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Application of the Project Based Learning (PjBL) Learning Model to the Skills of Making Vertical Gardens for Class 4 Students at SDN Durungbedug

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Abstract

Skills are an important skill for someone to have to face problems, especially in the 21st century era. Sharpening skills needs to be done from an early age and can be done through various efforts. The aim of this research is to determine the extent to which the implementation of the Project Based Learning (PjBL) learning model has improved the skills of grade 4 students at SDN Durungbedug in making vertical gardens. The method used in this research is Classroom Action Research (PTK) with a quantitative approach. The data collection techniques used were tests and observations with data analysis in the form of quantitative descriptive analysis. The subjects in this research were 4th grade students at SDN Durungbedug. The results of the research showed that 6 students got grades with sufficient criteria and 9 students got grades with good criteria in cycle 1, while in cycle 2 it was found that 3 students got grades with good criteria and 12 students got grades with very good criteria. From these results it can be concluded that the application of the Project Based Learning (PjBL) learning model with a project in the form of creating a vertical garden and recycled pots as a planting medium can improve students' skills.

Keywords: Project Based Learning Model, Skills, Vertical Garden

1. Introduction

Each individual possesses different skills and levels of ability. Skills are the competencies someone has in expressing ideas or thoughts through creativity. According to Erlangga (2017), skills can be defined as intelligence, proficiency, or an individual's ability to complete a task or solve a problem. Meanwhile, Miranti et al. (2022) argue that skills emerge through experience and repeated learning, which cannot be easily obtained, thus students can improve their skills through stages and experiences that prepare them to face future challenges. In the 21st century, skills are crucial for individuals to cope with competition. With the right skills, individuals are expected to find not just one solution but multiple solutions to problems (Zubaidah, 2017). Skills become a competence that can help someone find the right solution to a problem and can be developed through repeated learning.

Skills must be honed early on as an effort to realize human resources capable of meeting demands and challenges. This aligns with the meaning of 21st-century learning, which aims to create a generation ready to face the challenges and demands of the rapidly advancing technological and informational era (Mardhiyah, Hanifa et al., 2021). Elementary school is an appropriate level to start honing a child's skills, as skill development cannot be achieved with just one or two attempts. Skill improvement is more effective when done repeatedly. The skills needed to face 21st-century challenges are known as the 4Cs: creativity, collaboration, communication, and critical thinking (Sukmawati et al., 2024).

The enhancement of student skills can be achieved through various methods and efforts. This is in line with Zubaidah's (2017) opinion that, in order to produce a generation ready to face challenges, schools are expected to innovate in improving skills through various learning models and approaches that allow students to collaborate and innovate in solving problems. Learning models can serve as a guide for educators in planning learning activities that are suitable for students, as well as designing educational tools. According to Khoerunnisa & Aqwal (2020), a learning model is a

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pattern developed based on various principles and theories by experts, which can be used as a guide in creating effective and efficient learning activities to achieve the expected learning objectives. Mirdad (2020) also states that the choice of learning model must be adjusted to the classroom and students' conditions so that the learning tools designed based on that model can be implemented effectively to achieve the learning goals.

There are many types of models, methods, and approaches in learning, allowing educators to combine them to achieve the desired learning outcomes. However, educators are often hindered by environmental conditions, such as in the area where the author conducted research, at SDN Durungbedug. After observing, the author identified one of the obstacles faced by educators: the limited space of the school. Therefore, to optimize the green space, plant arrangement is carried out in parts of the yard and in front of the classrooms. SDN Durungbedug has an inorganic waste workshop program, but the utilization of waste has not been optimal. After further observation, particularly in the 4th-grade class, it was found that students in this class did not understand the function of the waste workshop program at school and had never utilized inorganic waste.

The appropriate learning model to optimize the inorganic waste program at SDN Durungbedug into a product is the Project-Based Learning (PjBL) model. In line with Hamidah & Citra's (2021) view, the Project-Based Learning (PjBL) model is a learning model focused on students, with the teacher acting as a facilitator, allowing students to take an active role in a project and hone their skills through the creation of a product. Similarly, Syarifah et al. (2021) argue that the Project-Based Learning (PjBL) model is student-centered and can be chosen by educators to address problems in project-based learning, which requires the creation of a product as the learning outcome. The Project-Based Learning (PjBL) model becomes a student-centered learning approach because students have the opportunity to construct their projects, leading to the creation of a product and honing their skills (Surya et al., 2018).

Improving student skills and fostering a love for the environment through the Project-Based Learning (PjBL) model can be achieved through the project of creating a vertical garden using inorganic waste. Vertical gardens are a new innovation that emerged due to the lack of land for planting, where plants are grown on a vertical surface without relying on soil as a planting medium (Tolangara & Ningrum, 2018). Vertical gardens are implemented to optimize limited space as a place for plant empowerment, so the planting will be done in containers like pots, and the plant arrangement will be vertical (Rahmansyah et al., 2023). Creating a vertical garden not only aims to enhance students' skills but also serves as an effort to implement the P5 (Pancasila Student Profile Strengthening Project) activity in the Merdeka Curriculum. P5 is an activity aimed at improving students' abilities in Pancasila through project-based activities that align with the Pancasila student profile indicators, which include noble character, independence, critical reasoning, collaboration, creativity, and global diversity (Yuntawati & Suastra, 2023).

Several previous studies have discussed optimizing green space through the creation of vertical gardens, making this research relevant. A study by Febrianti et al. (2021) titled "Assistance in Creating Vertical Gardens as an Effort to Improve the Green Building Concept in SD IT Meulabo" explains that creating a vertical garden using a steel frame helps improve environmental quality and reduce air pollution by optimizing open green spaces while enhancing students' and teachers' knowledge and skills at SD IT Meulabo. Widiastuti & Fauziyah (2024) also conducted research titled "Design of Hanging Gardens (Vertical Gardens) as a Solution for Environmental Greening at TK Tarbiyatul Athfal 53 in Mijen, Semarang" which explored creating vertical gardens using plastic bottles and PVC pipes as planting containers. This activity aimed to create an educational, aesthetic, and sustainable green open space while raising awareness and environmental concern among students at TK Tarbiyatul Athfal 53. Furthermore, a recent study by Hildegardis et al. (2024) titled "Creating Vertical Gardens from Used Bottles for the Implementation of P5 at SDK Maumere 2, Sikka Regency" focused on educating teachers and students about creating vertical gardens from plastic bottles as planting containers and supporting the P5 program, which emphasizes environmental preservation and student creativity.

These previous studies highlight that the creation of vertical gardens aims to increase environmental awareness and reduce air pollution in the globalized era by optimizing open green spaces. This research offers novelty compared to previous studies, as it focuses on applying the Project-Based Learning (PjBL) model to create vertical gardens using inorganic waste plastic bottles as planting media. This research aims to determine how the Project-Based Learning (PjBL) model can enhance the skills of 4th-grade students at SDN Durungbedug in creating vertical gardens. It also aims to optimize the use of the waste workshop at SDN Durungbedug into valuable items such as pots. Additionally, this study is expected to contribute to reducing air pollution and enhancing students' love for the environment.

2. Literature Review

2.1 Project-Based Learning (PjBL) Model

The Project-Based Learning (PjBL) model is a learning approach that focuses on project completion as the core of the learning process. Through PjBL, students actively explore, design, and develop solutions to real-world problems or challenges, making the learning process more meaningful. In line with Hamidah & Citra (2021), the Project-Based Learning (PjBL) model is student-centered, with the teacher acting as a facilitator, allowing students to actively participate in a project and enhance their skills through the creation of a product. Similarly, Syarifah et al. (2021) argue that the Project-Based Learning (PjBL) model is student-centered and can be chosen by educators to address issues in project-based learning, which requires the creation of a product as the learning outcome. The Project-Based Learning (PjBL) model is a student-centered approach because it provides students with the opportunity to construct their projects, leading to the creation of a product, thus honing their skills (Surya et al., 2018).

2.2 Skills

Skills refer to an individual's ability to perform a task or job well and accurately through practice, experience, or education. Skills encompass technical mastery, cognitive abilities, and social competencies that enable a person to achieve goals or solve problems effectively. According to Erlangga (2017), skills can be defined as intelligence, proficiency, or the ability of an individual to complete a task or solve a problem. Miranti et al. (2022) argue that skills emerge through experience and repeated learning, which cannot be easily acquired. Therefore, students can improve their skills through stages and experiences that prepare them for future challenges. In the 21st century, skills are essential for individuals to face competition. With the right skills, individuals are expected to find not just one solution but multiple solutions to problems (Zubaidah, 2017). Skills become competencies that help someone find the right solutions to problems and can be developed through repeated learning.

2.3 Vertical Gardens

A vertical garden is a method of gardening where plants are arranged vertically on walls or other upright structures. Vertical gardens are an innovative solution to the lack of planting space, as plants are grown on vertical surfaces without relying on soil as the planting medium (Tolangara & Ningrum, 2018). The vertical garden (also known as a “vertical garden”) is implemented to optimize limited space for plant empowerment. In this method, plants are grown in containers such as pots, and the plant arrangement is done vertically (Rahmansyah et al., 2023).

3. Methods

This research uses Classroom Action Research (CAR) with a design based on the Kemmis and Mc. Taggart model. This is because the study aims to investigate whether the implementation of the Project-Based Learning (PjBL) model can be a solution to enhance students' skills, specifically in the project of creating a vertical garden. Classroom Action Research (CAR) is an iterative study conducted through systematically planned actions, which will be implemented directly in the classroom. This allows the researcher to observe and reflect on these actions in order to improve the quality of the learning process and outcomes in the classroom (Utomo et al., 2024). CAR follows a cyclical research process, consisting of four stages: planning, implementation, observation, and reflection (Aida & Arwin, 2023). In the Kemmis and Mc. Taggart model, the four components of CAR—planning, implementation (action), observation, and reflection—are viewed as a continuous cycle or loop (Ilham, 2021).

The research location is in Durungbedug Village, Candi District, Sidoarjo Regency, specifically at SDN Durungbedug. The subjects of the research are the 4th-grade students of SDN Durungbedug, consisting of 15 students. These students will serve as both the subjects and the main researchers, as well as the participants in the actions. The study will take place in October 2024. The data used in this research are quantitative, with data collection techniques including tests and observations. The data analysis used in this research is descriptive quantitative analysis. This study includes two cycles, namely Cycle 1 and Cycle 2, which are in accordance with the design of the Kemmis and Mc. Taggart CAR model, as illustrated in Figure 1.

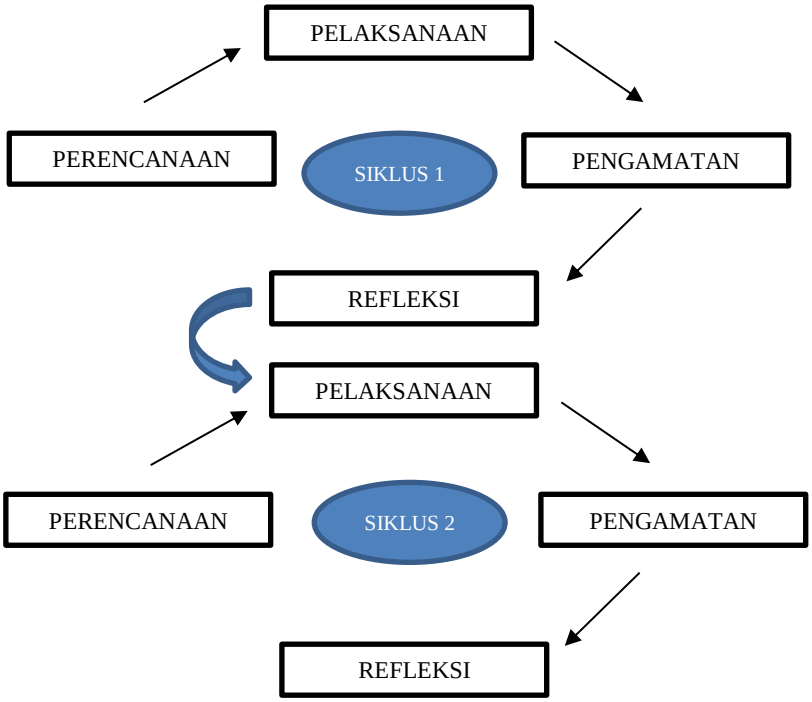

Figure 1. Kemmis & Mc. Taggart Model Design (in Indonesia)

4. Results and Discussion

4.1. Results

The researcher conducted observations at SDN Durungbedug on October 14, 2024. From the observations, the researcher discovered that SDN Durungbedug has a good program, namely the inorganic waste workshop program; however, the inorganic waste has not been fully utilized. The most accumulated inorganic waste is plastic cups. From the researcher's observations, these plastic cups were predominantly used iced tea cups. The findings from this initial observation led the researcher to the idea of creating a vertical garden using plastic cups as the planting medium or containers. This idea is supported by the condition of the school's limited open land, which can optimize the use of available space. The project will be implemented through the Project-Based Learning (PjBL) model. The study will use two cycles, with pre-tests and post-tests administered to the 4th-grade students to measure whether the application of the Project-Based Learning (PjBL) model can improve students' skills in creating vertical gardens.

a. Cycle 1

In Cycle 1, the researcher planned the learning activities for the 4th-grade students without using the Project-Based Learning (PjBL) model, only utilizing a lecture and question-and-answer approach. The researcher also designed a test to be given to the students to measure their understanding and skills before they were taught using the Project-Based Learning (PjBL) model. The action was carried out on October 21, with the lesson conducted using the lecture and question-and-answer approach. At the end of the lesson, students were given a test sheet. During this action phase, the researcher also observed the students, both during the lesson and during their break time.

The test administered before teaching using the Project-Based Learning (PjBL) model aimed to assess students' knowledge and skills in several areas, including knowledge about plants, knowledge about recycling, and skills in designing and constructing vertical gardens. The assessment for this initial test will be based on a scoring rubric as shown in Table 1.

Table 1. Rubric for Cycle 1 Test Assessment

Aspect	Very Good (4)	Good (3)	Fair (2)	Poor (1)
Knowledge about plants	Can name 4 basic plant needs (water, sunlight, soil, and fertilizer) and how to care for plants. Can name 3 or more types of plants suitable for pot planting.	Can name 2-3 basic plant needs and how to care for plants. Can name 3 or more types of plants.	Can name 1 basic plant need and how to care for plants. Can name 1-2 types of plants.	Cannot name plant needs or how to care for plants. Cannot name plant types.
Knowledge about recycling	Understands the concept of recycling and the importance of protecting the environment. Can name 5 or more examples of recyclable items.	Has a limited understanding of recycling, but understands the importance of protecting the environment. Can name 3-4 examples of recyclable items.	Has little understanding of recycling and environmental protection. Can name 1-2 recyclable items.	Does not understand recycling or the importance of protecting the environment. Cannot name recyclable items.
Skills in designing and constructing a vertical garden	Can create an aesthetically and functionally pleasing vertical garden design, considering color and layout. Can design appropriate drainage holes and choose suitable hangers and paint types.	Can create an aesthetically pleasing vertical garden design. Can design appropriate drainage holes and determine strong hangers for pots.	Can create an aesthetically pleasing vertical garden design. Can choose a suitable hanger for pots.	Cannot create a vertical garden design. Cannot design a proper pot structure.

The maximum score a student can achieve is 12. The score obtained will be converted into a grade using the following formula:

$$Grade = \frac{(score\ obtained)}{(maximum\ score)} \times 100$$

The grades students receive will be categorized into criteria as shown in Table 2.

Table 2. Assessment Criteria

Score	Criteria
81 - 100	Very Good
61 - 80	Good
41 - 60	Satisfactory
21 - 40	Poor
1 - 20	Very Poor

The test results conducted on 15 students from the 4th grade at SDN Durungbedug are presented in Table 3.

Table 3. Cycle 1 Test Results

Student	Aspect		Total Score	Criteria
	Knowledge about Plants	Knowledge about Recycling	Skills in Designing and Constructing Vertical Gardens	
S1	2	3	2	7
S2	3	3	3	9
S3	2	3	2	7
S4	3	3	2	8
S5	3	3	2	8

Student	Aspect	Total Score		Criteria
	Knowledge about Plants	Knowledge about Recycling	Skills in Designing and Constructing Vertical Gardens	
S6	3	3	3	9
S7	3	3	2	8
S8	3	2	3	8
S9	2	2	2	6
S10	2	3	2	7
S11	3	3	3	9
S12	3	3	2	8
S13	3	3	3	9
S14	3	2	2	7
S15	3	2	2	7

b. Cycle 2

In Cycle 2, the researcher designed the lesson using the Project-Based Learning (PjBL) model with the final product being a vertical garden with recycled pot planting media. The action in Cycle 2 was carried out on October 25. The lesson used the Project-Based Learning (PjBL) model. The lesson began with an introduction to the concept of vertical gardens and recycling, followed by the creation of recycled pots from plastic cups collected from the school's waste workshop, then planting and arranging the pots. The lesson ended with the administration of a test. During the action, the researcher also observed students' activities from the introduction to the creation of the vertical garden. The test in Cycle 2 had slightly different aspects from the test in Cycle 1. Table 4 shows the assessment rubric for the Cycle 2 test, including the aspects to be assessed and their corresponding criteria.

Table 4. Cycle 2 Test Assessment Rubric

Aspect	Very Good (4)	Good (3)	Satisfactory (2)	Poor (1)
Knowledge about Plants and Vertical Gardens	Can explain the concept, benefits, and steps to create a vertical garden accurately. Can explain how to care for plants properly and name 3 or more types of plants suitable for vertical gardens.	Can explain the concept and benefits of vertical gardens accurately. Can explain how to care for plants properly and name 1-2 types of plants suitable for vertical gardens.	Can explain the concept of vertical gardens accurately. Can name 1-2 types of plants suitable for vertical gardens.	Cannot explain the concept of vertical gardens. Cannot name suitable plants for vertical gardens.
Understanding of Recycling	Can explain the concept of recycling and its environmental impact well. Can name all the tools and materials required to make recycled pots for vertical gardens.	Can explain the concept of recycling and its environmental impact. Can name some tools and materials for making recycled pots for vertical gardens.	Can explain the concept of recycling. Can name 1-2 tools or materials for making recycled pots for vertical gardens.	Cannot explain the concept of recycling. Cannot name tools or materials for making recycled pots for vertical gardens.
Skills in Creating Vertical Gardens	Can create aesthetically and functionally pleasing recycled pots, strong pots with secure hangers, functional drainage holes, and healthy growing plants.	Can create functional recycled pots, strong pots with secure hangers and some functional drainage holes, with healthy growing plants.	Struggles to make sturdy recycled pots with strong hangers and functional drainage holes; plants are wilting.	Cannot create recycled pots for vertical gardens.

The scores obtained in Cycle 2 will be converted into grades and categorized according to the criteria used in Cycle 1. The criteria categorization is based on Table 2. The post-test results in Cycle 2 are shown in Table 5.

Table 5. Post-Test Results Cycle 2

Student	Aspect	Total Score		Criteria
	Knowledge about Plants	Understanding of Recycling	Skills in Designing and Constructing Vertical Gardens	
S1	3	3	3	9
S2	4	4	4	12
S3	3	4	4	11
S4	3	3	4	10
S5	4	3	3	10
S6	4	4	4	12
S7	4	3	4	10
S8	3	4	4	11
S9	3	3	3	9
S10	3	3	4	10
S11	4	3	4	11
S12	3	3	4	10
S13	3	4	4	11
S14	3	3	4	10
S15	3	3	3	9

c. Comparison Between Cycle 1 and Cycle 2

The comparison of scores between Cycle 1 and Cycle 2 is more clearly illustrated in Table 6.

Table 6. Comparison of Cycle 1 and 2 Scores

Score Criteria	Number of Students in Cycle 1	Number of Students in Cycle 2
Very Good	0	12
Good	9	3
Satisfactory	6	0
Poor	0	0
Very Poor	0	0

From Table 6, it is evident that there was an improvement in students' scores from the Cycle 1 test to the Cycle 2 test after implementing the Project-Based Learning (PjBL) model with the vertical garden and recycled pot project. In Cycle 1, there were still students who scored within the "Satisfactory" range, and no students received a "Very Good" rating. However, in Cycle 2, there was an improvement with the PjBL model, where learning became student-centered and focused on solving real-life problems through imagination, planning, and fiction-based approaches (Nurhadiyati et al., 2021). The knowledge of 4th-grade students about plants, recycling, and their skills in design, construction, and creative thinking showed significant improvement in Cycle 2. This was evidenced by the absence of students who received a "Satisfactory" score, and 12 students received a "Very Good" rating.

4.2. Discussion

From the Cycle 1 test results in Table 3, it can be seen that 6 students scored within the "Satisfactory" criteria and 9 students scored within the "Good" criteria. From the researcher's observations of the 4th-grade students' habits, it was

found that 8 students frequently discarded trash carelessly. In the classroom, there were also food wrappers and torn paper scattered on the floor. The 4th-grade students cleaned the classroom when school was over. It was observed that the students were not very attentive to the litter in the classroom because they did not immediately dispose of it but instead waited until school ended. The test results and observations from Cycle 1 did not meet the researcher's expectations, which led to the addition of Cycle 2.

From the Cycle 2 test results, it was found that 3 students scored within the "Good" criteria and 12 students scored within the "Very Good" criteria. During the action phase of Cycle 2, the researcher observed that students discussed how to divide the colors for the pots for the vertical garden project. The students also worked together to solve problems when there were shortages of tools or materials. For instance, when creating drainage holes, students used heated nails to make the holes since there was no soldering iron available. When making the hangers, the students tried several types of string before settling on a small but strong rope that could hold the weight of the pots. During the planting process, it was discovered that there were not enough plants, so the researcher and students discussed solutions and agreed to propagate the plants available at the school. In addition to observing the actions, the researcher also looked at the students' habits and found that they had started to dispose of trash properly. The students consistently watered their plants, showing that they were taking responsibility for their care.

The implementation of the Project-Based Learning (PjBL) model helped enhance students' creative and critical thinking skills, as students learned to solve problems by generating unique and creative ideas or alternatives (Sari et al., 2019). As observed in Cycle 2, the 4th-grade students successfully solved problems that arose due to the limited tools and materials available, such as when creating drainage holes, determining strong hangers, and finding additional plants. The discussions and idea-sharing demonstrated effective cooperation among the students. Not only did the students' knowledge and skills improve, but their awareness of environmental protection also increased. This was evident from Cycle 1, where students still discarded trash carelessly, while in Cycle 2, students began to make it a habit to dispose of their trash properly and started contributing to maintaining the environment. Additionally, in Cycle 2, it was clear that students took responsibility for their plants, ensuring they grew healthy.

5. Conclusion

Based on the discussion provided, this study shows that the Cycle 1 test results for the 4th-grade students indicated that 6 students scored within the "Satisfactory" criteria and 9 students scored within the "Good" criteria after learning that was teacher-centered. It was also found that the students' environmental awareness was still lacking, as evidenced by observations of some students still discarding trash carelessly. After applying the Project-Based Learning (PjBL) model in Cycle 2, the test results showed that 3 students scored within the "Good" criteria and 12 students scored within the "Very Good" criteria. Observations from Cycle 2 revealed that students' creative and critical thinking skills were sharpened as they solved problems that arose during the vertical garden project. Their environmental awareness also increased, as seen by their habit of disposing of trash properly. Furthermore, their sense of responsibility grew, as they consistently took care of their plants to ensure they remained healthy.

From the results of Cycle 1 and Cycle 2, it can be concluded that the implementation of the Project-Based Learning (PjBL) model with the vertical garden and recycled pot project has improved the skills of the 4th-grade students at SDN Durungbedug in creating vertical gardens, including design skills, construction skills, and creative and critical thinking in solving problems. In addition to skills, students' knowledge also improved, as seen in the test results, because the test assessed not only skills but also knowledge about vertical gardens and recycling. The vertical garden project also succeeded in fostering students' love for the environment.

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