results of the assessment of the learning device of the PjBL and Etnobameti integration model and the assessment of critical thinking according to student answers, the score showed a good to very good criteria of 78.5% and only a less than sufficient criteria of 15%. The critical thinking assessment was carried out to respond to students' abilities in analyzing facts to form subjectively and complexly all student activities in the design and implementation of the project based learning (PjBL) and Etnobameti integration learning model covering marine biodiversity material. The assessment of critical thinking intelligence includes rational and systematic analysis, evaluation of factual evidence, data interpretation, inference (conclusion), and self-reflection. Esty Cahyaningsih, et al, 2025, that the assessment of thinking intelligence cannot be separated from the assessment of the PjBL learning model and also the integration of the use of local culture that is integrated with the material being studied, even training high-level critical thinking skills. Collaborative learning like this produces students who think critically, creatively, and achieve learning objectives optimally.

Students' critical thinking skills regarding scientific truths related to the application of the project based learning (PjBL) and Etnobameti integration model continue to be developed, because it does not eliminate its social context, this is proven by the collaboration between students and the community discussing the meaning of bameti activities for community life. Dwi Lyni Sari, et al 2024, that PjBL learning pays attention to aspects of socio-cultural inclusion, can be used to develop diverse local cultures and be applied to the world of education and learning, especially the integration of PjBL with local culture will increase students' thinking intelligence.

Critical thinking skills in answering questions about how the integrated learning model of PjBL and Etnobameti changes the mindset about marine biodiversity and the role of local communities in supporting coastal and marine ecosystems as a conservation area. Through the teacher professional development (PPG) course, various critical thinking questions are needed to improve students' thinking skills regarding the advantages or disadvantages of the integrated model of PjBL and Etnobameti, which is very necessary as an approach to the local wisdom of the Maluku community culture. Aprilia Wahyuning Fitri, et al, 2025, stated that learning strategies by utilizing the cultural environment of the local community make it easier for students to understand material related to the surrounding environment and increase learning activities.

The development of learning tools through the project based learning (PjBL) integration model connected with local cultural wisdom can improve critical thinking skills, because it makes learning more contextual and meaningful and increases innovative work, serves to increase student motivation, facilitates understanding of the material, which is taught and supports student professionalism as a teacher. Rahmawati Darussyamsu, 2023, that through continuous training for teachers in understanding and designing innovative learning such as PjBL based on local approach wisdom, the feedback is very positive, where the learning model that integrates local wisdom has been effective in improving students' critical thinking intelligence.

Teacher professional development through the development of learning tools based on local wisdom of the "bameti" culture as a local tradition of the community is used as a learning model "Ethnobameti" which is designed contextually, effectively, attractively, and innovatively to improve students' understanding in combining

various learning models with a local wisdom approach. The integrated PjBL learning model Etnobameti enriches students' learning experiences in completing the teacher professional development (PPG) course. According to Taufik, et al, 2025, the PjBL learning model emphasizes a project, is a complete, continuous learning and can make students actively move to find information to complete project assignments or innovative works created.

There is a very significant influence of the application of the syntax of the PjBL model integrated with Etnobameti between the application of syntax and students' critical thinking about biodiversity material, this can be seen from the results of the analysis showing a value of df = 23-22 = 1 with an F value = 53.022 where the significance level is 000, <p 0.05, this means that there is a significant influence between the syntax of the PjBL integration model with Etnobameti on students' critical thinking intelligence about marine biodiversity material. This is in accordance with the view of Ni Made Wisudari Pratiwi, et al, 2026 that various results of literature and research studies show that the Project-Based Learning (PjBL) learning model integrated with local cultural models has a positive and significant effect on students' critical thinking skills in biology subjects. This learning model improves learning abilities in analyzing, evaluating, and creating solutions to contextual biology problems.

The learning syntax of the project besad learning integration model with ethnobameti is very significantly related to the critical thinking ability about the mastery of biodiversity material by students, this is proven by the results of the linear correlation test showing a linear correlation value, namely the value of R2 = 0.707, then there is a linear correlation between the syntax of the PjBL integration learning model with Etnobameti on students' critical thinking in the application of marine biodiversity material, the relationship is 70.7% with the application of syntax and only 29.3% is related to other factors. The existence of students' critical thinking abilities is because the syntax of this learning model is structured, systematic, innovative so that it improves students' thinking abilities. Rahmawati Darussyamsu, 2023, that the syntax of the project besad learning model integrated with local culture can lead to students' activeness in analyzing, synthesizing information and evaluating in concluding a learning process in the form of a product. Thus, the application of the syntax of the project-based learning (PjBL) integration model with Etnobameti is directly proportional to the increase in students' critical thinking in the implementation of the development of learning tools for teacher professional development courses.

The integrated project based learning (PjBL) model with Etnobamati designed by students in the form of learning tools clearly reveals the formulation of learning outcomes in the form of innovative products or works derived from marine biodiversity materials. This can be seen from the results of the assessment of students' innovative works in the form of learning videos, brochures, plaques, handicrafts and food menus derived from various types of marine violins. The assessment results show a variety of innovative works created, with the value of the innovative work score criteria from good to very good at 95.8% and only 4.2% with less to sufficient criteria. Rudi Hartono, et al 2024 that innovative works or products of student learning outcomes in teacher professional development courses with good and very good criteria are clearly seen from the results of the innovative work assessment. Anindya Primadayuning Putri et al, 2023, that the implementation of projectbased learning (PjBL) model integrated with biology material with local wisdom can improve students' understanding of the material studied through thinking intelligence, Thus the design of the PjBL model learning integrated with Etnobameti which is a local culture implemented by students in microteaching in class is an innovative learning. Various forms of innovative work created by students are closely related to critical thinking skills, analytical skills, skills in composing various products from marine biota materials. Goodman and Stivers (2010) explain that the implementation of project based learning (PjBL) can be integrated with various approaches or local wisdom of a culture as a learning strategy without eliminating tasks that are

built on real activities in the form of a product or innovative work.

The innovative work of students is formulated in the learning tool of the project-based learning (PjBL) model integrated with Etnobameti shows real products (learning videos of bameti activities, shellfish crafts, various culinary menus from various types of marine biota, etc.). The experience of students in designing the PjBL integration model with Etnobameti can improve creativity and critical thinking skills of students. This learning model changes learning to be more meaningful, contextual, innovative and fun, in accordance with the needs of learning skills in today's technological era. Denita Farida, et al., 2024 that ethnobiology can be integrated with various learning models, because it is related to the culture of local communities and encourages students to understand biological material, the ethnobiology model becomes the focus of contextual learning that makes it easier for students to easily understand biodiversity material. Yenny Anwar, et al., 2024 that the integration model of project based learning (PjBL) and Ethnobiology which is an innovative learning approach, combining project-based methods with local wisdom studies related to the development of marine biodiversity material (various types of marine biota). The PjBL learning model integrated with local culture is very effective and closely related to improving critical thinking skills, creativity, and innovative work according to student learning outcomes

Based on the assessment of the regression correlation between the syntax (steps) of the problem based Learning (PBL) and Etnobameti integration models on innovative work or student learning product results in the form of learning device development, which shows a significant regression correlation, this is proven by the correlation value of R2 = 0.438 or 43.8% influenced by syntax while 56.2% influenced by other factors especially student knowledge seen in the form of critical thinking intelligence. The results of the analysis also show the influence of the Etnobameti integrated PjBL syntax on innovative work or student learning product results about marine biodiversity according to the df value = 23-22 = 1 with an F value = 17,886 where the significance level is 000, <p 0.05, this means that there is a significant influence between the syntax of the project based learning (PjBL) integration learning model and Etnobameti on student innovative work. Sisi Kurnia, et al, 2023, that there is an influence and correlation between this syntax and innovative works in the form of learning video reports, posters, brochure plaques and shellfish crafts as well as food menus are student activities in creating and communicating ideas, which directly improve the skills of learning outcomes in the form of innovative products or works.

According to Putri Purnama et al, 2023 that the implementation of PjBL integrated with local wisdom strategies or approaches and implemented with good and correct learning steps greatly influences students' critical thinking intelligence towards mastering the material. especially integrated with local wisdom-based learning strategies, The existence of a regression correlation between the learning steps of project based learning (PjBL) and Etnobameti integration with innovative work or student learning outcomes looks very close and causal (cause and effect). Each stage of the Etnobameti integrated PjBL designed by students ensures that the innovative work (product) produced is of high quality, relevant to marine biodiversity material, and reflects students' abilities.

Lecturer assessment of the learning syntax of the integrated project based learning (PjBL) and Etnobameti model for innovative work (products) made by students, is conveyed by lecturers in the lecture process and will be assessed in the microtiching process by students. Mulyadi, et al 2023, the importance of teachers or prospective teachers mastering the learning syntax and committing to implementing it in the correct order. This is in accordance with the sequence of syntax assessed, namely (1) Start with Essential Question, the lecturer asks questions with interesting contextual problems related to marine biodiversity, which can be made into a product or innovative work, (2) Design Project Plan, the lecturer describes various types of marine biota that are easy to obtain and can be made into various

innovative works (products) using various tools, materials, and designs) carefully to prevent the failure of the innovative work (products) made, (3) Create Schedule, the lecturer makes an agreement with students regarding innovative work (products) according to the completion time in the PjBL and Etnobameti integrated learning tools, (4) Monitoring, lecturers monitor and guide students directly in compiling innovative works (products) according to the material on types of marine biota (marine biodiversity), (5) Assess the Outcome, lecturers determine the quality of innovative works (products) and receive feedback from students, (6) Evaluation of the Experience, lecturers reflect on the entire process carried out by students, and provide an understanding of the importance of developing learning tools for the PjBL and Etnobameti integration model in understanding marine biodiversity material as raw material for making innovative works (learning product results). According to Elissa Evawani, et al, 2024, to develop professional teacher abilities, it is necessary to have a good understanding of learning syntax and be committed to implementing it in the correct order.

The development of innovative learning models, especially for prospective teachers, is focused on project-based learning (PjBL) models integrated with various approaches or learning models. Hafifah Namira et al. (2024) explained that the implementation of PjBL will ultimately result in innovative work (products) resulting from students' creative thinking skills and understanding of the material. Critical thinking skills are related to the ability to understand PjBL syntax through a series of assessments, including active, collaborative, and structured processes, as well as PjBL steps integrated with other approaches and learning models.

According to the correlation regression analysis shown in the graph, there is a significant correlation between students' understanding of the syntax of the Etnobamati integrated PjBL model and their critical thinking skills and innovative work. This indicates that the higher the score (very good or good), the higher the critical thinking skills score, and the higher the quality of the innovative work or product of the students' learning outcomes. Junruang, C., & Kanjug, I.n (2025), that the existence of innovative work (products) resulting from quality student learning is due to the correlation between critical thinking and innovative work in the project based learning (PjBL) and Ethnobiology integration learning model showing a positive relationship where critical thinking skills function as the main foundation that encourages the creation of innovative work.

Students' critical thinking skills are very helpful in evaluating project results, correcting errors, and refining innovations to be more effective and efficient. According to Denita Farida, et al. 2024, the integration between the PjBL model and Ethnobiology strengthens the problem-solving context, which ultimately requires students to think critically to design innovative solutions that are relevant to biological material and their environment. Using critical thinking skills to analyze real problems such as the use of various medicinal organisms, nutritious food, shellfish crafts becomes a project opportunity. Christopher P Dwyer, et al, 2025 that the relationship between critical thinking and innovative work is a very close functional and causal (cause-effect) relationship, where critical thinking acts as a foundation or spark before creative ideas are implemented into an innovation. Simply put, critical thinking analyzes situations, while creative thinking generates ideas, and innovation applies those ideas in the form of the latest innovative work.

The critical thinking skills possessed by critical students help filter relevant and irrelevant information, ensuring that innovative work is based on valid data. Innovative work often requires creativity (generating new ideas), but creativity alone is not enough, critical thinking is needed to evaluate creative ideas. Dimas Arya Soeadyfa Fridyatama, et al, 2025 that without critical thinking, innovative work ideas may be original but cannot be implemented or do not solve problems efficiently. Critical thinking can encourage the creation of innovative work or learning products that apply creative ideas into real forms of innovative work that provide quality to a learning process.

CONCLUSION

Based on the data obtained and the analysis of student responses related to the Etnobameti integrated project-based learning (PjBL) model on marine biodiversity, the implementation of integrated PjBL significantly impacted students' critical thinking skills in understanding biodiversity.

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