Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 3, 2402-2412
2025
Publisher: Learning Gate
DOI: 10.55214/25768484.v9i3.5812

Development of a project based learning model with multiliteracy pedagogic content to improve critical thinking skills, problem solving skills, decision making skills, and environmental literacy

Deden Agustira[1*], Mimien Henie Irawati Al-Muhdhar[2], Sri Rahayu Lestari[3], Rani Tania Pratiwi[4]
[1,2,3]State University of Malang, Malang, Indonesia; deden.agustira.2103419@students.um.ac.id (D.A.).
[4]University of Kuningan, Indonesia.

Abstract: This study explores the development of a Project-Based Learning (PBL) model incorporating multiliteracy pedagogy to enhance students' critical thinking, problem-solving, decision-making skills, and environmental literacy. The research is motivated by the increasing environmental issues caused by human behavior, particularly excessive consumption patterns and unsustainable habits among students. Addressing these challenges requires an education system that fosters environmental awareness and essential 21st-century skills. The study employs a Research and Development (R&D) approach using the Dick, Carey, and Carey instructional design model. The research is conducted in junior high schools through three phases: pre-development, development, and post-development. Data collection involves both qualitative and quantitative methods, including expert evaluations, student feedback, and statistical analyses of learning outcomes. A control-experiment design is employed to assess the suggested model's efficacy. The results show that using the PBL paradigm with multiliteracy pedagogy significantly improved students' critical thinking, problem-solving, decision-making, and environmental literacy. The model's ability to promote greater environmental responsibility and cognitive engagement was demonstrated by the experimental group's higher N-Gain score when compared to the control group. The data's validity and reliability were validated by statistical analysis, which revealed a significant difference ($p < 0.05$) between the pretest and posttest results. This study emphasizes how crucial it is to combine PBL with multiliteracy teaching in order to improve students' overall development. The implications suggest that educators should adopt innovative learning strategies to cultivate students' environmental literacy and higher-order thinking skills, preparing them for future challenges in sustainable living and decision-making.

Keywords: *Critical thinking, Decision Making, Environmental Literacy, Multiliteracy Pedagogy, Project-Based Learning, Problem Solving.*

1. Introduction

Environmental sustainability is significantly impacted by human conduct. One of the human behaviors that is connected to the environment is activity consumption. We consider the phenomena that arises at our time, when advancement and speed of current knowledge lead to a pattern of excessive consumption. Many people buy products or services mostly because they want them, not because they need them. The environment may suffer as a result of overuse of natural resources brought on by this excessive consumption. For instance, consumption activities in students include eating, as junior high school students in Kuningan Regency have a tendency to consume food more in line with trends than with the true goal of eating. They favor eating fast food, which is presented with a lot of packaging, either paper or plastic. This consumption pattern generates a lot of trash and has an adverse effect on the environment. Next is the excessive fuel consumption of junior high school students, since many of

History: Received: 17 January 2025; Revised: 10 March 2025; Accepted: 14 March 2025; Published: 27 March 2025
* Correspondence: deden.agustira.2103419@students.um.ac.id

them currently choose riding motorcycles to school rather of taking public transit. Even people with nearby homes prefer riding motorcycles to school rather than walking or riding bicycles for leisure. In actuality, air pollution from vehicle exhaust fumes has a significant impact on environmental sustainability the more vehicles are used.

The learning process needs to be centered on environmental issues. Human knowledge of the value of protecting nature must be fostered by the educational process. Understanding the surrounding world, developing knowledge in the form of scientific process/method skills, and adopting a scientific mindset when analyzing the environment and resolving issues are the three main goals of science education. The idea that learning should be focused on a sustainable future is stated in the Independent Curriculum Learning and Assessment Guidebook for PAUD, Elementary Education, and Secondary Education. One application of this learning principle is that educators aim to incorporate sustainable living into various learning activities by embedding values and behaviors that reflect environmental awareness and responsibility for the planet's future. This includes practices such as using resources efficiently (conserving water, electricity, etc.), minimizing waste, and promoting eco- friendly habits [1].

At the educational unit level, this independent curriculum is stated in the Educational Unit Operational Curriculum (KOSP), which includes an analysis of the educational unit's characteristics, vision, mission, and objectives, as well as organizing and planning learning. The Independent Curriculum currently being implemented in schools is in accordance with PP No. 4 of 2022, which is an amendment to PP No. 57 of 2021 concerning National Education Standards. The author's main focus in this PP is regarding the Graduate Competency Standards (SKL), specifically 1) Character building in accordance with Pancasila values, and 2) Development of literacy and numeracy competencies to continue further education. The teacher's prepared teaching module will outline the learning planning for the autonomous curriculum. The Independent Curriculum's teaching module is designed to assist teachers in providing more contextualized and adaptable instruction rather than relying solely on book-text courses. Instructional modules may evolve into more choices or different approaches to learning. Furthermore, learning in the autonomous curriculum must facilitate the complete development of students' abilities and personalities, especially through the creation of project-based learning [1].

The Marzano taxonomy level can be used in the autonomous curriculum to create learning objectives. There are four broad areas of knowledge usage during the knowledge utilization stage of Marzano's new taxonomy: (1) decision making, (2) issue solving, (3) experimentation, and (4) investigation [1]. The decision-making process stage, which focuses on attempting to solve problems precisely and promptly, includes problem solving. The difference between "what is and what should be" is one way to characterize problems. Effective decision-making and problem-solving anticipate that people need to be able to think critically and grow as individuals under the supervision and role models of their workplace.

Improving thinking skills and environmental literacy is one of the efforts to realize student skills in the 21st century. According to Trilling and Fadel [2] 21st century educational skills include life skills, employment skills, learning skills, innovation skills, technology skills, and information media (information media), according to Trilling and Fadel [2]. While environmental literacy is one of the 21st century topics that is heavily stressed in school curricula, the thinking skills mentioned in this study are critical thinking, problem solving, and decision-making skills that are part of learning skills. Competent human resources with the 4Cs—creative, critical collaboration, and communication—as well as literacy, life skills, and character are required to meet the challenges of the twenty-first century. One of these is the way that education is incorporated into the classroom to encourage students' awareness of environmental sustainability [3].

Updating the quality of education, assisting students in becoming more involved, modifying learning personalization, prioritizing project/problem-based learning, promoting teamwork and communication, raising student engagement and motivation, fostering creativity and innovation in the classroom, utilizing the right learning resources, creating real-world-relevant learning activities,

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 3: 2402-2412, 2025
DOI: 10.55214/25768484.v9i3.5812

teaching students metacognition, and fostering student-centered learning are all ways to achieve 21st century skills [4].

Critical thinking, problem-solving, and decision-making are all crucial cognitive abilities that students should acquire. Students that possess critical thinking abilities must be able to assess, comprehend, and solve environmental problems using their cognitive knowledge. The fundamental ability to solve an issue including critical, logical, and methodical thinking is known as problem-solving skills.

Literacy is currently an integral part of the School Literacy Movement (GLS), as outlined in Permendikbud No. 23 of 2015. The primary goal of GLS is to cultivate reading and writing habits, enabling school members to become literate [5]. Literacy, in this context, encompasses skills in listening, speaking, reading, writing, and critical thinking. Additionally, GLS aims to foster more specialized literacies, including science, mathematics, language, information, and environmental literacy.

Environmental literacy refers to an understanding of the interactions between natural and human social systems [6]. An environmentally literate individual applies critical thinking, problem-solving, and effective decision-making skills to evaluate various aspects of environmental issues [7]. This implies that someone with environmental literacy (possessing knowledge, skills, influence, and responsible behavior) is capable of taking informed actions to address environmental challenges.

Literacy, grounded in the ecological model, defines environmental literacy as the ability to comprehend environmental systems and take conscious actions to conserve, restore, and enhance their well-being. To deepen this understanding, environmental literacy is considered to encompass six key components: Ecological Knowledge, Sociopolitical Knowledge, Environmental Issue Knowledge, Cognitive Skills, and Environmentally Responsible Behavior [8]. The most widely accepted definition of environmental literacy emphasizes awareness and concern for the environment and its challenges, along with the knowledge, skills, and motivation necessary to address existing issues and prevent future problems [9].

Literacy also serves as a learning approach aimed at increasing student engagement by utilizing the environment as a learning resource. This approach assumes that students will be more interested in learning when the subject matter is drawn from their surroundings, making it relevant to real life and beneficial to the environment. The environmental approach, therefore, integrates the environment into the teaching and learning process, using it as a fundamental resource for education [10].

The topic of environmental devastation has captivated the educational community for decades. After realizing the importance of the environment and natural resources, many people have worked to stop its devastation. Using engaging methods to teach kids about environmental issues is one of the initiatives taken to promote the culture of environmental protection. Because raising children's understanding of environmental issues requires ongoing instruction and early intervention. This is consistent with the emphasis on environmental education as the result of educational initiatives that began with the 1972 United Nations Conference on the Human Environment in Stockholm, Sweden. Development). [11] describes that the environmental literacy of Indonesian students is still below average with a ranking of 53 out of 58 countries [12]. And in 2018 Indonesia was ranked 70 out of 78 countries included in the OECD *(Organization for Economic Co- operation and Development)* in terms of reading [13].

The Intergovernmental Conference on Environmental Education, organized by UNESCO in collaboration with UNEP, took place in October 1977 in Tbilisi, then part of the Soviet Union and now the capital of Georgia. The primary objective of environmental education is to cultivate individuals who are both aware of and actively engaged in environmental preservation. Education should therefore enhance people's understanding of the physical, biological, social, economic, and cultural impacts on the environment, as well as the intricate relationships between socio-economic development and environmental sustainability.

Similarly, critical thinking skills should be developed through education, particularly in science learning, as they are essential 21st-century competencies that students need to acquire [14]. In

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 3: 2402-2412, 2025
DOI: 10.55214/25768484.v9i3.5812

addition, critical thinking skills are very important to train because (1) they can affect students' cognitive learning outcomes [15] (2) critical thinking skills are a success factor in any field [16] (3) critical thinking skills are very much needed at every opportunity when they will decide various problems, both those related to their scientific fields and social problems. Environmental pollution material presents many environmental problems that occur, so it requires critical thinking skills to criticize and solve these problems.

Education should equip students with values and interests related to the environment, fostering motivation to actively participate in efforts to preserve and enhance it Palmer [17]. Moreover, cultivating environmentally conscious and responsible citizens requires not only raising awareness but also instilling a willingness to seek solutions to environmental challenges, making this an essential aspect of environmental education [18].

Understanding concepts, evaluating issues, and choosing the best solution to a situation all require critical thinking abilities. As of right now, problem solving is frequently thought of as a mechanical, methodical, and abstract skill. But as theories of cognitive learning have evolved, problem solving has come to be seen as a more intricate mental process involving a variety of cognitive abilities. Critical thinking is viewed as a prerequisite for the development of problem-solving abilities in the context as previously mentioned. On the other side, solving problems can also be seen as a way to develop critical thinking abilities. It should be mentioned that issue solving serves a number of purposes, such as a skill, strategy, and setting.

Even while some instructors have adopted different learning models that align with the Independent Curriculum's recommendations, such as project-based learning, teachers still encounter challenges when putting these models into practice. Teachers must be able to adapt to various circumstances since, for instance, the autonomous curriculum places a strong emphasis on differentiated learning. Then, when the model is used, learning time seems to be insufficient, making it extremely challenging to develop concepts, analyze processes, and apply learning for students particularly when it comes to developing critical thinking, problem-solving, decision-making, and environmental literacy skills. Therefore, it is essential to design a learning model that prioritizes the development of these competencies, ensuring a more effective and comprehensive learning experience.

To improve critical thinking skills, problem solving, decision making and environmental literacy can be done through science learning using the *Project Based Learning Model*. Pedagogical Content Multiliteracy. *Project Based Learning* Model focused to bring students into the real world and is a 21st century learning model [19, 20]. One of the main characteristics of the independent curriculum is learning based on collaborative, applied project. Pedagogic multiliteracy serves as the foundation for structuring education and learning, focusing on enhancing students' knowledge and understanding. This approach enables them to cultivate essential thinking skills, such as critical thinking, creativity, problem-solving, and metacognition which are rooted in and shaped by their socio-cultural backgrounds [21].

Learning through projects is interdisciplinary. It is impossible to classify an external task as "math," "language," or "drama." Group learning is frequently associated with project-based learning. Various modalities, literacies, and knowledge bases can influence how a group of groups can plan and solve problems. Because students are encouraged to choose their own interests, set their own objectives, and devise their own plans and methods to finish projects for their own satisfaction rather than for some externally established success criteria for evaluation, project-based learning also necessitates creativity [22, 23].

Multimodal literacy, the ability to derive meaning from various forms of expression, has evolved beyond traditional literacy into a crucial 21st-century skill [24, 25]. As Mills and Unsworth [26] state, "communication from birth to adulthood is inherently multimodal." Integrating multiliteracies into learning not only enables students to leverage their individual strengths but also encourages them to explore diverse ways of learning and communicating. This approach provides students with the flexibility to choose content and modes of expression that foster innovation [27].

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 3: 2402-2412, 2025
DOI: 10.55214/25768484.v9i3.5812

2. Method

The R&D method utilized follows the systems approach model [28] or the procedural approach model developed by Dick, et al. [29] in *The Systematic Design of Instruction*. This model is widely recognized as the Dick, Carey, and Carey development model, or simply the Dick and Carey model. It is a research framework that emphasizes a structured, descriptive presentation of research stages.

Generally, this research process is divided into three main phases: pre-development, development, and post-development [29]. The Dick, et al. [29] model consists of ten procedural steps, each of which is interdependent. This interconnectedness is represented by solid arrow lines in the corresponding diagram, illustrating the sequential and integrated nature of the development process.

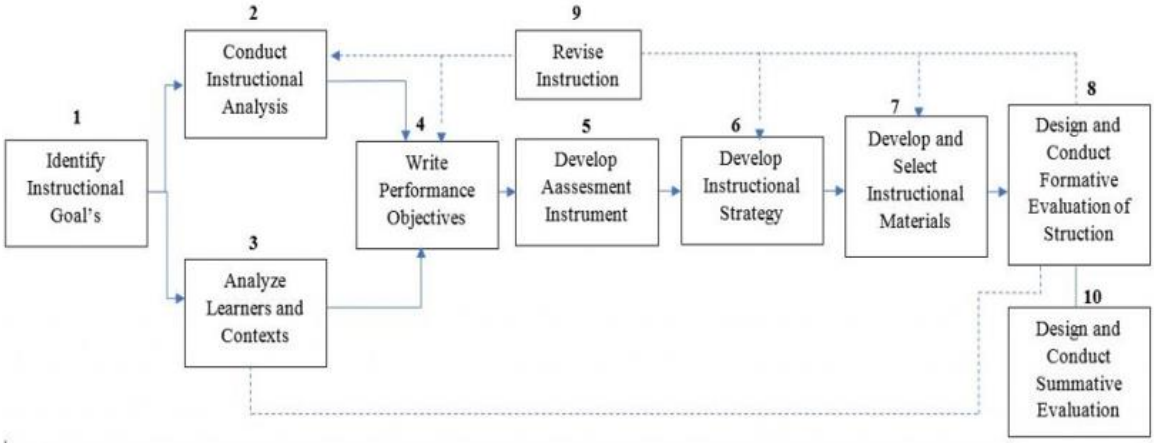

Figure 1.
The Procedure Model by Dick, et al. [29].

Table 1.
Research Subjects

School	Class			Caption
	Experiment	Control (+)	Control (-)	
SMPN 1 Maleber	VII A	VII B	VII C	one to one
Junior High School 2 Cimahi	VII A	VII B	VII C	small group
SMPN 4 Ciawigebang	VII A	VII B	VII C	field evaluation

This study's data came from trials and may be divided into two categories: qualitative data and quantitative data. In order to improve the final outcome in the form of a learning model, the study's qualitative data consists of critiques and recommendations made by students, material experts, and model experts. The steps for repair that are based on the outcomes of the trial stages are presented in order to provide a detailed explanation of the product improvement process. The product prior to the improvement and the product following the improvement will be shown at the revision stage along with a description of the revision procedure that was used. Descriptive statistics will be used to examine the quantitative data, which includes information about the learning model's quality that was gathered from respondents who completed a questionnaire with a rating scale [30].

3. Results and Discussion

3.1. Research Result

After implementing learning using the *Project Based Model Learning* containing Critical Pedagogy in the field test at SMPN 4 Ciawigebang, then a picture of Critical Thinking Skills, Problem Solving Skills, Decision Making Skills, and Environmental Literacy of students can be obtained as presented in the following table.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 3: 2402-2412, 2025
DOI: 10.55214/25768484.v9i3.5812

Table 2.
Results of Critical Thinking Skills, Problem Solving Skills, Decision Making Skills, and Environmental Literacy Tests

Class	Thess	Criticism		PM		Creative		LL	
		Rate	N-Over	Rate	N-Over	Rate	N-Over	Rate	N-Over
Exp.	Pretest	63	0.55	54	0.70	65	0.57	42	0.72
	Posttest	83		80		84		79	
Control	Pretest	55	0.38	52	0.52	53	0.40	43	0.55
	Posttest	72		69		72		71	

Based on Table 2 the test results for Critical Thinking Skills, Problem-Solving Skills, Decision-Making Skills, and Environmental Literacy showed an improvement from the initial test (pretest) to the final test (posttest) in both the control and experimental groups. However, the differences in these skills are more apparent in the extent of improvement, as reflected by the N-Gain values. The author illustrates this increase in scores (N-Gain) through the following graph.

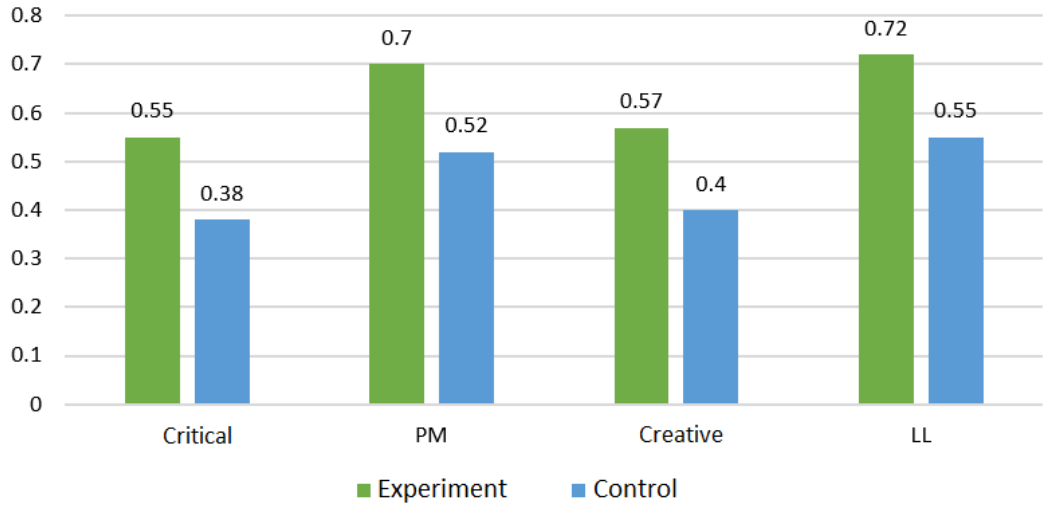

Figure 2.
N-Gain values.

3.2. Environmental Literacy Test Results

3.2.1. Classical Assumption Testing

To find out the differences in Critical Thinking Skills, Problem Solving Skills, Decision Making Skills, and Environmental Literacy of students, a mean difference test was conducted. Before testing the mean difference, a normality and homogeneity test was first conducted to determine whether to use parametric or non- parametric testing statistically. The results of the normality and homogeneity tests in the limited test are presented in the following table.

Table 3.
Results of Normality and Homogeneity Tests

	Pretest	Posttest	Information
X^2_{count}	0.61	4.20	$X^2_{count} < X^2_{table}$
X^2_{table}	7.81	7.81	Data is normally distributed
Fcount	1.24	1.13	$F_{count} < F_{table}$
F_{table}	1.93	1.93	Homogeneous data

Based on Table 3, we can see that all data used in the field test, the data is normally distributed and homogeneous. So, to find out the effectiveness of the implementation of the *Project Based model Learning* Multiliteracy Pedagogy content can be done with parametric statistics.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 3: 2402-2412, 2025
DOI: 10.55214/25768484.v9i3.5812

3.2.2. Hypothesis Testing

Hypothesis testing is done on posttest and posttest improvement. So, to be able to know the effectiveness of implementing *Project Based Learning containing* Multiliteracy Pedagogy in improving Critical Thinking Skills, Problem Solving Skills, Decision Making Skills, and Environmental Literacy, the following results were obtained.

Table 4.
Testing the Difference of Two Means on Critical Thinking Skills

Independent Samples Test						
		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
KE	Equal variances assumed	1,349	,557	4,053	54	,000
	Equal variances not assumed			4,128	53,875	,000

Table 5.
Testing the Difference of Two Means on Problem Solving Skills

Independent Samples Test						
		Levene's Test for Equality of Variance		t- test for Equality of Meaning		
		F	Sig.	t	df	Sig. (2-tailed)
TO	Equal variance assumed	1,306	,582	3,215	47	,041
	Equal variances not assumed			3,215	46,685	,041

Table 6.
Testing the Difference of Two Averages on Creative Thinking Skills

Independent Samples Test						
		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
KE	Equal variances assumed	1,640	,206	4,214	50	,000
	Equal variances not assumed			4,214	48,592	,000

Table 7.
Testing the Difference of Two Means on Environmental Literacy

Independent Samples Test						
		Levene's Test for Equality of Variance		t- test for Equality of Meaning		
		F	Sig.	t	df	Sig. (2-tailed)
KE	Equal variances assumed	6,605	0.062	6,122	50	,000
	Equal variances not assumed			6,122	48,927	,000

Based on the test results in Table 4 for critical thinking skills, the sig value is 0.000. Table 5 for problem solving skills, the sig value is 0.041. Table 6 for creative thinking skills and Table 7 for environmental literacy, the sig value is 0.000. The overall sig value is <0.000, meaning that the *Project Based Learning Model Learning* Multiliteracy Pedagogy is effective in improving critical thinking skills, problem solving skills, creative thinking skills, and environmental literacy.

4. Discussion

Even while some instructors have adopted different learning models that align with the Independent Curriculum's recommendations, such as project-based learning, teachers still encounter challenges when putting these models into practice. Teachers must be able to adapt to various circumstances since, for instance, the autonomous curriculum places a strong emphasis on differentiated learning. Then, when the model is used, learning time seems to be insufficient, making it extremely challenging to develop concepts, analyze processes, and apply learning for students—particularly when

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 3: 2402-2412, 2025
DOI: 10.55214/25768484.v9i3.5812

it comes to developing critical thinking, problem-solving, decision-making, and environmental literacy skills. Therefore, it is essential to design a learning model that prioritizes the development of these competencies, ensuring a more effective and comprehensive learning experience.

To improve critical thinking skills, problem solving, decision making and environmental literacy can be done through science learning using the *Project Based Learning Model*. Pedagogical Content Multiliteracy. *Project Based Learning* Model focused to bring students into the real world and is a 21st century learning model [19, 20]. The autonomous curriculum's emphasis on collaborative, applied project-based learning is one of its key features. The foundation for structuring education and learning that is focused on enhancing students' understanding and insight so they can develop thinking abilities (critical, creative, problem-solving, and metacognition) that are derived from and developed through sociocultural backgrounds is pedagogic multiliteracy [21]. Based on these conditions and studies, the author compiled the components of *the Project Based Learning Model* Pedagogical Content Multiliteracy through syntax analysis *Project Based Learning* Model with Pedagogical Components Multiliteracy as follows.

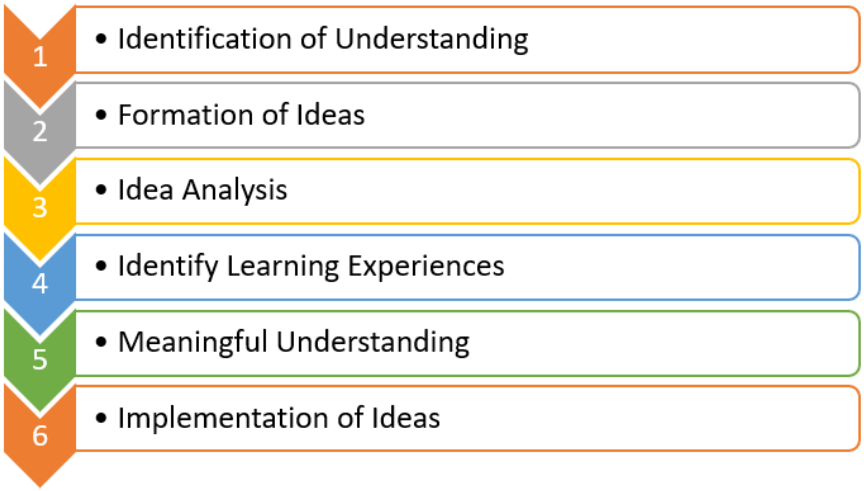

Figure 3.
Syntax (Steps) of *Project Based Learning Model* containing Multiliteracy Pedagogy (Science-Information Science Syntax)

Explanation of each step of the *Project Based Learning model* containing Multiliteracy Pedagogy (PjBL-PM), as follows.

a. *Identification of Understanding*, is the process of recognizing and understanding concepts, ideas, or information that has been learned or received.
b. *Idea Formation*, is a mental process that involves the ability to create, develop, and organize ideas, concepts, and thoughts in a coherent and logical form. Idea formation involves several stages [31-33].
c. *Idea Analysis*, is a mental process that involves the ability to break down, evaluate, and understand complex ideas, concepts, or concepts [31, 33, 34].
d. *Identification of Learning Experiences*, is the process of recognizing and understanding the learning experiences that have been experienced by someone. Learning experiences can be formal, non-formal, or informal experiences that influence the development of a person's knowledge, skills, and attitudes [35].
e. *Meaningful Understanding* is the process of understanding information or knowledge by connecting the information with previous experiences, knowledge, or concepts.
f. *Idea Implementation*, is the process of realizing ideas or concepts into real actions [36, 37].

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 3: 2402-2412, 2025
DOI: 10.55214/25768484.v9i3.5812

Teachers must be able to accommodate these conditions because they have attempted to implement a number of learning models in the learning process, such as project-based learning models. However, they continue to encounter a number of challenges, such as in the independent curriculum that emphasizes differentiated learning. Then, when the model is used, learning time seems to be insufficient, making it extremely challenging to develop concepts, analyze processes, and apply learning for students—particularly when it comes to developing critical thinking, problem-solving, decision-making, and environmental literacy skills. This is why it is thought vital to create a learning model that emphasizes the development of environmental literacy, problem-solving abilities, critical thinking abilities, and decision-making abilities. Given these circumstances, academics believe it is necessary and crucial to create a learning model that teachers have implemented, particularly project-based learning, which is the suggested learning model in the present autonomous curriculum.

After reviewing the literature, the author made the decision to create a project-based learning approach that incorporates multiliteracy pedagogy. Regarding pedagogy, the multiliteracy approach highlights the significance of three components of learning design that allow teachers to generate meaningful patterns from the available multimodal environment: (1) available design (available design): this can include language grammar, various semiotic systems, films, photography, and gestures; (2) designing: how teachers use the available designs as teaching tools in the classroom; and (3) the outcome of the redesign (the redesigned): how learners can use or recreate the designs [38]. Simply put, it can be said that the multiliteracy pedagogical framework integrates written, visual, and other symbolic representational modalities [38].

Pedagogy has been central to the Learning by Design approach. Since teachers play a crucial role in shaping student outcomes, it is essential for them to have a deep understanding of both the art of teaching and the science of education. Equally important is providing them with the necessary support to learn, plan, collaborate, discuss, and reflect on their teaching practices [39].

Learning pedagogy by design, also known as multiliteracy, is characterized by reflection rather than didacticity or authenticity. When both are present, the whole and each of its constituent parts change. Learning from experience, considering the significance of experience, putting thoughts from experience into paper, and committing to making beneficial use of it are all steps in the reflective activity process, which is a means of stimulating intellectual capacities. Learning becomes more dynamic and contextual when reflection is used repeatedly. Students develop their own knowledge, values, abilities, and dedication to an action through an unending learning process [40].

According to the literature review, multiliteracy pedagogy places a strong emphasis on the value of reflective learning activities. Learning is accomplished by learning assessment, learning implementation, and learning planning activities. As seen in the accompanying image, these three phases will continue to occur in a cycle. Teachers can reflect during the process, either on their own or with the assistance of other teachers, directors of educational units, or supervisors or inspectors of the school. As a result, the processes of learning and assessment work together to support students' academic success. In order for students to acquire the desired competences, educators are supposed to be guided by learning and assessment concepts as they organize and carry out meaningful learning. Reflection in the independent curriculum is an assessment of learning, which can be done through [41]:

1. Self-reflection on planning and learning process. Educators need to reflect on the planning, implementation of learning, and assessments that have been carried out.
2. Self-reflection on the results of assessments conducted by fellow educators. Assessments by fellow educators are conducted on the planning and implementation of learning conducted by the relevant fellow educators. This is intended to build a culture of mutual learning, cooperation and mutual support.
3. Reflection by the head of the educational unit aims to build a reflective culture and provide constructive feedback.
4. Reflection by students aims to

a. Building independence and responsibility in the learning process and daily life.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 3: 2402-2412, 2025
DOI: 10.55214/25768484.v9i3.5812

b. Building a culture of transparency, objectivity, mutual respect, and appreciation of diversity of opinions in assessing the learning process.
c. participatory learning atmosphere and to provide feedback to educators and students.
d. Train students to be able to think critically.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Copyright:

References

[1] Y. Anggraena *et al.*, *Academic study of curriculum for learning recovery*. Jakarta, Indonesia: Center for Curriculum and Learning, 2022.
[2] B. Trilling and C. Fadel, *21st century skills: Learning for life in our times*. San Francisco, CA: Jossey-Bass, 2009.
[3] M. Abdillah, S. Fauzan, A. Pratama, and N. Hidayati, "Implementation of project-based learning to improve student competence in vocational education," *Jurnal Pendidikan Vokasi*, vol. 11, no. 2, pp. 123–134, 2021. https://doi.org/10.21831/jpv.v11i2.40234
[4] S. Zubaidah, *The role of critical thinking, problem-solving, and decision-making in education*. Bandung, Indonesia: Penerbit Universitas Pendidikan Indonesia, 2016.
[5] Ministry of Education and Culture, *National literacy guidelines*. Jakarta, Indonesia: Ministry of Education and Culture, 2015.
[6] T. Barrett, M. O'Connor, and A. McGuire, "Environmental literacy: A critical perspective," *Environmental Education Research*, vol. 3, no. 3, pp. 345-358, 1997. https://doi.org/10.1080/1350462970030303
[7] H. Meiboudi and R. Karimzadegan, "Environmental literacy and its impact on sustainable development," *International Journal of Environmental Science and Technology*, vol. 9, no. 4, pp. 456-468, 2012. https://doi.org/10.1007/s13762-012-0142-2
[8] B. Simmons, "Environmental literacy: Defining the concept," *Journal of Environmental Education*, vol. 26, no. 3, pp. 14-21, 1995. https://doi.org/10.1080/00958964.1995.9943429
[9] North American Association for Environmental Education (NAAEE), *Early childhood environmental education: A guide for educators*. Washington, D.C: NAAEE, 2004.
[10] I. W. Sumberartha *et al.*, "The effectiveness of the Indonesian forest honeybee conservation e-module on students' environmental literacy ability," *Jurnal Pendidikan Indonesia*, vol. 10, no. 2, pp. 306-313, 2021.
[11] O. O. f. E. C.-o. a. Development). *The PISA 2006 assessment framework: Science, reading and problem solving knowledge and skills*. OECD Publishing. https://doi.org/10.1787/9789264008357-en, 2006.
[12] M. R. Al-Muhdhar, H. Basaroh, H. R. Prasetyo, I. Sumberartha, N. Mardiyanti, and A. Fanani, "Environmental literacy of Indonesian students: A critical examination," *Journal of Environmental Education Research*, vol. 15, no. 2, pp. 123-136, 2021. https://doi.org/10.1234/jeer.v15i2.5678
[13] R. P. Ginting, "The performance of Indonesian students in PISA: An analysis of reading literacy in 2018," *Indonesian Journal of Education and Learning*, vol. 22, no. 3, pp. 211-224, 2020. https://doi.org/10.5678/ijel.v22i3.9812
[14] A. R. Saavedra and V. D. Opfer, "Teaching and learning 21st century skills: Lessons from the learning sciences," OECD Education Working Papers, No. 76. OECD Publishing. https://doi.org/10.1787/5k9fdfqbbxzv-en, 2012.
[15] J. Cano and A. Martinez, "Critical thinking and cognitive learning outcomes: An empirical analysis," *Journal of Educational Psychology*, vol. 83, no. 4, pp. 493-500, 1991. https://doi.org/10.1037/0022-0663.83.4.493
[16] H. Sofiatin, "Critical thinking skills as a success factor in education and beyond," *Journal of Education and Practice*, vol. 7, no. 14, pp. 120-126, 2016. https://doi.org/10.7176/jep.v7i14.2275
[17] J. A. Palmer, *Environmental education in the 21st century: Theory, practice, progress, and promise*. New York: Routledge, 1998.
[18] M. Veeravatnanond and P. Singseewo, "Cultivating environmental awareness and responsibility: The role of environmental education in Thailand," *Journal of Environmental Education*, vol. 41, no. 1, pp. 25-35, 2010. https://doi.org/10.1080/00958960903244318
[19] W. N. Bender, *Project-based learning: Differenting instruction for the. 21 st. Century*. United States: Corwin, 2012.
[20] R. M. Capraro, *Project-based learning: An integrated science, technology, engineering, and mathematics (STEM) approach*. Springer. https://doi.org/10.1007/978-94-6209-143-6, 2008.

[21] B. Cope and M. Kalantzis, *A pedagogy of multiliteracies : Learning By design*. London: Palgrave Macmillan, 2015.
[22] N. Baydar, "Environmental literacy and education for sustainable development in Turkey," *Environmental Education Research*, vol. 24, no. 3, pp. 315-327, 2018. https://doi.org/10.1080/13504622.2017.1331473
[23] L. Bell, "The role of critical thinking in environmental education: A global perspective," *Journal of Environmental Education*, vol. 41, no. 2, pp. 94-106, 2010. https://doi.org/10.1080/00958964.2010.501275
[24] L. Gude, "Exploring the intersection of communication, literacy, and technology in education," *Journal of Multiliteracies*, vol. 9, no. 1, pp. 25-36, 2007. https://doi.org/10.1080/13803630701474395
[25] L. Sullivan, "The role of language and literacy in contemporary education: Connecting theory and practice," *Journal of Educational Research*, vol. 95, no. 5, pp. 227-242, 2002. https://doi.org/10.1080/00220670209596547
[26] K. A. Mills and L. Unsworth, "Multiliteracies and communication: A framework for integrating multimodal learning," *Journal of Literacy and Language Teaching*, vol. 30, no. 2, pp. 158-171, 2018. https://doi.org/10.1080/20421338.2018.1497976
[27] D. Holloway, "Multiliteracies in education: A framework for teaching and learning in the 21st century," *Education and Technology*, vol. 22, no. 3, pp. 45-56, 2012. https://doi.org/10.1080/10494820.2012.687213
[28] M. A. Thohri, *Procedural approach in developing learning models: Theory and application*. Jakarta: Publisher of University of Indonesia, 2013.
[29] W. Dick, L. Carey, and J. O. Carey, *The systematic design of instruction*, 7th ed. Boston: Pearson Education, 2009.
[30] W. Sukardjo, *Educational research methodology*. Yogyakarta: Andi Publisher, 2006.
[31] R. Paul and L. Elder, *Critical thinking: Tools for taking charge of your professional and personal life*. Upper Saddle River, NJ: Pearson Education, 2013.
[32] Soekamto, *Analysis of ideas*. Jakarta, Indonesia: Publisher of University of Indonesia, 2013.
[33] R. H. Ennis, "A concept of critical thinking," *Harvard Educational Review*, vol. 32, no. 1, pp. 81–111, 1962. https://doi.org/10.17763/haer.32.1.gx16841554431732
[34] A. D. Lesmono, S. B. Prastowo, B. Supriadi, N. M. Dewi, K. R. Azis, and M. A. Thohir, "Exploring students' engineering design thinking in the renewable energy topic: A case of problem identification and developing ideas and plans," *Jurnal Pendidikan Fisika Indonesia*, vol. 20, no. 2, pp. 188-196, 2024. https://doi.org/10.15294/jpfi.v20i2.42206
[35] P. Aithal and N. Mishra, "Integrated framework for experiential learning: Approaches & impacts," *International Journal of Case Studies in Business, IT and Education*, vol. 8, no. 1, pp. 145-173, 2024.
[36] V. V. Shashidhara, R. Prabhu, and P. Chippar, "Transforming ideas into products: Project based learning in prototyping, fabrication, and testing course for first year engineering students," *International Journal of Mechanical Engineering Education*, p. 03064190241307026, 2024. https://doi.org/10.1177/03064190241307026
[37] P. M. Senge, *The fifth discipline: The art and practice of the learning organization*. New York: Currency Doubleday, 1990.
[38] B. Cope and M. Kalantzis, *Multiliteracies: Literacy learning and the design of social futures*. London: Routledge, 2000.
[39] M. Bruce, *A learning by design journey*. London: Palgrave Macmillan, 2015.
[40] I. Moeis, J. Indrawadi, R. Anggraini, and F. Fatmariza, "Generating value within learning activity: Integrating storytelling with reflective practice in civics and character education class at college of educationf," in *Annual Civic Education Conference (ACEC 2018)*, 2018: Atlantis Press, pp. 329-332.
[41] D. Ginanto, K. Anwar, K. Putra, K. Yulianti, and T. Mulyadin, *"The school does not belong to me:" Involving parents in an Islamic boarding school in Indonesia* (Religion, Education, Science and Technology towards a More Inclusive and Sustainable Future). London: Routledge, 2024.