

Mainstreaming environmental education in the teacher education curriculum in the Philippines

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ABSTRACT

In the Philippines, environmental education (EE) is a mandate, and at the higher education level, the teacher education programs can serve as a context for EE. During the first semester of the 2016-2017 school year, this pilot study tested teacher education lessons integrated with environmental concepts and principles using EE materials developed by the department of environment and natural resources (DENR) among the 2,420 third year teacher education students in eight institutions of the national network of normal schools (3NS). Data were collected using a validated researcher-made test on environmental concepts and principles. Qualitative data were collected through class observations, focus group conversations, interviews, and authentic student outputs, the capstone projects. The t-test between the pre-test and post-test means (4,838) showed a substantial improvement in the EE test at a level of 0.05 significance across all ten disciplines in eight institutions. The EE mainstreaming in the teacher education curriculum using DENR EE materials and researcher-made and searched EE materials was found effective in enhancing the students' level of competence in terms of environmental concepts and principles. Institutionalization of the mainstreaming of EE in the teacher education curriculum and the cross-cutting inclusion of EE in higher education programs through national policy is strongly recommended.

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1. INTRODUCTION

Environmental education (EE) is a multidimensional concern of global significance. This multidimensional nature requires a concerted effort of different stakeholders to ensure adequate, accurate, and effective EE. In the current state of the environment worldwide, characterized by crises and degradation, it becomes more relevant and exigent than ever to promote deep and widespread EE among the different sectors of the society, the academe included. It is important to note, for instance, that the Philippines is highly vulnerable to disasters, having been identified as the country most affected by disaster due to climate change from 1994 to 2013 and ranked fifth in the climate risk index [1].

The Philippines has a number of laws related to the environment and natural resources. Among these are: the National Environmental Awareness and Education Act of 2008 [2], the Philippine Disaster Risk Reduction and Management Act of 2010 [3], the Philippine Clean Air Act of 1999 [4], and the Ecological Solid Waste Management Act of 2000 [5]. However, the existence of these laws does not guarantee that they are observed unless all stakeholders are proactively involved. Not only the government but also the people

play a crucial role through active participation and support. A step toward this is the proper education of the people who will also be the actual beneficiaries of any developments related to the environment.

In particular, the national awareness and EE act of 2008 supports undertakings related to EE by calling on the education sector to take necessary action to do its share in the EE of various sectors of society. Moreover, this law supports collaboration between the Department of Environment and Natural Resources (DENR) and academic institutions such as interagency and multi-sectoral efforts and capacity-building. The Philippines Commission on Higher education (CHED), Department of Education (DepEd), and the Technical Education and Skills Development Authority (TESDA), in cooperation with DENR and other related agencies, are mandated to conduct national capacity-building programs such as training courses, seminars, workshops on EE, development, and production of EE materials and teacher-education [2].

At the higher education level, the teacher education program is widely accepted as a context for EE. The United Nations Educational Science and Cultural Organization (UNESCO) considered teacher education programs and teacher educators as key players in the reorientation of sustainable education [6]. They argued that educational institutions serve critical positions in the global education community and have the ability to bring about improvements in education systems that will form the awareness and skills of future generations. An education which addresses sustainability inheres EE, and the teacher education program which produces educators across levels serves as context for EE, thus enabling the institutions offering teacher education to fulfill their critical roles of reshaping the knowledge, skills, and attitudes of the future generations. In the Philippines, the National Network of Normal Schools (3NS) is a consortium of highly reputable institutions which are pioneers in offering the teacher education programs.

With the vulnerabilities encountered by the country, there exists a strong need to educate the people to become environmentally responsible. EE may be in the form of integration in the curriculum, which may be called as "greening the curriculum" [7]–[11]. The effective practices in the EE program identified by Stern, Powell, and Hill [12] can be used in educating future educators about the environment using the materials produced by DENR. It is understood that the pre-service teachers who will be the frontline service providers in schools have the opportunity to influence the young generation on how to behave in environmentally responsible ways. These future teachers can serve as role models for future students and become agents of transformation and sustainable development in their respective classrooms, schools, and communities.

This paper on the mainstreaming of EE in the different disciplines in the teacher education curriculum aims to report the pilot-testing of an EE intervention for pre-service teachers using the validated EE-enriched session plans using the DENR EE materials. Specifically, the study addressed the following research questions: i) What lessons in teacher education courses may be embedded with environmental concepts and principles using the DENR EE materials?; ii) What is the students' level of competence in terms of environmental concepts and principles covered by the lessons in the different disciplines?; iii) What is the effectiveness of mainstreaming the EE-enriched lessons in the different teacher education courses?

EE is crucial amidst the devastations and threats to the environment. Both the laws related to the environment and natural resources and knowledge about the environment from social science and science perspectives provide the foundation for EE, which help determine the scope or content, purposes, and strategies for EE, which will be embedded in the different courses. With support from stakeholders, relevant school policies, curriculum or instructional materials, and competent and committed EE teachers, this type of EE will help develop eco-mentors who will then serve as agents of transformation and sustainable development. Figure 1 shows the paradigm for the mainstreaming of EE in the teacher education curriculum.

Of the numerous laws on the environment and natural resources, the act to promote environmental awareness through EE and for other purposes explicitly provides the education sector's involvement in environmental protection and conservation [2]. Such involvement includes raising public awareness and improving education on various environmental concerns. This law specifically supports inter-agency and multi-sectoral efforts to support the state, which is mandated "to promote national awareness on the role of natural resources in economic growth and the importance of environmental conservation and ecological balance towards sustained national development" [2].

Aside from the relevant laws related to the environment, the body of knowledge about the environment, both from science and social science perspectives, is necessary to gain a full and deep appreciation of EE. For instance, the information contained in EE materials produced by the DENR in partnership with discipline experts provides the knowledge base for the content or scope of EE integration in a tertiary-level academic program. However, the technical knowledge about the environment will not suffice in designing and developing an EE intervention that will be relevant or appropriate for different groups of learners or clients. Therefore, a social science perspective about the environment will help ensure that the purposes and strategies for implementation are suitable to the level and schema of the target clients. In this way, the EE will not be simply learning about the environment but rather learning for the environment [13].

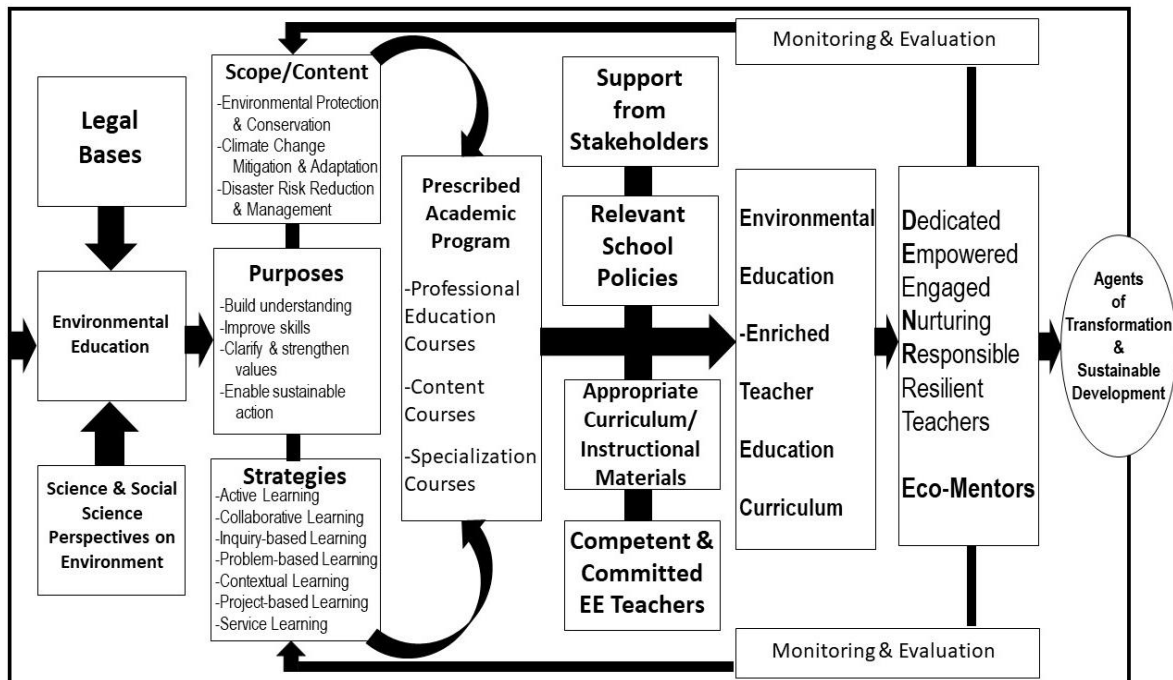


Figure 1. Theoretical paradigm

Considering these as bases, the content or scope of the EE program or intervention includes concepts and principles on environment protection. These are considered in the design of the lessons which embed EE as far as allowed by the available DENR EE materials. In addition to the content or scope, the purposes of the EE need to be clarified at the outset. Grounding on the Monroe, Andrews, and Biedenweg [14] new framework for EE, this study's framework adopts three of EE's purposes: build understanding, improve skills, and enable sustainable action. An EE program or intervention should aim beyond enhancing knowledge and building skills related to the environment. Rather, it should focus on clarifying and strengthening values and enabling sustainable action. Knowledge of environmental concepts and principles, and skills in applying these, do not guarantee appropriate action unless the necessary values such as discipline, love and respect for the environment, and compassion for others, especially the marginal sectors and others, are imbibed by the people themselves. There then is a strong need to include clarifying and strengthening values to ensure holistic and genuine EE.

With content or scope and purposes in place, there is a need to specify strategies for implementation or delivery. Among the strategies suggested by Monroe, Andrews, and Biedenweg [14] and generally recognized as learner-centered strategies include active learning, problem-based learning, collaborative learning, inquiry-based learning, contextual learning, project-based learning, and service-learning. These strategies are premised on the principle of "learning by doing" and therefore are deemed to stimulate the active participation of the learners. Similarly, these strategies will provide an opportunity to apply or transfer learning, thus ensuring a meaningful learning experience.

The content or scope, purposes, and strategies for delivery or implementation are considered in making innovation in the teacher education curriculum through the integration of EE. The effective and efficient delivery of these lessons would require support from stakeholders such as school officials and teachers and relevant school policies to permit innovation in the curriculum. Additionally, appropriate materials and competent and committed teachers are necessary for the actual delivery of the lessons. The materials refer to the EE materials produced and provided by DENR. The teachers who will deliver the lessons will be provided with orientation and self-help resource in the form of a toolkit. In this way, the teachers will have the necessary preparations for the delivery of lessons which mainstream EE.

The learners or clients of the EE – enriched teacher education curriculum is expected to adequately gain environmental competencies making them dedicated, empowered, engaged, nurturing, responsible, and resilient teachers in the future. This gain in environmental competencies is assessed based on the extent of attainment of the competencies based on the four purposes mentioned previously, such as building understanding, improving skills, clarifying and strengthening values, and enabling sustainable action. The

clients of the EE-enriched curriculum will become eco-mentors who can serve as agents of transformation and sustainable development in their workplaces and respective communities. In a cyclical vein, these eco-mentors will conduct EE in their classrooms, schools, and communities in the future and become exemplars of EE [15].

For decades, UNESCO has reiterated the crucial role of EE in developing the education sector as one of the main players. In the 1990s, teacher education systems and teacher educators were described as key players in the reorientation of sustainable education [6]. It argues that educational institutions play a crucial role in the global education community and have the ability to bring about improvements in education systems that will influence the awareness and skills of future generations. Expectedly, EE is a component of education aimed at sustainable development, and one of the appropriate contents for EE is the teacher education program.

Currently, however, the curriculum lacks substantial coverage of EE. For instance, in an analysis of curriculum and students' discourses, Pasin and Bozelli [16] found that most of the students reported having had contact with EE in their tertiary education and revealed multiple perceptions of the subject. Most of the speeches suggested that the definitions of the EE are limited to protection or restoration, and some indicated misunderstanding about the aims of both the EE and the ecology disciplines. In addition, the curricular matrix of this undergraduate course (teacher education) revealed a predominance of hours devoted to courses that address the world from a biological viewpoint, and undergraduate students argued that they had no experience with recent EE legislation. As a significant interdisciplinary area, EE needs careful planning to minimize challenges. Relatedly, the framework designed by Monroe, Andrews, and Biedenweg [14] that organizes varied EE activities and strategies commonly used in various situations is also a useful guide. This new paradigm proposes that categories are nested and varied by intent, offering environmental educators and communicators a shared language to address and compare their work.

Similarly, considering environmental psychology to better understand the difference between environmental knowledge or awareness and environmental actions, the concept suggested by Kollmuss and Agyeman [17] can be used as input in preparing the EE program or interventions. They claim that the proposed model of pro-environmental behavior does not assign a direct relationship to environmental awareness and pro-environmental behavior and that environmental knowledge, beliefs, and attitudes along with emotional engagement make up a dynamic "pro-environmental consciousness" that is rooted in larger personal values and influenced by personality characteristics and others. In short, Kollmuss and Agyeman [17] argue that environmental knowledge and environmental consciousness do not necessarily contribute to environmental actions.

The approaches for EE vary due to different factors such as school support, EE teachers or implementers, context, and others. EE may be in the form of integration in the curriculum, which may be called as "greening the curriculum" [7]–[11]. Other EE may be non-formal and take place outside a prescribed curriculum or outside the classroom or school, such as in eco-attractions [18], school gardens [19], forest conservation [20], botanical gardens [21], or place-based education [22]. An example of EE is done as a transversal theme in the school curricula, that is, the teaching that has to be present in compulsory education as a "guardian" of interdisciplinarity in the different areas – not in the form of isolated teaching units but as clear connecting axes of objectives, content, and procedural principles [23]. Another example can be done through pedagogical play, such as open-ended, modeled, and purposefully framed play [24].

The attainment of expected outcomes of EE, whether as integration in the curriculum or not, maybe beset with challenges such as dissonance in advocated EE practices and teaching realities or in environmental knowledge or awareness and pro-environmental behaviors. In view of the difference between advocated activities and teaching realities in EE, previous researchers make three points [25]: to bring environmental theorists into line with the actual and immediate needs of teachers and teaching practices; to address the contradictions and uncertainty inherent in EE theory; and to determine what can be realistically achieved.

Other problems facing EE may include those inherent in the education system or those related to the production and implementation of EE materials or the availability of teaching and learning tools, time, and classroom size. The EE curriculum, which is incorporated into teacher preparation or pre-service training, involves various stakeholders and is likely to include challenges. The critical challenges faced by the implementation of the EE program aimed at incorporating EE into secondary education include sustainability issues, the diffusion of curricula innovation in the secondary school sector, and the lecturers' potential resistance to the implementation of integrated EE [10]. Likewise, stakeholders involved in creating and implementing EE modules felt melancholy about what was deemed "dark matter" in the challenges of introducing a true environmental learning practice group. Some of the systematic criteria of the teacher education program itself may have restricted the structure of the seminar and functional aspects of the program, which are embedded deeply in the culture of schools generally and do not support the goals of promoting EE and environmental pedagogy [9]. Other obstacles found in EE include lack of teaching and learning facilities, time, and wide class size [26].

In EE, the teacher plays a pivotal role in implementing the different activities. An inter-generational communication within a program and a certain form of teacher engagement, and the identity and style of the instructor, are among the program elements which may positively influence the outcomes of the EE program [12]. Interestingly, Emmanue and Ambe [7] found that the teacher's professional qualification and area of study do not significantly influence the implementation of the EE curriculum; thus, a teacher must not specialize in EE as a course before he can teach it in the secondary school. This finding means that teachers from various disciplines other than environmental science or EE may effectively teach environmental concepts and principles as integrations in their respective lessons. With the significant role of the teachers in developing an environmentally literate citizenry, the government has the responsibility to enhance their capacity in teaching EE [26].

Strategies that actively engage the learners work well in EE. Generally, students taught using the participatory modes performed better than their counterparts in the conventional lecture group [9]. This strategy offers the learners, as individuals and together in groups, the unique opportunity to read, accept and internalize the basic environmental concepts and principles, and access to immediate feedback, which motivates learners to want to learn more. In addition, Stern, Powell, and Hill [12] identified, among others, the following as effective EE practices in the research studies on EE program evaluation: i) Active and experiential engagement in real-world environmental problems, particularly issue-based, project-based, and investigation-focused programs in real-world nature settings; ii) Empowerment and student-centered learning; iii) Emotional connections made during the program; iv) Social engagement such as cooperative group work; v) Holistic experience; vi) Explicit linking of the program to students' home lives; vii) Focus on specific places and issues; and viii) Explicit provoking of student reflection. Dunkley [18] also mentioned that experiential learning offered by eco-attractions aid to re-establish affective connections between the natural world and young learners' everyday lives and encourage individuals to question their existing ecological knowledge and explore and discuss sustainability further, a progressive approach to EE which appears to be effective. Given the literature relevant for a deep appreciation of EE, it can be surmised that EE is a discipline contiguous to general education, and to teacher education in particular, which still needs attention, and preferably formal investigations along outcomes of EE program, EE lessons and materials, EE learning experience vis-à-vis pro-environmental behaviors, teacher's roles or involvement in EE, and strategies which may be used in EE to address different types of learners.

2. RESEARCH METHOD

2.1. Research design

This research used descriptive research design and pre-experimental research design. The descriptive research was used to describe the EE materials and their utilization in the different lessons in the different teacher education courses and to describe the teacher education students' environmental awareness and environmental competencies. This research design is deemed appropriate since descriptive research aims to describe a phenomenon and its characteristics rather than how or why something has happened [27]. Documentary analysis was used to describe the EE materials and the 120 EE-enriched lessons in the different teacher education courses, namely, professional education courses, content courses for bachelor in elementary education (BEED), and specialization courses for bachelor in secondary education (BSED), namely; English, Filipino, mathematics, biological sciences, physical sciences, social studies, music, arts and physical education (MAPE), and technology and livelihood education (TLE). A survey using a validated researcher-made test was used to determine the teacher education students' environmental awareness and environmental competencies before and after EE intervention.

The pre-experimental design was used to test whether the EE-enriched lessons in the different teacher education courses can enhance pre-service teachers' environmental awareness and competencies in the eight universities. According to Frey [28], pre-experiments designs are research schemes in which a subject or a group is observed after a treatment has been applied to test whether the treatment has the potential to cause change. Pre-experiments are often preparative forms of exploration before engaging in experimental endeavors, providing cues or indications that an experiment is worth pursuing. Pilot testing was used to determine whether the EE-enriched lessons have the potential to enhance the environmental awareness and competencies as a means of further validating the juror validated session plans in teacher education courses that integrate environmental concepts and principles using the DENR EE materials.

2.2. Respondents of the study

A total of 2,420 teacher education students participated in the pilot testing. It was conducted during the 1st semester, school year 2016-2017 in the eight universities that are members of the 3NS. Of the eight universities, two come from Luzon, four from the Visayas, and two from Mindanao.

2.3. Sources of data

The main sources of the data were the pre-test and post-test results. Other data sources were the observation of the classes, interviews with the class observers, focus group discussions, documentation of the lecture series implementation, and analysis of the student outputs. The analysis and revision of the session plans were done in July 2017 after the jurors' critiquing. The documentation of the implementation and the class observations were conducted during the first semester of the school year 2016-2017.

2.4. Data gathering tools

The study used the following data gathering tools: i) Pre-test and post-test on environmental concepts and principles; ii) Class observation guide; and iii) Focused group discussion (FGD) guide questions. The pre-test on environmental concepts and principles consists of 15 modified true or false items, 15 multiple choice type of test items with four options dealing with varied environmental concepts and principles, and an essay type of question on responsible environment-related actions and behaviors they practice consciously. The Post-test has similar contents, but the items are sequenced differently. The essay part deals with the student's reflection on their experiences gained from the lessons and how their day-to-day decisions and behaviors were influenced by the environmental concepts and principles discussed in the lessons. The class observation guide focused on the EE integration or activities. The FGD guide questions pertain to the environmental concepts and principles gained or retained, the experiences related to EE in the different lessons, the insights gained from the learning tasks related to EE, and the applications of the environmental concepts and principles in daily lives.

2.5. Statistical tools

Data were interpreted using the statistical tools. They included frequency count, percentage, weighted mean, mean, and t-test. The ratings for interpretation of the level of competence in terms of environmental concepts and principles included: 6 and below being poor/needs improvement; 7 to 12 being fair; 13 to 18 being satisfactory; 19 to 24 being very satisfactory; and 25 and above being excellent.

3. RESULTS

3.1. Lessons in the teacher education courses embedded with EE

The mainstreaming of EE in the different lessons in the teacher education courses covered the environmental concepts and principles in the absence of an official list of minimum EE competencies for pre-service teachers. The delivery of the lessons used the available DENR EE materials provided to the universities repeatedly in the different lessons in the different disciplines, as applicable. Table 1 shows the different types of DENR EE materials and their utilization during the mainstreaming of EE in the teacher education curriculum.

Table 1. Utilization of DENR materials in the mainstreaming of EE in the teacher education courses

Types of DENR materials	Areas/Disciplines												Total frequency of utilization	Overall % of utilization
	1	2	3	4	5	6	7	8	9	10	11	12		
Printed materials	4	19	16	5	23	0	13	1	5	9	17	4	116	81.12
Non-print materials	0	0	3	0	0	0	0	0	0	0	1	0	4	2.80
Downloaded from DENR website	0	0	0	0	4	5	0	0	0	0	0	0	9	6.29
Materials used at capability building	7	0	0	2	2	0	0	0	2	1	0	0	14	9.79
Total	11	19	19	7	29	5	13	1	7	10	18	4	143	100.00

Legend: 1. Professional education (BEED); 2. Professional education (BSED); 3. Science, technology, engineering, and mathematics (STEM); 4. Humanities and social sciences (HUMMS); 5. English; 6. Filipino; 7. Mathematics; 8. Physical science; 9. Biological science; 10. Social science; 11. MAPE; and 12. TLE

An important feature of the delivery of the EE-enriched lessons is the inclusion of orientation, pre-test and post-test administration, and, most importantly, the project proposal preparation, revision, and implementation. The orientation provides the participants clearly with the objectives of the engagement, while the pre-test and post-test provide them as well as the teachers with their level of competence in terms of environmental concepts and principles. Of note is the inclusion of project proposal making, revision, and implementation, which allows the students to transfer learning, thus allowing them to apply the knowledge, skills, and attitude they gain from the different lessons and EE activities. In the context of metacognition, the students may be expected to have active participation when they know the purpose of the activities and they know and understand what they know about EE.

The strategies used in the lessons are learner-centered and include lecture-discussion using multimedia presentations, collaborative learning, cooperative learning, reflective learning, game-based learning, and project-based learning, which all involved the learners actively. The formative assessments include individual, dyadic, and small group activities. These include the question and answer, poster making, reflective writing, video analysis, individual writing task using a worksheet, differentiated group tasks using a worksheet, simulated quiz bee, and other learner-centered activities. These lessons used the activity, analysis, abstraction, and application (4As) strategy or present, engage, explore, recall, relate, reflect and create/collaborate (PERC), an innovative learning model designed specifically for these lessons.

Based on the time allotment for each lesson, 60 minutes to 180 minutes or approximately a half-day engagement for two lessons was allotted. The lessons were either equivalent to one session or two sessions depending on the scope of the subject matter. In addition to the explicit EE integration in the lesson proper, EE is also integrated in other parts of the lesson, such as motivation, generalization, evaluation/assessment, and homework/assignment.

As shown in Table 2, the frequency of integration of EE in the 120 lessons aside from the explicit EE integration in the lesson proper ranged from 11 in MAPE to 34 in English. Salient results reveal that the disciplines with the greatest number of integrations in addition to the explicit EE are English with 34 or 13.71%, professional education (BSED) with 29 or 11.69%, and physical science with 28 or 11.29%. Of the total 248 EE integration, the assessment tasks ranked first with 69 or 27.82%. If the homework is not considered, there is a total of 233 EE integration.

Table 2. EE Integration in the different parts of the lesson

Discipline no.	No. Lessons delivered	Part of the lesson					Total	%	Rank
		Motivation	Values integration	Generalization	Assessment	Take-home/assignment			
1	10	0	8	8	4	3	23	9.27	4
2	10	4	1	9	15	0	29	11.69	2
3	10	3	4	5	2	0	14	5.65	9
4	10	4	2	6	10	0	22	8.87	6
5	10	8	10	9	7	0	34	13.71	1
6	10	6	7	6	4	0	23	9.27	4
7	10	5	3	0	4	1	13	5.24	10
8	10	7	5	7	4	5	28	11.29	3
9	10	1	9	3	5	2	20	8.06	7
10	10	3	0	5	5	0	13	5.24	10
11	10	5	4	3	3	3	18	7.26	8
12	10	2	0	2	6	1	11	4.44	12
Total	120	48	53	63	69	15	248		
%		19.35	21.37	25.40	27.82	6.05		100.00	
Rank		4	3	2	1	5			

Legend: 1. Professional education (BEED); 2. Professional education (BSED); 3. (STEM); 4. (HUMMS); 5. English; 6. Filipino; 7. Mathematics; 8. Physical science; 9. Biological science; 10. Social science; 11. MAPE; and 12. TLE

3.2. Students' level of competence in terms of environmental concepts and principles covered

The student's level of competence in terms of the environmental concepts and principles covered by the lessons were gauged considering the test. As shown in Table 3, out of the 2,420 students, 1,111 or 45.91% had a satisfactory level of competence in environmental concepts and principles, while 670 or 27.69% had a very satisfactory level of competence. A minimal number of students had either excellent or poor levels of competence. Generally, the students had a satisfactory or very satisfactory level of competence in EE.

Table 4 summarizes the student's level of environmental competence in the eight 3NS institutions based on the EE test. Generally, students from five institutions (university A, B, D, G & H) had a satisfactory level of competence. Meanwhile, the students from two universities (university C and E) had fair, and students from only one university had a very satisfactory level of environmental competence. It is also noted that the students from university F had the highest mean score (18.72), while the students from university C had the lowest mean score (7.03).

Table 3. Level of competence in environmental concepts and principles per discipline (n=2,420)

Disciplines	Level of EE competence										Total	
	Excellent		Very satisfactory		Satisfactory		Fair		Poor			
	f	%	f	%	f	%	f	%	f	%	f	%
Prof Ed	3	0.75	111	27.82	178	44.61	102	25.56	5	1.25	399	16.49
Content courses	0	0.00	114	27.40	203	48.80	57	13.70	42	10.10	416	17.19
English	16	5.93	83	30.74	106	39.26	57	21.11	8	2.96	270	11.16
Filipino	6	2.80	73	34.11	103	48.13	24	11.21	8	3.74	214	8.84
Mathematics	1	0.45	47	21.36	117	53.18	46	20.91	9	4.09	220	9.09
Biological science	3	1.67	64	35.56	90	50.00	22	12.22	1	0.56	180	7.44
Physical science	0	0.00	46	22.44	88	42.93	69	33.66	2	0.98	205	8.47
Social studies	9	4.86	88	47.57	69	37.30	13	7.03	6	3.24	185	7.64
MAPE	1	0.64	24	15.29	67	42.68	57	36.31	8	5.10	157	6.49
TLE	0	0.00	20	11.49	90	51.72	59	33.91	5	2.87	174	7.19
Total	39	1.61	670	27.69	1111	45.91	506	20.91	94	3.88	2420	100.00

Table 4. Level of environmental competence of students in the 3NS institutions (n=2,420)

3NS Universities	Students' level of EE competence		
	Mean score (30)	Performance level	Interpretation
University A	16.69	54.42	Satisfactory
University B	15.59	51.96	Satisfactory
University C	7.03	10.38	Fair
University D	15.27	50.90	Satisfactory
University E	9.78	33.10	Fair
University F	18.72	62.41	Very satisfactory
University G	14.70	48.98	Satisfactory
University H	16.71	55.65	Satisfactory
Over-all mean	14.31	45.98	Satisfactory

3.3. Effectiveness of the mainstreaming of the EE-enriched lessons in the different teacher education courses

Table 5 shows that the difference between the overall pre-test and post-test results is significant at 0.05% level of significance, with t-test results at 4.83851790. Specifically, the results of the t-test for the eight universities are significant, although the post-test results in five universities (A, B, C, F & H) remained the same compared to the pre-test results in terms of qualitative description. In three universities (D, E & G), the qualitative description of the test results changed from satisfactory to very satisfactory (D & G) and fair to satisfactory (E).

Table 5. Comparison of competence in EE as revealed by the pre-test and posttest of eight universities (n=2,420)

School	Pre-test		Posttest		t-test	p-value	Interpretation
	Mean	I	Mean	I			
University A	16.69	S	19.56	S	4.99441231	0.00053010	Significant
University B	15.59	S	17.56	S	3.17036213	0.00659373	Significant
University C	7.03	F	10.38	F	5.98836265	0.00016381	Significant
University D	15.27	S	22.54	VS	11.48832292	0.00004378	Significant
University E	9.78	F	15.36	S	8.18671439	0.00000920	Significant
University F	18.72	VS	20.55	VS	2.86178431	0.01213778	Significant
University G	14.70	S	22.91	VS	7.11814364	0.00002777	Significant
University H	16.71	S	17.58	S	2.11318403	0.03622350	Significant
Over-all mean	14.40	Satisfactory	18.60	Very satisfactory	4.83851790	0.00064528	Significant

4. DISCUSSION

In the design and development of the EE-enriched lessons, the presentation of content and the pedagogy underpinning the curriculum design, which shapes the framing and its effect on learning [29], were considered. These EE-enriched lessons in the different teacher education courses represent a significant contribution to the explicit integration of EE in formal education in the country since teacher education is one of the areas to focus on in environmental and sustainability education (ESE) [30]. These materials can be considered a contribution to the national agency, the DENR, in promoting environmental awareness and education in the academe [2] and, therefore, partly addressing the lack of teaching and learning resources related to EE [26]. The incorporation of environmental values and concepts in the various teacher education courses supports UNESCO's argument that teacher education programs play a critical role in the global

education community and have the ability to bring about improvements in education systems that will form the awareness and skills of future generations [6].

Overall, this mainstreaming of EE in the teacher education curriculum can be considered as "greening the curriculum" [7]–[11], which can be considered flexible since the EE integration can be done in the different parts of the lessons. This EE integration is beyond what Pasin and Bozelli [16] noted as the EE integration from the biological perspective in contrast to a small number of courses that discuss and promote EE from other perspectives. Caceres [31] argued that it is necessary to break the hegemony of the discoveries of science over other disciplines in EE. And such breaking of the hegemony is evident in the mainstreaming of EE in the teacher education curriculum, which can be aptly considered as a response to what Glackin and King [13] call as learning about the environment rather than for the environment.

The initiative to mainstream EE in the teacher education can also be seen as preparation for environmental educators. Eames and Birdsall [32] argued that environmental educators need pedagogical content knowledge – what to teach and how to teach it. This pedagogical content knowledge can be addressed during the pre-service teacher training through the EE-enriched lessons in the different courses rather than offered as a separate environmental science course. This kind of integration may also be seen as a way of expanding the future teachers' critical and transdisciplinary thinking about the field of EE [33].

Universities need to provide structured curricula that introduce students to EE, awareness, and critical thinking skills to encourage environmental literacy and discuss sustainable lifestyles and attitudes [34]. The mainstreaming of EE in the teacher education curriculum is an initiative to formalize the integration of EE in the curriculum at the higher education level with a national scope. Hence, the concerned national agencies such as the CHED and DENR may see this initiative as worthy of support.

The students' overall satisfactory level of competence may be explained by their exposure to environmental activities or education in the previous years or through other non-formal means such as personal reading or exposure to mass media and internet sources on EE. While these results are expected and favorable already since the students had exposure to EE in the previous years, the results suggest that they do not have a full understanding of the different environmental concepts and principles; hence over time, they may have gained some misconceptions, or that they may have no regular transfer of learning of environmental concepts and principles to everyday life through pro-environmental behaviors. Thus, it is still essential to have a review or refresher on environmental concepts and principles since environmental knowledge or environmental awareness does not guarantee pro-environmental behavior [17] and since EE should also improve skills and enable sustainable action aside from building understanding [14].

Moreover, the results imply the need for an institutionalized EE program for pre-service teachers and a wide-ranging "greening" of the teacher education curriculum either as integration in the courses where appropriate or as a comprehensive after-class program or academic support/enrichment EE program. Though the universities engage in activities or initiatives related to environmental protection and promotion through different organizations or clubs, these do not constitute an institutionalized comprehensive EE program for the pre-service teachers in general. Hence, there is a need for an institutionalized EE program which should be subjected to evaluation. Keene and Blumstein [35] propose that an evidence-based movement would improve the legitimacy and efficacy of EE. A culture of appraisal provides educators with a strong forum for the collaborative and productive accomplishment of the environmental objectives of the society.

Generally, these results imply that the exposure of the teacher education students to EE in the form of mainstreaming EE in the lessons significantly improved their level of environmental competence. These results imply that information or inputs during the EE integration or EE activities are relevant, the time devoted to EE is adequate, the strategies used are effective, and the activities are meaningful and actively engaged the learners, which were all supported by the class observations. Generally, the students gained significant learning experiences adequate to make them significantly improve their level of environmental competence.

Considering the framework of this study, the EE intervention conducted in eight 3NS universities is effective in attaining the three purposes of EE [14], which include building understanding, improving skills, and enabling sustainable action, and values clarification. In particular, the improvement of skills, clarification and strengthening of values, and enabling of sustainable action were shown through authentic assessment results, as evidenced by the project proposal making, project implementation, and project implementation assessment. As the students took action through their projects, the action competence approach, a necessary alternative to the traditional science-oriented approach to EE [36], came into play. These learner-center strategies, as purported by the research framework like active learning, collaborative learning, inquiry-based learning, contextual learning, project-based learning, and service-learning, may have stimulated the active participation of the learners adequately, thus led to significant learning. An important reason that explains the effectiveness of the EE mainstreaming can be attributed to the use of effective EE practices cited by Stern, Powell, and Hill [12], which Sims, Asselin, and Falkenberg [37] call as effective ESE pedagogical strategies.

As noted by the observers, the effective and efficient delivery of these lessons is also considered instrumental in the effectiveness of the EE intervention. The teacher's commitment, as mentioned by the students in the focus group discussions, may have sustained the motivation of the students to perform their tasks related to the environmental integration in the lessons, thus, retaining the environmental concepts and principles. This finding affirms the crucial role of the teacher [26] in the implementation of EE programs. It is implied that the delivery of the EE-enriched lessons, together with the teachers' commitment, may have led to the fostering of emotional well-being and promotion of hopefulness of the learners, which are typically given little attention in EE [38].

Students reported that they realized the significance of the lessons embedded with environmental concepts and principles as they have applied such to their daily lives already, as shown by responsible use of electricity and water (such as turning off lights when not needed, exercising practicality when washing clothes, using used water for watering plants), the practice of reduce, reuse and recycle (such as carrying of eco bags, reusing back part of the paper, using boxes or empty containers of food and groceries for some practical purposes such as organizing), and making a clean and green environment (such as segregating waste, minimizing waste, proper waste disposal and planting trees). This finding then suggests that the students' environmental knowledge was manifested in pro-environmental behaviors, contrary to the findings of Kollmuss and Agyeman [17].

In brief, the mainstreaming of EE in the teacher education courses effectively prepares the students to become eco-mentors. Through their performance in the test and, more specifically, in the project proposal making and implementation, these eco-mentors can be expected to become dedicated, empowered, engaged, nurturing, responsible and resilient teachers. Elliot, Dueck, and Rodenburg [39] argued that pre-service teachers who learn to collaborate with their community as a source of expertise and encouragement are more likely to create positive and lasting change in ESE. These results suggest that the "greening" of the teacher education curriculum may now be institutionalized without incurring additional units and costs on the part of the students. Subsequently, the teacher education institutions (TEIs) in the country may now proactively assist the DENR in the implementation of the National Awareness and Education act of 2008 and fulfill its key role in reorienting education for sustainability which integrally includes EE [6].

Since the EE-enriched lessons pilot testing is found to be effective, further validation can be carried out in the light of recent EE-enriched frameworks. For example, Clark *et al.* [40] suggest that EE work to shift people to action for the concrete benefit of the world and humanity. Wi and Chang [41] have proposed a transformative climate change education (TrEC) curriculum that emphasizes awareness, skills, and values to help people understand environmental problems and inspire them to take environmental action. Thus, both Monroe, Andrews, and Biedenweg framework for EE [14] used in this study, together with the five core outcomes for EE suggested by Clark *et al.* [40], and Wi and Chang's [41] TrEC may be considered in further improving and refining the mainstreaming of EE in the teacher education curriculum.

The further validation of the EE-enriched lessons in the different teacher education courses needs to consider contextualization since the different universities involved have different contexts. After all, as a condition of meanings and actions, the place is a dimension capable of contributing to the contextualization of EE [42]. In this way, the EE in the teacher education curriculum will not only be learning for the environment [13] but, more importantly, learning for the local environment. Areas for consideration in the further validation of the mainstreaming of EE in the teacher education curriculum include environmental philosophies [43], the time spent on the program since positive effects increase with time [44], promotion of collective responsibility in EE [45], and examination of EE practice innovations at the group rather than individual level [46].

Overall, the results of this study have shown to address gaps in the literature, such as the lack of substantial coverage of EE in the curriculum, specifically the teacher education curriculum. Notably, the current study provides evidence that EE can be substantially covered in the different fields of specializations in the teacher education curriculum. A specific example is the integration of environmental concepts and principles in the different parts of the lessons, such as the motivation, lesson proper, values integration, generalization, assessment, and homework. Moreover, the current study specifically addressed the gap in the strategies used in EE, such as the use 4As and PERC, an innovative learning model designed for this specific study. These two strategies were not specifically mentioned in the literature as strategies in EE.

In a country such as the Philippines, where the transversal integration of EE in the teacher education is yet to occur, the EE integration considered as "greening the curriculum" is done by embedding environmental concepts and principles in the different lessons as appropriate. This EE integration allows for learning environmental concepts and principles in an iterative process. In this way, the environmental concepts and principles are tackled repeatedly in the different learning tasks in the different lessons across learning contents or courses and year levels. The repeated tackling of environmental concepts and principles leads to the idea that environmental concepts and principles are interwoven in different learning contents, thus relevant to different aspects of life. Therefore, this mainstreaming of EE in the teacher education

curriculum serves as a compelling prelude to the transversality of EE in the curriculum in the country. Given the favorable results, the curriculum makers, policymakers, and academic leaders, primarily of TEIs, will be adequately informed to move toward making EE an integral part of the teacher education curriculum. Moreover, the nationwide dissemination of the validated EE-enriched lessons is important to start significant action towards nurturing the future eco-mentors. Essentially, this represents strong support for the law called the National Environmental Awareness and Education Act of 2008 [2].

5. CONCLUSION

The national initiative to mainstream EE in the teacher education program is significant. The mainstreaming can be done by integrating environmental concepts and principles in the different parts of the lessons using the EE materials developed by the DENR and other resources. The results of the pilot testing have shown that the implementation of the EE intervention in the form of lecture series using the EE session plans in the teacher education was found effective in enhancing the level of environmental competence of the students, as confirmed by the significant increase in tests results of the students. In addition, the efficacy of the intervention was noted through the students' improved skills and enhanced environmental behaviors, as demonstrated in the implementation of the capstone class project. It is believed that with the continued institutionalized inclusion of the EE in the teacher education curriculum, the environmental competencies of the future teachers will be enhanced, motivating them to correct their anti-environmental habits or irresponsible environmental behaviors.

Further validation of the mainstreaming of EE in the teacher education curriculum may be conducted in other higher education institutions (HEIs) such as private universities or community colleges. For future research, areas to be explored include further validation of assessment tools on EE, including practice-based learning or contextual learning assessment, development and validation of other lessons using other strategies such as phenomenon-based learning, and development and validation of instructional materials on EE. Other studies that may be pursued include the application of the environmental concepts and principles gained from the lessons a follow-up study on how the teacher education students' attitudes towards the environment have been changed or enhanced, and addressing gender issues related to the EE integration in the lessons, materials and assessment tools.

The limitations of this study pertain to the choice of EE concepts and principles integrated in the different lessons. These were solely based on the EE materials officially provided by DENR to Bicol University. The point of integration for EE in the different lessons was based on the existing syllabi for teacher education courses at Bicol University. These were the bases for the EE integration since there is no existing syllabus containing the EE concepts and competencies sequenced in spiral progression as a standard reference for preparing the EE-enriched lessons.

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