



Project-Based Learning: Butterfly Diversity Survey in Sekolah Alam Indonesia

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Abstract. Project-based learning (PjBL) is a form of student-centered teaching that works well in science learning activities with specific characteristics. Sekolah Alam Indonesia Mampang chose the theme of E.M.P.A.N.G restoration by observing butterfly diversity as the main project in its curriculum to provide learning experiences for learners that are more contextual and meaningful in implementing PjBL activities at this nature school. PjBL activities were carried out for three months from January to March 2023 at SAI Mampang. There were 44 students who participated in the PjBL activities at grade 8 Junior High School, which were divided into five different groups. Each group was accompanied by a facilitator from research planning to follow-up data collection efforts. Data collection of butterfly species in PjBL activities uses the exploration method by walking slowly. The most species of butterflies found were in February as many as 23 species. The types of butterflies in SAI Mampang that are dominantly found have dark patterns and colors so that they are not easily seen by predators and adapt well to grass or shrub habitats and flower gardens. Learners create follow-up activities such as butterfly photo exhibition, talk show, and drama performance.

Keywords: Project-based Learning, Biodiversity, Butterflies, Sekolah Alam Indonesia, Student-centered Learning.

1 Introduction

Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation and state [1]. One of the factors that can influence the success of education is the readiness of teachers to prepare students through the learning process [2]. Teachers can use learning models that are appropriate to the subject matter. An innovative learning model that provides opportunities for students to express ideas

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and ideas in one work so as to develop creativity and improve student learning outcomes is project-based learning [3].

Project-based learning (PjBL) is a good form of student-centered teaching in science learning activities with specific characteristics [4, 5, 6, 7], that can be used by focusing on coherence, depth, and motivation [8]. PjBL learning in which students are actively involved in real projects or constructive research that demands to apply learning objectives, work together, communicate, and share knowledge and understanding to achieve meaningful results [9]. In addition, the PjBL learning model can also develop and explore the hidden potential of students [10].

Project-based learning offers opportunities for collaboration, extensive feedback and student-driven experiences both independently and collaboratively with peers while collecting, analyzing data and building problem solutions into action [11, 12, 13]. The implementation of project-based concept development can improve the understanding of relationships and experiential reasoning of learners in schools [9] and can help students understand scientific knowledge [5].

Activities regarding PjBL have been carried out from the kindergarten and elementary school levels at SAI Mampang on the theme of Indonesian Heritage Exhibition with various different project names for each class. The implementation of PjBL outing activities took place at Taman Mini Indonesia Indah (TMII) by visiting various regional platforms in Indonesia [14], while PjBL activities have never been carried out at the SAI Mampang Junior High School level. Therefore, the first step in planning and implementing by the teacher as a facilitator of PjBL activities at the 8th grade junior high school level at SAI Mampang is needed with an agreement between students and teachers. The agreement was taken together to choose a theme, namely E.M.P.A.N.G (ecology, mission sustainable, productive, social at Mampang) restoration. The main objective of the project was to collect comprehensive scientific data on the diverse butterfly species present at SAI. Students are directly involved by providing the necessary training and guidance to observe, identify and classify butterfly species. This learning process encourages students to actively engage in nature observation, develop research skills and deepen their understanding of the importance of environmental sustainability so that they can protect and preserve habitats and identify potential threats to butterfly populations in the surrounding environment.

2 Method

PjBL activities were carried out for three months from January to March 2023 at Sekolah Alam Indonesia Mampang. There were 44 students who participated in PjBL in grade 8, divided into five different groups. Each group had 8-9 members. Each group was given 15 minutes in turn to observe the types of butterflies in each zone. Each group was accompanied by a facilitator from research planning to follow-up data collection efforts. Learners are guided to collect data once a week for up to 12 weeks or 12 times. The implementation of this project has several stages, including: 1) research planning and pre-survey preparation, 2) guided observation, 3) data collection, 4) identification process, and 5) follow-up efforts [15]. Implementing these stages, students are trained to be active and creative thinkers and engage in collaborative learning to work on group projects [16].

Data collection of butterfly species in PjBL activities uses the roaming method [17, 18], by walking slowly as far as 1,500 m² to look for butterflies which are divided into

five zones, including: 1) the zone around the classrooms with flower gardens; 2) the zone near the pond area; 3) the zone around the musholla and the spring that drains the pond; 4) the zone around the garden; and 5) the field zone surrounded by grass. When butterflies were found, data were recorded on the number of individuals, species, and activities. In addition, the type of food plant that was being sucked by the nectar was also recorded.

The Project Plan was created using the fish bone diagram method. This method makes it easier for facilitators when implementing it because it has the principle of "start from the end". In this principle, there are detailed approach factors for both subjects and activities that can facilitate and support learning activities and can realize project products and celebrations [14] (See Fig. 1.).

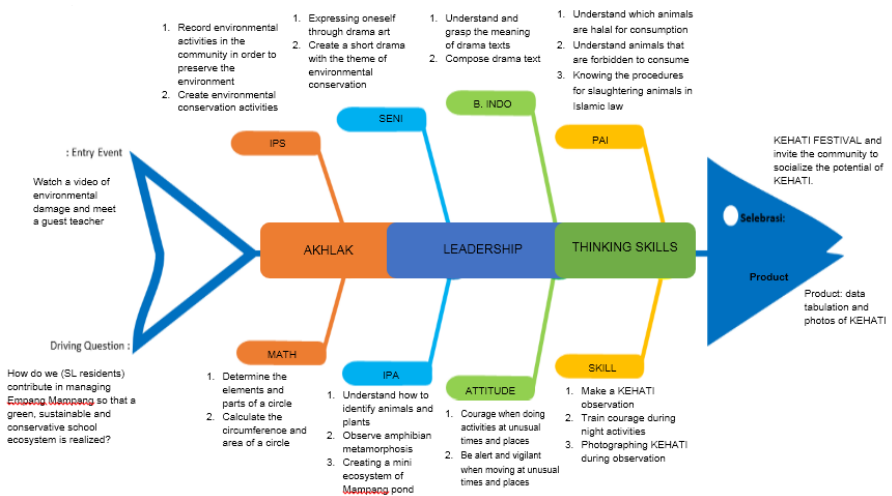


Fig. 1. Fish bone E.M.P.A.N.G restoration project [14]

The learning outcomes (LO) or learning achievements that students get include being 3 aspects of the Sekolah Alam Indonesia Mampang curriculum and regular subject subjects such as Matematika, Ilmu Pengetahuan Alam, Ilmu Pengetahuan Sosial, and Language. LOs and subjects have been adjusted to the needs in order to facilitate students in completing this project. The following LOs are the focus of assessment in this project (See Table 1.).

Table 1. Goals 3 of the SAI mampang curriculum

No	Morals	Leadership	Logic of Thinking
1.	Doing independently what can be done	Dare to lead during observation activities	Understand the methods and techniques in identifying KEHATI Mampang
2.	Listening to someone who is talking	Becoming a committee member during celebration activities	Understand socialization techniques to the community
3.	Being a well-mannered person	Dare to put on a performance for the celebration activity	Give opinions or ideas
4.	Being honest	Respect the opinions of group members	Fluent in expressing ideas
5.	Performing compulsory worship	Decision-making skills	Finding problems
6.	Courage when doing activities at unusual times and places	Able to convey ideas in a structured manner	Formulating the problem
7.	Feeling always watched over by Allah	Have a plan	Expressing appreciation in a work
8.	Guarding the tongue	Can set priorities	Provide evaluation in an activity
9.	Make a habit of reciting Thayyibah sentences		
10.	Ask for protection from wild animals		
11.	Performing the sunnah prayer Tahajud		

Students did not capture the butterflies, but only photographed them as documentation and identification process. The process of identifying butterflies is not only equating or matching images through the butterflies botanical garden identification guide book [19], but students also identify using professional applications such as iNaturalist. Each student created an account to help the identification process and waited for responses from experts in the field. Data analysis used in this study with descriptions in tabular form.

3 Results and Discussion

Research planning activities and pre-survey preparation were carried out one month before data collection took place. Students were given a driving question that can stimulate thinking about problems that occur in their environment, for example: what will we do to maintain the ecosystem of SAI Mampang so that a green area and fauna are preserved? What are the negative impacts that arise, if the pond ecosystem is polluted? Providing questions given by teachers to students is expected to increase inspiration in solving environmental problems [20].

Each team surveyed the five predetermined zones in the research area accompanied by a facilitator to see and record problems directly in their environment by documenting using tools such as cellphones and cameras. In addition, each team prepares equipment that will be used in the implementation of the project. The facilitator and learners come up with an agreement that the research will be carried out.

Facilitators together with students collect butterfly data at SAI Mampang using insect nets by filling in the observation sheets that have been provided. When the facilitator accompanied the students, there were a few obstacles in the field, namely students who were easily tired and there were not many butterfly catching tools. The existing obstacles must be reduced to maximize the existing potential and teachers can be creative by combining several learning models and methods in achieving the desired learning objectives [21].

The facilitator and learners review the role of butterflies in the ecosystem. The process of assistance by facilitators in the field can provide greater knowledge for students so that their experience will develop [22]. The level of thinking skills processed by students during the butterfly identification process using books is more visible and thorough because students not only match through pictures but also read descriptions of each type. In using the application, students upload photos and the results will come out a list of recommendations for the type of butterfly so that students are facilitated, but their thinking ability is reduced. The combination of using books and the iNaturalist application provides excellent benefits to students in increasing knowledge and thinking power.

Table 2. shows that the results of the identification of butterfly species at SAI Mampang obtained 169 individuals with 27 species and four families. During the three months of observation, the number of butterfly species found by students varied. The most species of butterflies found were in February as many as 23 species which were divided into two species from the Papilionidae family, 16 species from the Nymphalidae family, three species from the Pieridae family, and two species from the Lycaenidae family. The types of butterflies found in January were 12 species and in March the number was less at 10 species. This is because in February, many flowering plants (*Ageratum conyzoides*, *Tagetes erecta*, and *Bellis perennis*) in the school area were flowering so that it attracted butterflies to come to land and suck flower nectar. The process of taking flower nectar by butterflies can help pollinate plants. The presence of wildlife such as butterflies is very important in helping long-term conservation [15].

The most common butterfly species obtained at SAI Mampang are *Junonia orithya* as many as 31 individuals, *Appias olferna* as many as 31 individuals, *Ypthima horsfieldii* as many as 14 individuals, and *Hypolimnas bolina* as many as 13 individuals. The types of butterflies in SAI Mampang have dark patterns and colors so that they are not easily seen by predators and adapt well to grass or shrub habitats and flower gardens in the process of looking for food plant sources and resting places to perch on trees. Butterflies have very important ecological benefits that can be used as indicators of ecosystem health. The number of butterflies in a place indicates the quality of the environment is still good [23].

Follow-up conducted by students by making a celebration in which there are four series of activities, including butterfly photo exhibition activities carried out by each team by printing their best documentation and explaining to other teams and exhibition visitors about the role of butterflies in the ecosystem, talk show activities carried out by students by sharing their experiences and discussions after conducting research at SAI Mampang, each student has a role in staging a drama on the topic of the environment, and making a flower garden so that it becomes a source of food and can attract the presence of more butterfly species in the SAI Mampang environment.

Table 2. Species of butterflies obtained at SAI mampang

No	Family	Species of butterflies	Month		
			January	February	March
1	Papilionidae	<i>Papilio demoleus</i>	4	6	1
2		<i>Papilio memnon</i>	1	0	2
3		<i>Graphium sarpedon</i>	0	1	1
4	Nymphalidae	<i>Hypolimnas bolina</i>	7	5	1
5		<i>Hypolimnas misippus</i>	0	3	2
6		<i>Moduza procris</i>	0	1	0
7		<i>Doleschallia bisaltide</i>	0	2	0
8		<i>Junonia orithya</i>	2	25	4
9		<i>Junonia iphita</i>	2	0	0
10		<i>Junonia hedonia</i>	1	1	1
11		<i>Junonia alamana</i>	1	0	0
12		<i>Junonia atlites</i>	0	1	0
13		<i>Ypthima horsfieldii</i>	6	8	0
14	<i>Ypthima philomena</i>	0	1	0	
15	<i>Ypthima nigricans</i>	0	1	0	
16	<i>Ypthima pandocus</i>	0	1	0	
17	<i>Euploea eunice</i>	0	1	0	
18	<i>Euploea mulciber</i>	0	2	1	

19		<i>Melanithis leda</i>	0	1	0
20		<i>Neptis hylas</i>	0	9	2
21		<i>Elymnias hypermnestra</i>	0	2	5
22	Pieridae	<i>Appias olferna</i>	8	21	0
23		<i>Eurema hecabe</i>	0	6	0
24		<i>Eurema blanda</i>	1	2	0
25	Lycaenidae	<i>Zizinia otis</i>	2	10	0
26		<i>Parnara bada</i>	1	0	0
27		<i>Potantus omaha</i>	0	3	0
Number of Individuals			36	113	20
Number of Species			12	23	10

The assessment process begins during the formulation of the problem, the implementation when solving the problem, and the celebration of the completion of the problem. Assessment from the facilitator is done through the stages of observation assessment (qualitative assessment) and numerical measurement (quantitative assessment). Direct observations were made when students observed butterflies, it was seen that the aspects of students' skills that increased were catching butterflies using insect net tools and the lessons that could be taken by students were that patience and dexterity were needed when doing so. The skill of photographing butterflies is a favorite part because the resulting photos must be clear for identification and exhibition purposes during the celebration. Quantitative assessment is done by the facilitator from the summative test at the end of the semester as well as portfolio creation that contains self-assessment and peer assessment.

4 Conclusion

Learners and facilitators together came up with an agreement from the survey of problems to carry out project-based learning. During the three months of observation, the number of butterfly species found by learners varied. The most species of butterflies found were in February as many as 23 species which were divided into two species from the Papilionidae family, 16 species from the Nymphalidae family, three species from the Pieridae family, and two species from the Lycaenidae family. The types of butterflies in the SAI Mampang that are dominantly found have dark patterns and colors so that they are not easily seen by predators and adapt well to grass or shrub habitats and flower gardens. Learners make follow-up activities such as butterfly photo exhibition activities, talk show activities, and drama performances.

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