Using Place-Based Outdoor Learning (PBOL) Teaching Model in Promoting Students' Conceptual Understanding of Ecological Concepts

Joy C. Chavez
Education Program Supervisor
DepEd Regional Office V (Bicol)
Rawis, Legazpi City, Philippines
joy.chavez1@deped.gov.ph

Abstract

Ecological literacy provides unraveling a comprehensive understanding of environmental issues and problems. Nevertheless, applying this understanding often requires more than essential experiential learning. This study highlights a crucial, however frequently neglected, need for ecological literacy that allows educators and consultants of the distinct disciplines of education to apply methodical knowledge when encountering environmental and behavioral difficulties. The mixed-method research primarily intended to investigate how to promote students' conceptual understanding of ecological concepts using the Place-Based Outdoor Learning (PBOL) teaching model. The findings showed that using place-based outdoor learning to understand ecological concepts is further effective than the classroom setting (CSI) approach. The student's overall understanding of ecological concepts has significantly improved. Thus, results are highly recommending that educators in different fields can develop environmentally friendly controlling processes and contribute effectively to integrative work groups dealing with environmental issues and problems; and pedagogy and curriculum development on the strengthening evidence of the benefits of PBOL activities that influence students, including improved connection with the natural situated places; exploring how the PBOL teaching model can increase explicit memory and retention of concepts, and how reinforcement between the affective and the cognitive influence help scaffold higher-order learning.

Keywords:
Place-Based Outdoor Learning, Biodiversity, Interactions, Classroom Setting Instruction, and Conceptual Understanding

1. Introduction

Place-based outdoor learning has been conveyed in various ways that this method serves as an educational tactic used in a local environment and is an advantage to the teaching and learning process. This approach focused more on experiential learning that allows students to do significant work and encompass local difficulties and perceptions into the curriculum (Yavuz and Cakmak, 2018).

Ecological science is distinctively prepared to address challenging ecological complexities in a convoluted and rapidly shifting world. It is supposed to promote significant awareness and focus environmental problems in entirely geographical levels' occurrences. Educators and consultants have been rising to these challenges by creating innovations and teaching-learning development.

Globally, the Philippines is a top priority for global conservation because it is a biodiversity hotspot and a megadiversity country. The high species diversity and a very high level of endemism are because it is composed of many isolated islands, the tropical location of the country, and the once extensive rainforest areas. Unfortunately, the Philippines is also one of the world's most threatened hotspots because of biodiversity loss (Castillo, 2020). This biodiversity loss is associated with many environmental issues, such as climate change, pollution, deforestation, ocean systems collapse, inland water degradation, electronic and nuclear waste, and loss of biodiversity. These issues are so complex, yet one may perceive their interrelatedness, and if left unhindered, will have probable catastrophic economic, health, and even biological consequences (Hasnat et al., 2018). These environmental problems will only become relevant to our students' lives if they are experientially learned experiences that expose them to meaningful contexts where they discover how these diverse entities work together, bringing the learner a unified whole. A deep understanding of the earth systems interaction is significantly enhanced by integrating direct experiences in the natural environment into the current K-12 curriculum. If this is done, teachers contribute to developing scientifically, technologically, and environmentally literate and productive members of society (Orion. 2019).

Students' ecological literacy may be achieved through experiential instruction where individuals delve into environmental concerns, take part in problem-solving, and act for their resolve. Consequently, the individuals can create an authentic understanding of environmental issues and can make informed and responsible decisions.

Nevertheless, today's learners are confined to the four corners of the classroom, learning most of the time in the virtual world of technology, making them uncaring and unconscious of their natural environment. The absence of exposure to nature gradually makes them indifferent to nature. This phenomenon of Nature Deficit Disorder (NDD) by Williams et al. (2022). He explained that NDD in humans, especially children, occurs when they spend less time outdoors, resulting in various behavioral problems.

To address NDD, Williams et al. (2022) suggested environmental instruction in informal outdoor locations and environmental project-based community learning. Place-based learning is an alternative environmental education teaching model (Soares, 2022). Engaging in varied activities allows students to connect to the natural world. Place-Based spaces provide a diversity of natural resources and spaces that are hard to replicate indoor environments. Similarly, the Place-Based Learning (PBL) teaching model provides students with learning experiences in a meaningful context resulting in a conceptual understanding of human-environment connections.

With the hope of upgrading science achievement, this study was conducted in the Department of Education, Region V (Bicol). Out of 13 divisions of the DepEd schools in Bicol, there were four (4) divisions where mastery learning of science among six (6) learning areas was far from being achieved (NAT, SY 2017-2018). This alarming scenario requires that teachers teach to the standards and strive to achieve a complete conceptual understanding. Using emerging trends like PBL is very timely in the context of K-12 science. Moreover, selected schools from Divisions of Albay, Camarines Sur, Naga City, and Iriga City were selected as the locale of the study due to their lack of instructional resources like some science laboratory apparatuses and equipment, functional libraries, and Information Technology Equipment (ITE) that help supplement the learning gaps especially in understanding ecological concepts. Nevertheless, more importantly, rural school settings are rich in natural environments such as school mini-forest, *gulayan sa paaralan,* grass lawns, and others, where place-based learning is very appropriate. In this study, the place-based learning environment serves as the actual science laboratory where understanding ecological concepts become engaging for students.

The scenarios provided the background for the conduct of the present study. Many of our students probably suffer from Nature-Deficit Disorder (Williams et al., 2022). Moreover, the schools in the Philippines are surrounded by possible settings for nature study through place-based activities; the advantages of place-based learning must be understood and appreciated. Lastly, evidence is needed to support the claim that studying science concepts face-to-face has more incentives both for the teachers and students.

1.1 Objectives

This study sought to investigate using the Place-Based Learning (PBL) Teaching Model to promote students' understanding of ecological concepts.

Specifically, the study sought to answer the following questions:

1. What is the level of students' conceptual understanding of ecological concepts: biodiversity, and interactions before and after learning the concepts in the PBL teaching model and classroom setting instruction (CSI) approach?

2. How effective is the PBL teaching model compared to classroom instruction in promoting conceptual understanding and retention of ecological concepts: biodiversity and interactions?
3. Do the study group, collaboration learning, and investigation impact conceptual understanding?
4. Do the control group, self-directed learning, and deep questioning impacts conceptual understanding?

2. Literature Review

The literature review is divided into three major segments: studies regarding the elements of the Place-Based Outdoor Learning (PBOL) Teaching Model as an alternative instructional approach in environmental education and spiral progression in the K 12 Curriculum of the ecological concepts: Biodiversity and Interactions. Lastly, the review culminates with a discussion of research gaps in environmental education and how the PBL model is used as a scaffold for environmental literacy.

A. (Place-Based Learning) Teaching) Model: Nature, Impacts, and Challenges

Significant practices in natural environments are vital for a deeper understanding of nature. Some variables positively affect their concern and appreciation of environmental issues (Bloom et al., 2019). Thus, increased use of PBL by science educators and incorporating these experiences into the science curricula will contribute to the realization of producing scientifically and environmentally literate individuals exposed to informal locations (natural history and science museums), and place-based outdoor spaces (school grounds, gardens, other instinctive lands).

The study of Boren and Schmitt (2022) was a quasi-experiment consisting of control and experimental groups. Each group had 16 children aged 5-6 years. After the activities were performed, children in the experimental group showed a statistically significant improvement in their test results for naming the leaves and connecting the fruits or cones to the corresponding leaf. Also, Bird (2022) found that outdoor learning effectively improved science learning. In the study, students were given the task of producing their ways of finding plants and animals that lived on their school grounds or at a site close to the school (i.e., one group cataloged the life in their school pond, another looked at plants on their school field, one group walked to a local beach and another group investigated trees in a local woodland). These studies showed that PBL is a potent approach for learning early science, for there are several activities children can engage in.

Children's place-based learning and play are considered the basis of a joint body-mind focus where pupils review their relations with others and nature and value experience when they are absorbed in activities that fully take on their interests, skills, and capacities (Green & Rayner, 2022). Thus, the need to develop policies and practices related to place-based play, outdoor curricular studies, and playground materials for educational purposes may be a significant shift in environmental science instruction.

Teachers have critical roles in supporting the full use of place-based space and recognizing the value of collaboration in providing students with authentic experiences with nature (Ito & Ignao, 2020). The focus group discussion done by Ito and Igano also revealed that young children's learning becomes diverse and rich when exposed to natural place-based learning space.

On the other hand, the mixed method study of Schokker (2022) found many positive educational values of place-based education in rural settings and a linkage between affective and cognitive values. To support the beneficial effects of the approach, questionnaires, interviews, and observations were utilized to support the conclusions objectively.

It is essential, however, that PBL activities, according to him, should be supported by reflective practice. Takano (2020) showed that teachers engaging in many field trips as place-based activities seldom have pedagogical knowledge and experience. It is essential, therefore, that outdoor teaching should be carefully planned. Materials to be used, challenges that may be encountered, class management, and demotivated students may affect the activity's success or failure.

Furthermore, place-based learning allows pupils to combine and develop their knowledge of actual environmental and everyday phenomena. To overcome the gap between pupils' knowledge and their actions in terms of environmental education, Wang et al. (2021) suggested that teachers should integrate place-based learning into their teaching practice because it develops real and meaningful outdoor learning, which develops in pupils' skills that are required for appropriate sustainable development in the future. In like manner, engagement in place-based and experiential education activities was the approach initiated by Thomas (2020). He added that meaningful engagement of students in real-world context requires preparation on the part of the teacher; the core of this approach is the significance of personal reflection of students and teachers or the experience.

B. Research gaps in environmental education and how the PBL model can be used as a scaffold toward environmental literacy

Herman et al. (2020) described how they used a framework for the technology-enhanced place-based learning expeditions to plan small and local expeditions and what they learned through the process. An array of mobile and digital technologies was incorporated into the projects. This was done to support geocaching activities and enable students to capture images and reflections from the field. *Geocaching* is an outdoor recreational activity in which participants use a Global Positioning System (GPS) receiver. They also used handheld computers with sensors and social media such as video-sharing and audio-sharing websites. The implementation of the framework aided them in the design of the research checklist. They concluded that place-based learning would be more effective if students were allowed to explore rather than be dictated by what to do. They recommended that teachers doing place-based learning instructional designs consider the framework a roadmap rather than a principle. Also, the designs should address local realities and not prevent teachers from developing better designs. Moreover, they suggested that the location and the issue to be examined during expeditions should be thoroughly selected so the students can connect to familiar contexts and engage them in community issues. Therefore, teachers using place-based learning spaces must think creatively about looking for local places in inspiring and practical ways.

Coates and Primlott (2018) studied the “Curriculum for Excellence,” which has a policy vision of a more integrated and holistic form of education and a commitment to increased levels of place-based learning in schools. They found out through semi-structured interviews with key national, local, and school stakeholders that they agree on aims. However, their disagreements on the frequency and quality of place-based learning in schools negatively impacted on conducting of place-based learning activities. However, there is evidence that some atypical schools developed the best place-based learning programs despite the limited policy-related issues and unclear national policy.

3. Methods

This study used the mixed research design, which combines qualitative and quantitative data and approaches in particular research. It is also a component of mixed method research because discrete components of inclusive inquiry consider the qualitative and quantitative that remain distinct data collection and analysis, combining the qualitative and quantitative components during the interpretation and reporting of the project. It specifically utilizes the expansion component mixed-method, wherein different methods were used for distinctive analysis components that the results are presented side-by-side rather than woven into a single story.

The experimental research design was used as the quantitative part of the study, specifically, the Solomon-Four-Group Design (McGahee, T. & Tingen, M. (2019), as presented in Table I below. The practical experimental design uses the Solomon four-group design to investigate a pretest's main effect and the interaction between the pretest and treatment.

Table 1. Solomon Four-Group Design with Post-Posttest

Randomly Assigned Group	Pretest	Treatment	Posttest	Post-Posttest
A (Camarines Sur)	O_1	X	O_2	O_3
B (Naga City)		X	O_2	O_3
C (Albay)	O_1		O_2	O_3
D (Iriga City)			O_2	O_3

(O_1 = Pretest; O_2 = Posttest, O_3 =Post-Posttest; X= PBL teaching model)

The first and second objectives of the study were addressed by employing the experimental design. In contrast, the quantitative part of the study is quasi-experimental research because the entire classes of Grade 8 students at the schools within the chosen divisions of DepEd Region V were asked to participate. Nonetheless, the random assignment of classes of selected divisions into study and control groups was done.

Two of the four divisions were randomly assigned as study groups called the PBOL classes (that is, these classes will be taught using the Place-Based Outdoor Learning teaching model), while the other two divisions are called the CSI classes (that is, these classes will be taught using the Classroom Setting Instruction approach). Thus, to utilize the

Solomon Four Group design, only one of the PBOL and one of the CSI classes will be given a pretest, but all four classes were given a post-test and post-post-test (Table 1).

The Grounded Theory research tradition was also applied as part of the qualitative study. Grounded Theory research design aimed to discover theoretical precepts about social psychological processes and social structures grounded in data (Strauss & Corbin, 2018). Grounded theory (GT) is a systematic methodology in the social sciences involving theory construction through data analysis (Martin & Turner, 2020). In this non-traditional model of research, the researcher chose an existing theoretical framework and only then collected data to show how the theory does or does not apply to the phenomenon under study.

The mixed method research utilized the following instruments: *conceptual understanding test*, pre-tests, post-test, and post-post-tests were designed as a two-tiered test based on the work of Treagust (2018), as cited by Sahin and Cepni, 2020) wherein in the test, after each of the multiple-choice items, the test-taker was asked to state the reasons for the marked choices. Thirty (30)-item conceptual understanding test was prepared by the researcher guided by the Most Essential Learning Competencies (MELCs) indicated in the K to12 Science Curriculum Guide (DepEd, 2019). A Table of Specifications (TOS), which serves as a test blueprint, shall be made first before constructing the Conceptual Understanding Test. The test was divided into two parts, comprised of Biodiversity and Interaction as the ecological concepts. S*tudents' journal logs*, part of each PBOL and CSI lesson, are assignments requiring students to use a journal log, which they submit before the start of the next session. Prompts were provided to students to facilitate the activity. *Lesson Plans and* two sets of lesson plans (e.g., PBOL lesson plans and CSI lesson plans) were developed for the study. Each set is composed of seven plans. All these lessons will also be submitted to five (5) Education Program Supervisors in Science to validate content and learning experiences. *Formal Observation*, three observers were asked to observe the students' interaction and collaboration as they were being taught using the PBL and CSI lessons. A formal observation form will be designed for this purpose. In *Semi-Structured Interviews*, selected students were interviewed to elicit how PBL activities improve their interactions and collaboration with fellow students.

4. Data Collection

The results of the quasi-experiment from the Solomon-four-group design were analyzed using the maximum likelihood regression analysis, which combines an analysis of the impact of the treatment in the posttest-only groups with the same effect in the pre-and post-test groups. The 2 x 2 factorial design was reorganized based on the posttest data, where the first factor was whether a pretest had been given or not, and the second was whether the treatment had been given to the study groups comprised of the two divisions. Similarly, the ANOVA was used to estimate the treatment effect, the pretest effect, and the interaction effect of the pretest and treatment (Baig et al., 2022).

The students' level of conceptual understanding was based on the scores and interpreted using the following scales:

Table 2. Level of Students' Conceptual Understanding

Score	Interpretation/Adjectival Rating
0 to 6	Very Low Level of Understanding
7 to 12	Low Level of Understanding
13 to 18	Mid-Level Understanding
19 to 24	High Level of Understanding
25 to 30	Very High Level of Understanding

The qualitative data obtained from the students' journal logs, semi-structured interviews with students, and formal observations were analyzed using the method of data analysis suggested by Bernard and Ryan (2020). Broadly, the process entails coding the narrative data into categories or concepts, interrelating the categories to form a substantive theory, and validating the theory by member checking or audit trail.

5. Results and Discussion

Students' level of conceptual understanding of biodiversity and interactions, before and after being taught using the PBOL teaching model and classroom setting instruction approach

Results show that before the instruction, the students taught using the PBOL model (study groups) obtained lower scores (M±SEM = 7.69±0.40, SD = 2.17) in the 30-item conceptual understanding test than those students taught using the CSI approach (control groups) (8.32±0.46, SD=2.30). After instruction, students in both study and control groups improved their scores (M±SEM) from the conceptual understanding test. However, when the scores were compared, a higher score was obtained by the students in the study groups (24.5±0.40, SD= 2.89) than those from the control groups (14.50±0.27, SD= 1.93). The results showed from the mean scores of the study were higher compared to the mean scores of the study groups than the control groups in the post-test indicating that the PBL model is further effective than the CSI approach in promoting students' conceptual understanding of ecological concepts.

Before instruction, students in the study group obtained lower scores (M±SEM = 3.90±0.17) than the control group (4.32±0.23) in the biodiversity items of the conceptual understanding test. However, after instruction, the study groups obtained higher scores (11.9±0.27) than the control groups (7.15±0.22). In the interaction items of the conceptual understanding test, the students in the study groups got a lower score (3.79±0.36) than the control groups (4.0±1.91). But after instruction, the control group got a lower score (7.33±0.24) than the study groups (12.3±0.23).

Two weeks after instruction, scores (M±SEM) in the conceptual understanding of biodiversity decreased in both the students in the study groups from 11.9±0.27 in the posttests to 5.56±0.23 in the post-posttest and the control groups from 7.15±0.22 in the posttest to 4.73±0.22 in the post-posttest. The same score was observed in the conceptual understanding of interactions of the study groups from 12.3±0.23 in the posttest to 5.24±0.20 in the post-posttest and of the control groups from 7.33±0.24 in the posttest to 7.12±0.18 in the post-posttest. Overall, the conceptual understanding of ecological concepts decreased for the study and control groups two weeks after instruction. For the study groups, a decrease from the posttest score of 24.5±0.40 to the post-posttest score of 12.68±0.29, while for the control groups, a decrease from 14.50±0.27 to 9.96±0.23 were observed. These results indicate that PBL and CSI did not promote retention of conceptual understanding of ecological concepts.

The utmost possible level of understanding was *very high* along with the students in the study and control groups that utilized the PBOL model and CSI approach, respectively. As shown in Table 3, many students had *a low* conceptual understanding of ecological concepts. Some students showed *a very low level* of understanding. After instruction using the PBOL model and CSI approach, the proportion of students with *low-level* understanding decreased. Several students in the experimental groups showed *midlevel*, *high,* and *very high* levels of understanding. None of the students showed a very high understanding of ecological concepts after being taught using the CSI approach. Furthermore, post-posttest showed that many students' levels of understanding did not remain *high* or *very high*, indicating that the PBL model and CSI approach did not promote the retention of conceptual understanding for many students. Nonetheless, compared with those taught using the CSI approach, more students taught using PBL had a relatively higher level of understanding.

Table 3. Distribution of students in the Study and Control Groups According to their Level of Understanding of Biodiversity and Interactions

Concept ○ Level of Understanding	Study Groups			Control Groups		
	Pretest (Camarines Sur)	Posttest (Camarines Sur and Naga City	Post-Posttest (Camarines Sur and Naga City)	Pretest (Albay)	Posttest (Albay and Iriga City)	Post-Posttest (Albay and Iriga City)
A. Biodiversity						
○ Very High		16(32.00)				
○ High		27(54.00)			3(5.88)	
○ Midlevel		7(14.00)	15(30.00)	1(4.00)	30(58.82)	8(15.69)
○ Low	21(72.41)		31(62)	18(72.00)	18(35.29)	29(56.86)
○ Very Low	7(24.14)		4(8.00)	6(24.00)		14(27.45)
B. Interactions						
○ Very High		22(44.00)				
○ High		26(52.00)			5(9.80)	1(1.96)
○ Midlevel	2(6.90)	2(4.00)	36(72.00)	3(12.00)	29(56.86)	9(17.65)
○ Low	14(48.28)		14(28.00)	14(56.00)	17(33.33)	35(68.63)
○ Very Low	13(44.83)			8(32.00)		6(11.76)
C. Biodiversity & Interactions (Combined)						
○ Very High		21(42.00)				
○ High		29(58.00)			2(3.92)	
○ Midlevel			28(56.00)	1(4.00)	42(82.35)	7(13.73)
○ Low	19(65.52)		22(44.00)	20(80.00)	7(13.73)	6(11.76)
○ Very Low	10(34.48)					38(74.51)

Effectiveness of the PBOL teaching model compared with classroom setting instruction approach in promoting conceptual understanding and retention of the students to the learned ecological concepts

The pretest results showed that the control group ($\bar{X}$= 8.32, SD= 2.304) got a slightly greater mean score than the study group in the pretest with $\bar{X}$= 7.69, SD= 2.173, but the difference was not significant. This indicates that the two groups of students were equal in terms of their conceptual understanding of biodiversity and interactions before the start of the lessons which were taught using the PBOL and CSI approaches.

Although the overall mean post-test score of the study groups with an $\bar{X}$= 24.50 and SD= 2.894 was significantly higher than the control groups ($\bar{X}$= 14.51, SD= 1.933), a significant increase in the post-test scores for biodiversity concept was shown in the study groups than in control groups. For the interaction concept, the control groups showed higher scores than the study groups. The results suggest that PBL is more effective than CSI in teaching the biodiversity concept, while CSI is more effective than PBOL in teaching the interaction concept.

In the classes wherein the PBOL model and CSI were used, a significant increase in the scores was shown in both ecological concepts: biodiversity and interaction. The overall mean scores showed also that both PBL ($\bar{X}$= 25.55 and SD= 2.429) and CSI ($\bar{X}$= 15.32and SD= 1.749) were effective as teaching models in promoting conceptual understanding.

The gain scores in the post-test ascertained that the PBL model is more effective than the CSI in teaching ecological concepts: Biodiversity and Interaction. As shown in Table 4, there had significantly greater scores for the students taught using PBOL teaching Model than the students taught using the CSI approach.

Table 4. T-Test of Gain Scores of the Students After Being Taught Using PBOL Teaching Model and Classroom Setting Instruction Approach

Concept	Gain Scores				*t*	df	*p*
	Place-Based Learning (PBL) (Camarines Sur) (N=29)		Classroom Instruction Setting (CSI) (Albay) (N=25)				
	M	SD	M	SD			
A. Biodiversity	8.62	1.741	3.32	1.952	-10.549	52	.000
B. Interactions	8.93	2.477	3.64	2.691	-7.520	52	.000
C. Biodiversity & Interactions (Combined)	17.86	3.632	7.00	2.887	-12.027	52	.000

Maximum Likelihood Regression Analysis was used. The main purpose of this tool was to compare the impact of the treatment in the posttest-only groups with the influence of the treatment in the pre-and post-test groups.

Table 5. Results of Maximum Likelihood Regression Analysis of Students' Responses on the Biodiversity and Interactions Test Items

Categorical Variable Information				
			N	Percent
Factor	Treatment	Classroom Setting Instruction (CSI)	25	46.3%
		Place-Based Learning (PBL)	29	53.7%
		Total	54	100.0%

Continuous Variable Information						
		N	Min	Max	Mean	SD
Dependent Variable	Posttest Score in the Conceptual Understanding Test	54	12	31	20.81	5.570
Covariate	Pretest Score in the Conceptual Understanding Test	54	4	15	7.98	2.236

Tests of Model Effects			
Source	Type III		
	Likelihood Ratio Chi-Square	df	Sig.
(Intercept)	248.120	1	.000
Treatment	26.272	1	.000
Pretest (Conceptual Understanding Test Items)	.007	1	.932
Treatment * Pretest (Conceptual Understanding Test Items)	1.154	1	.283

The descriptive statistics table presents a variation in the mean scores of the Conceptual Understanding Test (combined Biodiversity and Interaction test items) before and after teaching using PBOL and CSI. There is a slight difference in the standard deviations. The significance value for Pretest Scores (Biodiversity Test Items) is more than 0.05, as shown by the tests of model effects, indicating it has no significant impact on Posttest Scores (Biodiversity Test Items). Therefore, the significance value of the interaction term is higher than 0.10, which indicates it is irrelevant.

This analysis aims to determine if the Place-Based Outdoor Learning (PBOL) teaching model helps students understand the Biodiversity and Interactions concepts better than the Classroom Setting Instruction (CSI), controlling for the pretest before teaching the concepts. The General Linear Model (GLM) Univariate procedure was used to analyze covariance (ANCOVA) on the post-test scores after teaching the concepts. It was also inferred that there is no important interaction between the covariate (pretest) and the factor (treatment: PBOL or CSI).

Table 6. Results from the Students' Responses through General Linear Model (GLM) Univariate Analysis of Variance (Factorial ANOVA) on the Biodiversity and Interactions (Combined Test Items)

Tests of Between-Subjects Effects

Dependent Variable: Posttest Score in Biodiversity Test Items

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1415.359[a]	3	471.786	103.105	.000	.861[a]
Intercept	1731.352	1	1731.352	378.373	.000	.883
PBL	143.372	1	143.372	31.333	.000	.385
Biodiversity Pretest Items	4.699	1	4.699	1.027	.316	.020
PBL * Biodiversity Pretest Items	4.944	1	4.944	1.080	.304	.021
Error	228.789	50	4.576			
Total	25040.000	54				
Corrected Total	1644.148	53				

Parameter Estimates

Dependent Variable: Posttest Score in Biodiversity Test Items

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval		Partial Eta Squared
					Lower Bound	Upper Bound	
Intercept	27.648	1.485	18.622	.000	24.666	30.630	.874
[CSI]	-12.356	2.207	-5.598	.000	-16.790	-7.923	.385
[PBL]	0[b]	.	.	.	.	.	.[b]
Biodiversity Pretest Items	-.273	.186	-1.465	.149	-.646	.101	.041
[CSI] * Biodiversity Pretest Items	.276	.266	1.039	.304	-.257	.809	.021
[PBL] * Biodiversity Pretest Items	0[b]	.	.	.	.	.	.[b]

a. R Squared = .717 (Adjusted R Squared = .700)
b. This parameter is set to zero because it is redundant.

Table 6 revealed that there was a significant value for Treatment (PBOL) to the Tests of Between-Subjects Effects is lower than 0.05, implying that it has a meaningful impact on the conceptual understanding of the students about both the ecological concepts: Biodiversity and Interaction. The significance value of the interaction term is more important than 0.10, which shows its insignificance. Moreover, its partial eta squared term is near 0, showing negligible variation compared to the error term. These results suggest homogeneity of the coefficient for the covariate (pretest) across the levels of the factors.

Parameter estimates showed that the value of -12.356 for CSI was given to two students with a similar conceptual understanding of biodiversity and interactions before the treatment. After treatment among the CSI students, classes are 12.4 less than that of the PBOL classes.

In addition, the student's journal entries were analyzed using the grounded theory approach, which focuses on finding patterns of the social setting and structure built using place-based learning in learning ecological concepts from the bottom-up data collection method coding and analysis.

It showed that there are two dimensions (or patterns or categories) of learning ecological concepts using nature learning areas: "Experiencing nature while outdoor" and "Learning through nature areas." The first dimension is implied from six level I codes (or themes) from an analysis of numerous journal entries of the students' present typical journal entries used to generate themes and categories.

Furthermore, the post-post-test scores were significantly lower than the post-test scores, indicating that the PBOL teaching model and CSI approach were ineffective in improving students' retention and understanding of ecological concepts.

Despite the overall results of the inefficiency of Place-Based Outdoor Learning and Classroom Setting Instruction in promoting the retention of ecological concepts: biodiversity, and interactions, it was revealed that post-posttest scores of the students taught using the Place-Based Outdoor Learning ($\bar{X}$= 14.07, SD= 1.163) were higher than those taught using the Classroom Setting Instruction approach ($\bar{X}$= 12.24, SD= 1.422). This indicates that learning in nature, compared with learning indoors (classroom), is more effective in promoting conceptual understanding.

Impact of PBOL teaching model on the students' collaboration learning and investigation and classroom setting instruction approach on students' self-directed learning and deep questioning in conceptual understanding.

Classroom observation revealed that students in the PBOL classes were more collaborative and investigative than those in the CSI classes, while CSI classes were more focused on self-directed learning and deep questioning, where students were expected to answer the given questions incorporated in their learners' module. Students' collaboration and investigation were higher in self-directed learning and deep questioning taught using the PBOL model than those in the CSI approach. These findings were confirmed further by the qualitative observation written by the teacher observers (Table 7).

Table 7. Sample Qualitative observations on the students' collaboration and investigation; students' self-directed learning and deep questioning in learning ecological concepts: Biodiversity and Interactions

Place-Based Outdoor Learning (PBOL)	Classroom Setting Instruction (CSI)
A. Strength Observations • Students participated and worked together. • Each group completely displays interaction with the assigned task. • Group work is highly organized, and students are productively always engaged. • Students' interactions foster an environment of respect in the mini-school forest. • The teacher productively always engages students. • The lesson is suitable for outdoor activities because the students interact. • The students are challenged and have ample opportunity to become independent learners. • The students showed keenness and commitment to succeed and the ability to grasp and extend their learning. • Students maintain cooperation/collaboration and desire to learn or know about the available animals in the mini school forest. • Students enjoyed their tasks while they were in the school mini forest. Students worked collaboratively to finish their work. B. Weakness Observations • Students worked independently, were highly motivated in the activity, and interacted with each other.	A. Strength Observations • The teacher used varied strategies to attain the objectives. • Students are focused, completing the assigned task, and participating in activities. • Students were attentive to the technology used by the teacher; the classroom environment was conducive to learning. • Some students listened attentively to the teacher… • Group leaders effectively encouraged and supported the efforts of the group. B. Weakness Observations • Students were noisy. • Students were off-task and displayed minimal effort in most of the activity. • Slow-paced, lesson drifted; low-level tasks were observed • Students had less opportunity to learn independently, the pace was brisk and things were not appropriate.

Discussion

This study primarily planned to study the Place-Based Outdoor Learning (PBOL) teaching model in promoting students' understanding of ecological concepts. The first question the study sought is, "What is the level of conceptual understanding of the students about the ecological concepts: Biodiversity and Interactions before and after learning the concepts using the PBL teaching model and CSI (Classroom Setting Instruction)?" The results showed that the control groups(i.e., the classes taught using the CSI approach) had slightly higher pretest scores than the study group (i.e., classes taught using the PBOL model). T-test confirmed that this difference was not significant; thus, it indicated that the two groups of students were equal in terms of their level of conceptual understanding about Biodiversity and interactions before the start of the lessons. Therefore, before teaching the ecological concepts, the students in the control groups showed a slightly better standing in terms of prior knowledge. But after instruction, it was revealed that the students in the study groups had a higher understanding of the concept. These results further support that learning ecological concepts using the PBOL teaching model is more than effective and empowering compared to the classroom setting instruction approach. Moreover, the distribution of the student's responses to each conceptual understanding test on Biodiversity and interactions indicated that the PBOL model is more effective than the CSI approach in promoting an understanding of these ecological concepts. In most of the items, students in the study groups showed more improvement in understanding the concepts than in the control groups.

The results stated that using the real world is the way to learn about human subsistence. In the place-based outdoor environment, students are attached to the situated space's activities more in the process of memorization than analyzing situational and hands-on activities. Nature learning also allows for direct and experiential experiences that help them to become critical thinkers. This study's PBOL instruction highlights evidence supporting the teacher's and students' positive outcomes. These could be inferred in the post-instructional assessment.

The second objective of the present study is: "How effective is the PBL teaching model compared to CSI in promoting conceptual understanding and retention of learned ecological concepts: Biodiversity and Interactions?" The study's quantitative data revealed that the study groups obtained higher mean scores than the control groups in the posttest, indicating that the PBOL model is more effective than the CSI approach. These results were complemented by the test item facility analysis analyses, which also showed that the PBOL model is more effective than the CSI approach. Even when the posttest gain scores were analyzed, it was observed that the posttest gain scores ascertained that the PBOL model is more effective than the CSI in teaching ecological concepts. The students taught using the PBOL model had significantly greater gain scores than those taught using the CSI approach.

However, both PBOL and CSI failed to promote the retention of understanding of ecological concepts. Students' Conceptual understanding of ecological concepts decreased in the study and control groups two weeks after instruction. These results imply that both PBOL and CSI were not specifically successful in promoting the retention of conceptual understanding of the ecological concept. Post-posttest showed that many students' levels of understanding did not remain high or very high, revealing that the PBOL model and CSI approach did not promote retention of conceptual understanding for many students. Nonetheless, compared with those taught using the CSI approach, more students were taught using PBOL, which showed a relatively higher level of understanding.

Despite the overall inefficiency of PBOL and CSI in promoting the retention of ecological concepts, the results of the post-posttest scores from the students taught utilizing the PBOL teaching model showed that there were higher than those taught through the CSI approach. This indicates that learning nature compared with learning inside the classroom is more effective in promoting an understanding of ecological concepts. The results of the General Linear Model (GLM) Univariate analysis strengthened the conclusion that the PBOL teaching model helps students to understand the Biodiversity and Interactions concepts better than the CSI approach. This analytical procedure was used to perform an analysis of covariance (ANCOVA) on the post-test scores after teaching the concepts. Since the study used a Solomon-four-group design for the control groups for the pretest before teaching the concepts, it was assumed that there was no significant interaction between the covariate (pretest) and the factor (treatment: PBOL or CSI).

The significance value for Treatment (PBOL or CSI) is more than 0.05, indicating it has no significant effect on the student's conceptual understanding of Biodiversity. The value of -3.323 for CSI indicates that, given two students with a similar conceptual understanding of Biodiversity before the treatment, one may expect that the conceptual understanding of Biodiversity after treatment among the CSI classes is 3.3 less than that of the PBOL classes. The significance value for Treatment (PBOL) is less than 0.05, indicating that it significantly affects the conceptual understanding of Interaction. The value of -4.366 for CSI indicates that, for two students with a similar conceptual understanding of Interaction before the treatment, one can expect the conceptual understanding of Interaction after treatment among the students in the CSI classes to be 4.4 less than that of the PBL classes. Parameter estimates showed that based on the value of -12.356 for CSI, two students with a similar conceptual understanding of Biodiversity and Interactions before the treatment, one can expect the conceptual understanding of Biodiversity and Biodiversity after treatment among the students in the CSI classes to be 12.4 less than that of the PBOL classes.

"Do the study group, collaboration learning, and investigation impact on conceptual understanding?" and "Do the control group, self-directed learning, and deep questioning impact on conceptual understanding?" are the third and fourth research questions of this study. Classroom observations revealed that students in the PBL classes collaborated, investigated, and showed retention more than those in the CSI classes. Students' collaboration and retention were higher than collaboration among the students taught using the PBOL model than those in the CSI approach. Specific qualitative observations on the students in the study groups indicated that most of the students were engaged by listening to instructions and performing tasks required by the teacher, to become independent learners. It was also observed that students enjoyed their tasks and worked collaboratively to finish their work. The researcher's methodological, reflective, and personal notes confirmed that students' collaboration and social interactions were deepened by the activities embedded in the PBOL teaching model.

Conclusions and Recommendations for Future Studies

Understanding ecological concepts using the place-based outdoor learning (PBOL) teaching model is more effective than a classroom approach. Findings indicated that there is a significant difference in the statistical analysis results illustrating that the PBOL instruction has enabled students' conceptual understanding and retention regardless of challenges posed by place-based outdoor learning, it offered supplementary teaching and learning incentives for teachers and students. Students' overall understanding of ecological concepts has significantly improved. Thus, outcomes are highly recommending the educators in different fields can develop environmentally friendly controlling processes and contribute effectively to integrative work groups dealing with environmental issues and problems and the pedagogy and curriculum development as well as future research are offered, specifically, using PBOL teaching model as one of the frameworks for learning experiences should be tried for its positive effects on both learners and teachers; seminars and trainings should be conducted for science teachers to be fully equipped with pedagogical skills needed to implement the PBOL model and accurately oriented to achieve the intended results of the PBOL teaching model; if constructing a meaningful ecological understanding of least mastered topics on biodiversity and interactions requires sufficient time and planning, the science curriculum should consider the span of time for improving the conceptual understanding levels; infusing the PBOL teaching model into the science curriculum of environmental education should allow students to understand the real essence of the environment and appreciate the scientific explanations currently affecting nature; and although the PBOL teaching model has shown to be effective in improving conceptual understanding of ecological concepts, it is recognized that it should be employed only in topics that are appropriate for outdoor activities and when situated places are available in the school. Thus, future researchers should reflect on the strengthening evidence of the benefits of PBOL activities that influence students, including improved connection with naturally situated places; exploring how the PBOL teaching model can increase explicit memory and retention of ecological concepts, and how reinforcement between the affective and the cognitive influence help scaffold higher-order learning.

Acknowledgment

The author extends her gratitude to the Schools Division Offices of Albay, Camarines Sur, Naga City, and Iriga City for being the venue of the conduct of pilot testing of the PBOL lessons; their science teachers and learners for being cooperative and responsive during the data-gathering; and the Department of Education (DepEd) Region V for the support thru the Basic Education Research Fund (BERF) grant.

References

Boren, T. and Schmitt, P. (2022). Knowledge and Place-Based Development towards Networks of Deep Learning, European Planning Studies, DOI: 10.1080/09654313.2021.1928042

Bird, C. (2022). Use of the Outdoor Classroom and Nature-Study to Support Science and Literacy Learning: A Narrative Case Study of a Third-Grade Classroom. Journal of Science Teacher Education, 23(7), 789–803. https://doi.org/10.1007/s10972-011-9867-1

Castillo, M. (2020). Revisiting the State of Philippine Biodiversity and the Legislation on Access and Benefit Sharing. Philippine Council Agriculture Aquatic and Natural Resources Research and Development (PCAARRD). https://ap.fftc.org.tw/article/1836

Coates, J. and Primlott, H. (2018). Learning while playing: Children's Forest School experiences in the UK. Loughborough University, UK, British Educational Research Journal Vol. 12, No. 89, 2018. DOI: 10.1002/berj.3491Green. M. and Rayner, M. (2022). School ground pedagogies for enriching children's outdoor learning, Education 3-13, DOI:10.1080/03004279.2020.1846578 To link to this article: https://doi.org/10.1080/03004279.2020.1846578

Herman, et. al (2020). Students' Emotive Reasoning Through Place-Based Environmental Socioscientific. Mark Newton Research in Science Education volume 50, pages2081–2109 (2020)

Ito, H, and Ignao, C. (2020). Place-Based Environmental Education to Promote eco-Initiatives: the case of Yokohama, Japan, Regional Studies, Regional Science, 7:1, 292-308, DOI: 10.1080/21681376.2020.1794950 To link to this article: https://doi.org/10.1080/21681376.2020.1794950

Mai, et. al (2020). Testing the Effectiveness of Transfer Interventions Using Solomon Four-Group Designs. Department of Development Policy, Hiroshima University, Hiroshima 739-8529, Japan. Educ. Sci. 2020, 10(4), 92; https://doi.org/10.3390/educsci10040092

McGahee, T. & Tingen, M. (2019). The Use of the Solomon Four-Group Design in Nursing Research. Southern Online Journal of Nursing Research. Volume 9, No. 1. https://www.researchgate.net/publication/23745478

Sahin, S. and Cepni, A (2020). The Effects of Computer-assisted Material on Students' Cognitive Levels, Misconceptions and Attitudes towards Science

Schokker, J. (2022).Exploring Environmental Education through the Lens of Place-Based Transformative Learning: A qualitative case study of the Ecoliteracy Program at the Droevendaal Food Forest. Wageningen University & Research Chair group: Health and Society (HSO)

Soares, L. (2022). Placed-based Education for Inquiry Learning. International Journal for Cross-Disciplinary Subjects in Education (IJCDSE), Volume 13, Issue 1, 2022. Georgia Southern University Georgia, USA

Takano, T. (2020). How experiences transform over time: A retrospective study on place-based education in Micronesia and the Philippines, Journal of Adventure Education and Outdoor Learning, DOI: 10.1080/14729679.2020.1854098 To link to this article: https://doi.org/10.1080/14729679.2020.1854098

Thomas, T. (2020). Place-based inquiry in a university course abroad: Lessons about Education for Sustainability in the urban outdoors. International Journal of Sustainability in Higher Education ISSN: 1467-6370 Article publication date: 3 June 2020

Wang, et. al (2021). Google Earth Geoscience Video Library (GEGVL): Organizing Geoscience Videos in a Google Earth Environment to Support Place-Based Geoscience Education. School of Natural Sciences and Mathematics, University of Texas. doi:10.20944/preprints202205.0222.v1

Williams, et. al (2022). Nature Deficit and Senses: Relationships among Childhood Nature Exposure and adulthood sensory profiles, creativity, and nature relatedness. https://doi.org/10.1016/j.landurbplan.2022.104489

Yavuz A, & Safiye, C. (2019). The Effect of Place-Based Education Integrated Project Studies on Students' Problem-Solving and Social Skills. Asian Journal of Education and Training Vol. 5, No. 1, 183-192, 2019 ISSN (E) 2519-5387 DOI: 10.20448/journal.522.2012

Biography

Joy C. Chavez is a Regional Education Program Supervisor of the Department of Education (DepEd) Regional Office V (Bicol), Rawis, Legazpi City, Philippines. Before her promotion as one of the Supervisors in DepEd, she served as a Master Teacher II handling science and research subjects in Junior/Senior High Schools and as a part-time faculty of the two Universities in Bicol. In Addition, Dr. Chavez has served as a Division and Regional Science Trainer, Writer, and Content Consultant/Validator during her time at the Department of Education of Camarines Sur, Pili, Camarines, Philippines. She obtained her Master of Education (MAED) major in Environmental Science at the Ateneo de Naga University, Bagumbayan, Naga City, Philippines, and a Doctor of Philosophy major in Human Development Management at Universidad de Sta. Isabel, Naga City, Philippines. She conducted and implemented research in science and education. She is a permanent alternate member of the Regional Research Committee of the Department of Education (DepEd) Region V.