

## Development of Learning Materials in Environmental Science Based on Intellectual Capacity, Personal, and Civil Responsibility Assessments

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### Abstract

*In educational institutions, the development of learning materials is regarded as one of the major aspects that would promote student learning and help in the achievement of academic goals and objectives. To enrich the system of education, research need to be conducted and innovative methods to be promoted. The development in learning materials is brought about on the basis of number of aspects. In this study, the intellectual capacity, personal and civil responsibility on environmental science of the fourth year Bachelor of Secondary Education major in Biological Science students in one of the universities in Iloilo, Philippines were assessed using the validated researcher-made instruments based on the contents of the college readiness standards as described in Commission on Higher Education Memorandum Order (CMO) No. 20 series of 2013. Intellectual capacity gaps were identified by means of least test scores and less than half of the students got the test items correctly from the different topics of the subject while the personal and civil responsibility were noted from the least mean results of the answers of the participants in the questionnaires. Consequently, the identified gaps of the assessments serve as basis for the development of appropriate learning materials. Results revealed that the students had moderate level of intellectual capacity on the contents of environment and its components, ecological concepts, biodiversity, sustaining resources and environmental crises as well as a low level on environmental laws and management. For the personal and civil responsibility, the students showed moderately desirable attitudes toward accessing, validating, and sharing of environment-related information, a high and low level of participation in an individual and agency led initiated environment-related activities respectively. Among the identified gaps in intellectual capacity include the environmental management and laws; low level of awareness on various environment-related programs and plans of local government units, low level of participation in some environmental related activities initiated by agencies and unexplored potential of social media were descriptively statistically described as significant in the personal and civil responsibility. Correcting the gaps of these variables is important because it could improve competence and performance outcomes of the students. An Analysis, Design, Development, Implementation and Evaluation (ADDIE) model was utilized in developing the appropriate learning materials which were firmly woven based on solid evidence of the gaps identified in the intellectual capacity, personal and civil responsibility of the learner relative to this subject. Conclusively, the data pertaining to these capacities of students on Environmental Science is highly imperative to attain the penultimate objective of teaching this subject effectively.*

**Keywords:** Environmental Science; Environmental awareness; Attitudes; Development; Learning materials

## Introduction

### Background, Rationale, and Problem Statement

The Philippines is beset with environmental concerns brought about by inevitable development and increasing human population. Among these immediate concerns are pollution (air, land, and water), garbage, disasters, and loss of biodiversity that have ushered local natural resources into a dwindling state (Philippine Development Plan 2011- 2016 Result Matrices, 2011) as well as threatens food security, human health, and environmental sustainability. Despite these concerns, most Filipinos seem to stay complacent as it was recently reported that the trend in frequency and prevalence of environmental behaviours among Filipino adults has decreased from 1993 to 2010 (Reyes, 2014). Interestingly, however, the study of Reyes also revealed that education is a strong factor that influences behaviour. Hence, environmental science is regarded as a medium in developing environmentally responsible behaviour. Through environmental science, it is hoped that the society can develop environmentally literate citizens who are aware of as well as concerned about the environment and its associated problems. Specifically, it deals with the basic ecological concepts and principles of environmental problems and ways that would lead to the minimization, if not eliminate, of these problems. Moreover, it will also study patterns and processes in the natural world and their modification by human activity. These environmental problems together with the social, political and technological changes going on in the country have created greater demands and challenges to the education sector. Accordingly, the different levels of education have started to review and modify their curricula in order to meet these new demands. One of the strategies used to respond to these demands for change is to incorporate societal issues, including environmental issues, into the curricula and other educational programs.

Relative to this, the National Environmental Education Action Plan (the blueprint for implementing Republic Act (RA) 9512 - The Environmental Education and Awareness Act of 2008 (Chandran, Gunawardena, & Castro, 2017), recognized the need to undertake curricular studies to improve the present integration of environmental concerns in the curriculum which is offering Environmental Science as a general elective course in all tertiary students being offered during their freshmen and sophomore years. The undertaking of curricular study intends to achieve the objective of improving the delivery system of environmental education. In consonance with this need, the production of appropriate materials for the infusion of environmental dimension in selected subjects and courses was listed among the priority initiatives to further improve the delivery system. For instance, in 2017, the Commission on Higher Education issued a Memorandum Order No. 75 series (CHED, 2017) which set the policies, standards, and guidelines for Bachelor of Secondary Education (BSEd). Interestingly, under the BSEd Major in Science, one of the major courses which can be offered to students is Environmental Science.

In furtherance of the ongoing paradigm shift to learning competency based standards in Philippine higher education that underlies the provisions of Commission on Higher Education (CHED) Memorandum Order No.20 series (CHED, 2013), it aims to develop the three categories of competency based outcomes. These include the intellectual competencies, personal and civil responsibility for it is the fundamental purpose of higher education to produce well-rounded individuals who appreciate knowledge in a general sense, are open-minded because of it, secure in their identities as individuals also as Filipinos and cognizant of

their role in the life of the nation as well as the larger community Commission on Higher Education (CHED) Memorandum Order No.20 series (CHED, 2013).

While there is a growing interest among students to pursue this major course, there appears the lack of learning materials which are firmly woven based on solid evidence of knowledge and attitudes of the learner relative to this subject. If there is any available learning material for Environmental Science for Bachelor of Secondary Education major in Biological Science students, this needs to be developed by integrating the knowledge and attitude of students taking or interested in the course. This, therefore, signifies the essentiality of learner-centered design or teaching which takes into account interest of the learner, follows students' passions and capitalizes on their strength, helps students form a strong learning community, gets away with the idea of the teacher as the primary expert of the class, as well as works towards meeting individual students' needs as they grow.

The intellectual capacity, personal and civil responsibility data are essential in planning, implementing, and evaluating the current status of offering the Environmental Science subject. What will be known on these areas can expose many things which are highly significant either to develop learning materials or to evaluate the subject to a greater extent which is a more measured perspective based on the context of the student views and learning experience through time.. In the same vein, the amount or pieces of data relative to the knowledge gaps, the level of personal and civil responsibility of students may help in deepening the understanding of implementing whatever courses that are offered by an institution. This can serve as basis in aligning priorities and activities as well as harmonizing plans and programs intended for the course to achieve the expected results. In achieving quality education, specifically in offering the Environmental Science course, determining the intellectual capacity, personal and civil responsibility of students may facilitate the identification of needs, barriers, as well as solutions in program implementation particularly in designing and developing learning materials.

Given the fact that there is none or dearth of studies which focus on the intellectual capacity, personal and civil responsibility of students on Environmental Science as well as stressing the importance of learners' perspectives in formulating learning materials, the need to do research along this line is therefore imperative. This research endeavour with lens of magnifying the importance of intellectual capacity, personal and civil responsibility of students in Environmental Science is hoped to significantly contribute to the delivery of improved and quality education among college students.

### **Purpose of the Study and Research Questions**

This study aimed at assessing the level of intellectual capacity, personal and civil responsibility among 4<sup>th</sup> year students of Bachelor of Secondary Education major in Biological Science in one of the Universities in Iloilo, Philippines who were enrolled in Environmental Science during the first semester of academic year 2018-2019. Consequently, the study intended to develop a learning material based on the result of the assessment. Specifically, the study sought answers to the following questions:

1. What is the level of intellectual capacity of students on Environmental Science?
2. What is the level of personal and civil responsibility of students towards Environmental Science?

3. What are the gaps and barriers related to intellectual capacity, personal and civil responsibility of students?
4. What learning materials to be developed in teaching Environmental Science?

## **Review of Related Literature and Methodological Issues**

### **Environmental Science and Its Importance**

Environmental science is a broad, interdisciplinary field integrating aspects of biology, chemistry, earth science, geology, and social sciences. Being both holistic and reductionist, environmental science plays an increasing role in inquiry into the world around as well as in efforts to manage society and promote sustainability. Also, it is defined as the study of social science to understand human interactions with the environment and the effect of man-made programs on the environment, as well as for finding solutions to help protect and preserve the environment (Botkin & Keller, 2003). This subject also teaches man to use natural resources efficiently by: appropriately putting into practice environmental conservation methods; using the right tools to explore resources; adding value to natural resources; making sure machines are maintained appropriately; thorough training of human resources; provision of effective and efficient supervision; using the right techniques to minimize exploitation; as well as to understand behavior of organisms under natural conditions (Mayer, 2001).

### **Environmental Science Education in Tertiary Schools**

Republic Act No. 9512 (2008) which was enacted last December 12, 2008 provides that “environmental education shall encompass environmental concepts, principles and laws; state of international and local environment and its best practices; the responsibility of citizenry to the environment; the value of conservation, protection, rehabilitation and sustainable development of natural resources” (p.2). This provision will be used as a guide in the preparation of the research instrument in environmental science.

The National Environmental Education Action Plan (2018-2040) is the country’s official, national framework and guide to Education for Sustainable Development (ESD) (Galang, 2010) which is under the umbrella of Environmental Education (EE), accordingly specified that environmental education for higher educational level should provide students with a clear understanding of the intricacies and complexities of the different components of the environment, both natural and human-made ecosystems, enable to acquire a working knowledge of the interrelationships between humans and the different ecosystems, inculcate a set of values appropriate to the Filipino culture, be responsive to the present needs of the country as well as be anticipative in future needs, stress the importance of sustainable development and integrate into the general education curriculum, the significance of natural systems and environment as economic sources of growth also life-support systems. It is in the light of this integration that this study was conceived.

Commission on Higher Education (CHED) Memorandum Order No. 33 series (CHED, 2009) mandated tertiary education institutions to offer Environmental Education in the curriculum. Hence, this present study which will lead to the development of instructional material as output finds relevance in being aligned to the commitment of the Commission on Higher Education (CHED) to the implementation of Republic Act (RA) 9512.

## Instructional Material Development

Instructional material development is a systematic and reflective process of translating the principles of learning and instruction into plans (Smith & Ragan, 2010). One of the widely used model for preparing instructional materials is the ADDIE Instructional Model (Kurt, 2017) which stands for 'Analysis, Design, Development, Implementation and Evaluation'. The first step is to 'Analyze' and understand all aspects of the educational problem. The second step, 'Design', considers all components of instruction: evaluation, teaching strategies, implementation, course content, methods, and media. The third, 'Development', is where the 'needed things' are created: lecture material, visual aids, rubrics, etc. It is also important to validate what is being developed at this phase. 'Implementation' phase is where the actual instruction takes place. All planning and design are staged in this phase. 'Evaluation' phase tells whether or not the objectives are met and gathers information as to how the instruction can be improved.

There are a number of instructional models to choose from but for the purpose of designing an instructional material for environmental science education, the researcher preferred the 5E Instructional Model (Bybee et al., 2006) which proceeds in five phases: engagement, exploration, explanation, elaboration, and evaluation. Table 1 summarizes the significant activity undertaken in every phase:

Table 1

*Summary of the 5E Instructional Model (Bybee et al., 2006)*

Phase	Summary
Engagement	The teacher accesses the learner's prior knowledge and helps them become engaged in a new concept through the use of short activities that promote curiosity and elicit prior knowledge.
Exploration	Exploration experiences provide students with a common base of activities within which current concepts, processes, and skills are identified as well as conceptual change is facilitated
Explanation	This phase focuses on students' attention on a particular aspect of their engagement and exploration experiences and provides opportunities to demonstrate their conceptual understanding, process skills, or behaviours.
Elaboration	Teachers challenge and extend students' conceptual understanding and skills. Through new experiences, the students develop deeper and broader understanding, more information, and adequate skills.
Evaluation	This encourages students to assess their understanding and abilities and provides opportunities toward achieving the educational objectives.

## Research Design and Methodology

### Research Design

The study utilized the descriptive statistics and instructional material development research design. Descriptive data gathered were analyzed and used to describe the students' intellectual capacity, personal and civil responsibility as well as utilize it to create an appropriate instructional material in Environmental Science. The Analysis, Development, Design, Implementation and Evaluation (ADDIE) model was used in crafting the appropriate



instructional material development based on the identified gaps of the assessment in intellectual capacity, personal and civil responsibility.

## Research Methods

**Participants.** The participants of this study who answered the instruments after being pilot tested were taken from the sixty (60) fourth year students of Bachelor of Secondary Education major in Biological Science who were enrolled during the academic year 2018-2019 in one of the universities in Iloilo and had taken Environmental Science subject.

The information presented in Table 2 shows the distribution of the participants according to school and sex. The table reveals that 40% of the participants were taken from Miagao Campus and 60% were from La Paz Campus. Furthermore, 12% of the participants were male and 88% were female.

Table 2

*Distribution of Participants According to School Campus and Sex*

Sex	Miagao (n=24)		La Paz (n=36)		Total (n=60)	
	Frequency	%	Frequency	%	Frequency	%
Male	5	21	2	6	7	12
Female	19	79	34	94	53	88
<b>Total</b>	<b>24</b>	<b>100</b>	<b>36</b>	<b>100</b>	<b>60</b>	<b>100</b>

Procedures following the ADDIE Model as Basis for the Development of Learning Materials in Environmental Science are elaborated below.

**Analysis Phase.** The identified learning gaps in this study were determined from the means of least test scores and less than half of the students who got the test items correctly from the different topics of the subject while the personal and civil responsibility were noted from the least mean results of the answers of the participants in the questionnaires. These became the basis in the development and design of the content of the learning materials for this subject

**Development Phase.** The reliability and validity of the intellectual capacity, personal and civil responsibility researcher-made assessment tools were pilot tested to the thirty-seven (37) Second Year Bachelor of Science in Hotel and Restaurant Technology students who already took up Environmental Science and furthermore evaluated by three (3) external experts as panel members who made the constructive comments to the congruency of the contents of the instruments. Moreover, five (5) faculty members of the Science Department act as observers and evaluated the content and alignment of the learning materials to address the identified gaps of the assessment conducted. The pilot tested researcher made assessment tools were improved based from the comments of the evaluation of the panel members, faculty members and results of the validity and reliability of the students before it was conducted to the participants of the study.

**Design Phase.** For this respect and as respond to the identified gaps from the analysis phase, learning materials were prepared and designed using 5E Instructional Model by Bybee, et al. (2006).

**Implementation Phase.** In this phase, the researcher requested one College Science Instructor teaching Environmental Science to enact the developed learning material to the

twenty-five (25) Second Year College Bachelor of Science in Information Technology students in one of the Universities in Miagao Campus and it took four days (4) at one hour per lesson a day to finish the four lessons of the two modules developed. Observation sheets for the lesson presented were given and evaluated to the five (5) teacher observers of the Science Department and another three (3) external experts.

**Evaluation Phase.** The final evaluation and revision of the learning materials were analyzed by the panel members which consists of one (1) College Science Professor teaching Educational Technology, one (1) College Professor who acted as Chairman of the Instructional Material Development in one of the Universities in Iloilo and one (1) Professor major in Curriculum Development. All the students who participated in the implementation phase were asked to write a personal reflection and comments at the end of every lesson. A researcher-made evaluation rubric was prepared by the researcher based on the criteria for evaluations of modules were given panel members.

**Instruments.** A researcher-made instrument was designed to answer the problems of the study. The contents were attuned to the Environmental Science subject of the General Education Curriculum of Bachelor in Secondary Education major in Science as per Commission of Higher Education (CHED) Memorandum Order No. 20 series (CHED, 2013). It is divided into 4 parts, namely: Part 1. Profile of Participants; Part 2. Intellectual Capacity; Part 3. Personal Responsibility and Part 4. Civil Responsibility. The internal consistency of part 2, 3 and 4 of the instruments were subjected to reliability test during the pilot testing of the instruments to the thirty-seven (37) participants from second year Bachelor of Science in Hotel and Restaurant Technology (BSHRT) students. Scores of the participants in every part of the instrument were analyzed using the Cronbach alpha test in SPSS which suggest that if the obtained values of Cronbach alpha is 0.70 and above, the instrument is good, 0.80 and above is better, and 0.90 is best in terms of how closely related a set of items are as a group (Traub, 1994).

**Part 1- Profile of Participants** gathered information on each student's name, age, sex, and general weighted average in Environmental Science.

**Part 2- Intellectual Capacity** tested the level of knowledge of students to include environment and its components, ecological concepts, biodiversity, sustaining resources and environmental crises, as well as sustaining human societies as indicated in the Table of Specification (See Appendix 1). Coverage for the intellectual capacity of students in Environmental Science was based on the course description of Commission on Higher Education (CHED) Memorandum Order No.75 series (CHED, 2017). The researcher-made intellectual capacity instrument was in the form of a written, multiple-choice type of test guided by Ramsey, Hungerford and Volk (1989). Every correct answer is counted one point. The least count of items (i.e. bottom three) from the different components of the questions and items at which less than half of the students got it correct were considered as gaps in this assessment. This instrument has an 80-item knowledge test with a Cronbach alpha value of 0.77 which implies that the researcher made instrument was good and recommended for implementation use. The intellectual capacity mean percentage score was construed as the level of students' intellectual capacity described is Very High, High, Moderate, Low, or Very Low (Table 3).

Table 3

*Mean Percentage Score Description for Intellectual Capacity*

Mean Percentage Score	Qualitative Rating	Qualitative Description
86-100	Very High	means that students are highly knowledgeable in the contents that are included in the instrument
76-85	High	means that students are very knowledgeable in the contents that are included in the instrument
50-75	Moderate	means that students have an average level of knowledge in the contents that are included in the instrument
17-49	Low	means that students are fairly knowledgeable in the contents that are included in the instrument
0-16	Very Low	means that students are poorly knowledgeable in the contents that are included in the instrument

**Part 3-Personal Responsibility.** This part of the instrument gathered information on the level of awareness of students on environmental policies; rules and regulations; different environmental key activities; and the attitudes of students towards accessing, validating, and sharing environment-related information. There were fifteen (15) questions on awareness of students on environmental policies, rules and regulations, ten (10) items for the level of awareness of different environmental key activities and twenty-six (26) questions for attitudes of students towards accessing, validating, and sharing environment-related information.

This instrument was constructed in a five- point Likert-type scale with the assumption that it is possible to discover attitude by asking the individual to respond to a series of statements of preference (Fraenkel & Wallen, 2010). Items were constructed based on the awareness of students' in environmental policies, rules and regulations, and different environmental key activities. It consisted of statements if the students were highly aware or not with the law, policies and regulations and environmental key activities. Moreover, it consisted of statements on whether the students were highly desirable or not with their attitudes towards sourcing, sharing, and validating of environment-related information. Qualitative ratings were given with the corresponding mean score and descriptions as to the level of awareness as well as participation on environmental policies, rules and regulation also environment-related activities as shown in Table 4.

Table 4

*Mean Score Description for Level of Awareness and Participation on Environmental Policies, Rules, and Regulations and Environment-Related Activities*

Mean Score	Qualitative Rating	Qualitative Description
3.51-4.00	Highly aware	means that students are highly aware of the activity or law
1.51-2.50	Poorly aware	mean that students have poor awareness of the activity or law
2.51-3.50	Aware	means that students are moderately aware of the activity or law
1.00-1.50	Very poorly aware	means that students are very poorly aware of the activity or law



On the other hand, Table 5 shows the qualitative ratings with the corresponding mean scores and descriptions of the attitudes toward accessing, validating, and sharing of environment-related information. This instrument had a Cronbach's alpha value of 0.86 which implies that the researcher made tool was better and ready for implementation.

Table 5

*Mean Score Description for the Attitudes towards Accessing, Validating, and Sharing of Environment- Related Information*

Mean Score	Qualitative Rating	Qualitative Description
4.51-5.00	Highly Desirable	Means that the students exhibit highly desirable attitudes towards accessing, validating, and sharing of environment-related information
3.51- 4.50	Desirable	Means that the student exhibit satisfactory attitude towards accessing, validating, and sharing of environment- related information
2.51-3.50	Moderately Desirable	Means that the students moderately exhibit desirable attitudes towards accessing, validating, and sharing of environment- related information
1.51- 2.50	Undesirable	Means that the students fairly exhibit desirable attitudes towards accessing, validating, and sharing of environment-related information
1.00-1.50	Highly Undesirable	Means that the students poorly exhibit desirable attitudes towards accessing, validating, and sharing of environment- related information

**Part 4-Civil Responsibility** gathered information on students' level of participation in different programs and activities which are part of individual initiative and initiated or led by an agency. This instrument surveyed the intentional behaviours that students do either to participate or not to the environment- related activities individually or agency-led initiatives.

A total of twenty (20) items were included and the 4 point-Likert type scale was used. The students rated the listed environmental-related activities by checking in the column corresponding to their choices. Qualitative ratings were given the corresponding mean scores and description as shown in Table 6. This instrument had a Cronbach's alpha value of 0.71 which implies that it was good and ready for implementation.

Table 6

*Mean Score Description of the Level of Participation in Environment-Related Activities Initiated by an Individual or Agency-led Initiatives*

Mean Score	Qualitative Rating	Qualitative Description
3.51-4.00	Very High	means that students are highly participative in the activity
2.51-3.50	High	means that students are moderately participative in the activity
1.51-2.50	Low	means that students are poorly participative in the activity

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1.00-1.50	Very Low	means that students are very poorly participative in the activity
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### **Validation of Instruments**

The drafts of the instruments were submitted and evaluated to three Science Professors for content validation. Revisions were made considering their recommendations. The instruments were then pilot tested and personally administered by the researcher to the thirty-seven (37) participants from second year Bachelor of Science in Hotel and Restaurant Technology (BSHRT) students enrolled in Environmental Science during the first semester of the academic year 2018-2019. It was assumed that the second year students had taken the Environmental Science course. After the instruments were pilot tested, the results of the test scores of the intellectual capacity test were subjected to item analysis, discrimination indices and reliability test using the Cronbach alpha test in SPSS which was also used to analyze the reliability test of the personal and civil responsibility instruments. After the Cronbach alpha values of the reliability test of the different instruments were computed and its obtained values were good, the instruments were now ready for implementation to the participants of the study (i.e. 4<sup>th</sup> year BSED major in Biological Science).

Item analysis was used to determine the item difficulty and a process which examines student responses to individual test questions in order to assess the quality of those items and of the test as a whole. It is especially valuable in improving items which will be used again in later tests, but it can also be used to eliminate ambiguous or misleading items in a single test administration (Traub, 1994).

Discrimination indices (i.e. Upper –Lower Index Method) were used to measure an item's ability to discriminate between those who scored high on the total test and those who scored low, thus, it can differentiate among students on the basis of how well they know the material being tested (Kelley, Ebel, & Linacre, 2002).

Cronbach alpha test was used to measure how closely related as set of items are as a group and how consistent the results from the test are (Traub, 1994).

### **Data Collection Procedure**

A letter requesting for permission to conduct the study was sent to the University President for approval. Upon approval, the researcher arranged a schedule with the respective deans of the different departments, where the participants belonged. Then the researcher arranged the schedules of students with their respective teachers for the administration of the instrument in their respective classes. Students were requested to accomplish the survey questionnaire. They were given one hour and ten minutes to answer each instrument completely. The researcher made sure that all the items were filled up completely or answered by respondents prior to accepting their submission unless the students expressed discontinuity.

### **Data Analysis Procedure**

Mean, standard deviation, frequency count, and percentage were used to analyze data on intellectual capacity, personal responsibility and civil responsibility. Likert's scale was used to determine the level of intellectual capacity, personal and civil responsibility of the students.

## Development of Instructional Material (Module)

The development of instructional material in Environmental Science was based on the result of the assessment of intellectual capacity, personal and civil responsibility among teacher education students for the second semester of academic year 2018-2019 in one of the universities in Iloilo and was conducted accordingly as follows: (a) construction of data-gathering instrument and assessment tool; (b) pilot testing for the reliability and validity of the researcher-made assessment tool; (c) assessment of intellectual capacity, personal and civil responsibility among students; (d) analysis and gap identification of results; (e) development of learning materials based on data gathered from intellectual capacity, personal and civil responsibility assessment instrument result; (f) the created learning material was pilot tested; (g) evaluation of instructional material; (h) revisions of instructional material; (i) actual study of instructional material; (j) final instructional material

On the other hand, the ADDIE Instructional Design Model was used to direct the creation of instructional material in Environmental Science in the form of a module as shown in the steps below:

- (1) *Assessment* of Intellectual Capacity, Personal and Civil Responsibility among Students;
- (2) *Design* of Instructional Material;
- (3) *Development* of Instructional Material and Pilot Testing;
- (4) *Implementation* of Instructional Material through Actual Study;
- (5) *Evaluation Assessment* of Appropriateness, Effectiveness, and Relevance of Instructional Material.

## Results and Discussions

### Level of Intellectual Capacity of Students on Environmental Science

Making assessment an integral part of daily Environmental Science instruction is a challenge. It requires planning specific ways to use assignment and discussions to discover what students do and do not understand. Table 7 presents the level of intellectual capacity of students in Environmental Science based on the major components included in the course description of the subject stated in CMO No. 75 series of 2017 as expressed in mean percentage scores.

Table 7

*Level of Intellectual Capacity of Students on Environmental Science*

Major Components	No. of Item	Mean Percentage Score	Standard Deviation	Qualitative Description
Environment and Its Components	14	76.55	2.65	High
Ecological Concepts	23	64.57	3.24	Moderate
Biodiversity	20	73.58	2.29	Moderate
Sustaining Resources and Environmental Crisis	15	69.67	2.51	Moderate
Environmental Laws and Management	8	43.13	1.43	Low
<b>Overall Level</b>	<b>80</b>	<b>65.50</b>	<b>8.98</b>	<b>Moderate</b>

Note: Mean is described as follows: 86-100=Very High; 76-85= High; 50-75= Moderate; 17-49= Low; 0-16= Very Low

The overall level of knowledge was “moderate” ( $M = 65.50\%$ ;  $SD = 8.98$ ). This means that fourth year BSED major in Biological Science students had obtained an average foundational literacy in the major components included in the test items of environmental science in this study. It comes from recognizing how much learning is taking place in the common task of the school day instruction and how much insight into students learning, teachers can check out from this assessment (McNamee & Cheen, 2005). Furthermore, the students were highly knowledgeable in topics related to environment and its components ( $M = 76.55\%$ ;  $SD = 2.65$ ) which means that the students have a broad conceptual insights, relationships and context with the understanding of the detailed insight pertaining to these topics. This can be attributed also that these topics were already taught in elementary level of their science subjects, consequently, they have prior understanding and knowledge to these topics already. On the other hand, topics such as ecological concepts, biodiversity, sustaining resources, and environmental crises, the students manifested moderate level of knowledge, indicating that the students give a minimal response that is correct and fails to show the depth of their scientific and environmental knowledge and understanding. They may be confused about what constitutes the best answer, or they do not have the prior knowledge of the subject matter. Results of this study conforms to the study of Ejem and Bello (2013) on the moderate knowledge capacity among freshmen students in Bukidnon State University on some areas of environmental science (i.e. ecological concepts, biodiversity and environmental problems). Moreover, Sadik and Sadik (2014) also reported the moderate level of environmental knowledge of pre-service teachers. On the contrary, the results showed a low level of knowledge on environmental laws and management, which means that they were fairly knowledgeable on this topic. It implies that the students do not know what it is and how to do it right. Although, it was noted that the students were aware of its environment far longer than there have been laws to protect the environment. The problem is that the students were not interested in knowing and explaining regulations, statutes, local, national, international legislation and treaties designed to protect the environment from damage and to explain the legal consequences of such damage towards government or private entities or individuals. In addition to this, lessons in environmental management and laws are embedded on the latter part of the course on Ecology and General Biology for education students. So mostly, these topics are not discussed anymore because of time constraint.

### **Level of Personal Responsibility of Students towards Environmental Science**

Personal responsibility as defined in this study involves: (a) level of awareness of students on various environmental laws and activities and (b) attitudes of students’ towards accessing, validating, and sharing of environment-related information.

### **Students’ level of awareness on environmental policies, rules and regulations, and different environmental activities**

Table 8 presents the students’ level of awareness on the environmental policies, rules and regulation.

Table 8  
*Students' Level of Awareness on Environmental Policies, Rules and Regulations*

No	Item	Standard Deviation	Mean	Qualitative Description
1	No burning of garbage policy	0.44	3.85	Highly Aware
2	School policy on anti-littering and waste segregation	0.64	3.62	Highly Aware
3	DENR as the lead implementing government agency of environment and natural resources related programs and projects	0.59	3.60	Highly Aware
4	Municipal ordinances on anti-littering and its corresponding fines and penalties	0.68	3.50	Aware
5	Smoke belching laws	0.69	3.42	Aware
6	RA 7603 Ecological Solid Waste Management Act of 2000	0.77	3.30	Aware
7	Collection or paying of environmental fees in some tourist spot areas in the country	0.81	3.30	Aware
8	RA 8749 Philippine Clean Air Act	0.79	3.23	Aware
9	Republic Act 9275 Philippine Clean Water Act	0.85	3.18	Aware
10	RA 7942 Philippine Mining Act of 1995	0.76	3.17	Aware
11	Existence of civil society consultation prior to implementation of environment and natural resources related Programs	0.88	3.15	Aware
12	Imposing of corresponding fines and penalties for non-securing permits in transporting timber products requiring so (e.g. charcoal for trading purposes	0.86	3.15	Aware
13	RA 10654 which is the amended Philippine Fisheries Code of 1998	0.79	2.93	Aware
14	Waste segregation policy of LGU	0.99	2.82	Aware
15	Planting of trees as a requirement prior to application for securing	1.11	2.53	Aware
<b>Overall level of awareness</b>		0.33	3.25	Aware

**Note:** Mean is described as follows: Highly aware =3.51-4.00; Aware= 2.51-3.50; Poorly aware-1.51-2.50; Very poorly aware=1.00-1.50.

Overall, the students were aware of the environmental policies, and rules and regulations ( $M = 3.25$ ;  $SD = 0.33$ ). It indicates that they were moderately aware on the different environmental policies, and rules and regulations. Among the environmental policies, students were highly aware of the no burning of garbage policy ( $M = 3.85$ ;  $SD = 0.44$ ); the school policy on anti-littering and waste segregation ( $M = 3.62$ ;  $SD = 0.64$ ), and DENR as the lead implementing government agency of environment and natural-resources-related programs ( $M = 3.60$ ;  $SD = 0.59$ ). This means that the respondents are highly aware on these laws. High level of awareness was observed because of the massive information campaign conducted and presence of sign boards that made them aware of such laws and policies. On the other hand, tree planting as a requirement prior to application for securing marriage certificate ( $M = 2.53$ ;  $SD = 1.11$ ) and waste segregation policy of local government unit ( $M = 2.82$ ;  $SD = 0.99$ ) are the two least



policies which students were aware of. This may be due to the fact that such policies did not directly concern the students.

Table 9 shows the students' awareness on different environmental activities conducted.

Table 9  
*Students' Awareness on Different Environmental Activities*

No.	Environmental Activity	Mean	Standard Deviation	Qualitative Description
1	Activities led by school aimed at environmental protection and conservation (e.g. tree planting)	3.80	0.40	Highly Aware
2	Celebration and significance of Coastal Clean-Up	3.65	0.58	Highly Aware
3	Conduct coastal clean-up drive or do-day in the barangay	3.60	0.62	Highly Aware
4	Celebration and significance of Earth Day	3.42	0.72	Aware
5	Celebration and significance of Earth Hour	3.33	0.77	Aware
6	Implementation of National Greening Program	3.22	0.76	Aware
7	Areas prone to landslide, flood, storm surge and tsunamis in the municipality	3.22	0.76	Aware
8	Climate Change Adaptation Plan formulated by the municipality	2.83	0.83	Aware
9	Celebration and significance of Ocean Month	2.87	0.83	Aware
10	Comprehensive Land Use Plan formulated by the municipality	2.75	0.86	Aware
<b>Overall level of awareness</b>		<b>3.27</b>	<b>0.36</b>	<b>Aware</b>

**Note:** Mean is described as follows: Highly aware =3.51-4.00; Aware= 2.51-3.50; Poorly aware= 1.51-2.50-; Very poorly aware=1.00-1.50.

Overall, students were aware of the different environment-related activities ( $M = 3.27$ ;  $SD = 0.36$ ). They were highly aware of major environment-related activities such as: school-led activities towards environmental protection and conservation ( $M = 3.80$ ;  $SD = 0.40$ ) celebrations and significance of Coastal Clean-Up ( $M = 3.65$ ;  $SD = 0.58$ ) and conduct of coastal clean-up drive or do-day in the barangay ( $M = 3.60$ ;  $SD = 0.62$ ). This means that they were fully aware of these activities considering that these are integrated in school and in the community as part of environmental functions and social responsibility as able citizens. On the other hand, local government initiatives such as Comprehensive Land Use Plan ( $M = 2.75$ ;  $SD = 0.86$ ) and Climate Change Adaptation Plan ( $M = 2.83$ ;  $SD = 0.83$ ) were the two least environmental activities which students were aware of. This means that the students were moderately aware of this activity. Thus, it can be said that these initiatives are complex information and are beyond the grasp of the respondents.

Results of this study is in congruence with the study of Bernardo (2010) where he determined the attitudes and behavior of 486 college students through survey of students' perception on some environmental issues and concern in Region 2. Results showed that the students are generally aware of environmental problems particularly those directly affecting them but most did not seem to make sacrifices to improve the environment. Thus, students were most

concerned with the decrease in the quality of drinking water, air pollution, and damage to the ozone layer, garbage disposal and pollution of rivers and were least concerned with global climate change and radioactive contamination. Similarly, the study of Schultz (2002) reported that there was an emerging interest of students of universities in participating in the increase in consciousness of environmental values and problems. In addition, the level of improvement of the environmental attitudes of the students becomes evidenced when they started their higher education. Also, the study of Barreiro and Casal-Jimenez (1999) confirms that at different educational level consequently, it showed with favourable results on environmental attitudes. In the same vein, Corcoran and Wals (2004) stresses that Universities increasingly realize that their environmental impact is tremendous, not only in terms of the energy they use and the waste they generate, but perhaps first and foremost in the way they equip their graduates in dealing with sustainability issues in both their personal and professional lives.

### Students' level of attitudes toward accessing, validating, and sharing of environment-related information

Table 10 shows the students' attitude towards accessing environment-related information.

Table 10

#### *Attitudes toward Accessing Environment-Related Information*

No.	Items	Standard Deviation	Mean	Description
1	Accessing the internet in doing assignments related to environment	0.90	3.73	Desirable
2	Reading articles in social media such as Facebook, Twitter or Instagram about the environment	0.94	3.30	Moderately Desirable
3	Watching films or movies featuring environment and natural resources	1.02	3.03	Moderately Desirable
4	Watching television news about environment	1.12	3.02	Moderately Desirable
5	Attending symposium or seminar which tackles environmental issues or highlights other environmental related information	0.68	2.75	Moderately Desirable
6	Attending to forums, workshops and seminars related to environment in the past 12 months	0.68	2.75	Moderately Desirable
7	Joining the discussion with my friends/ relatives about environmental issues or any topic related to environment	0.89	2.65	Moderately Desirable
8	Asking help from classmates in understanding difficult topics about environment	0.58	2.63	Moderately Desirable
9	Listening to radio program featuring environmental concerns	1.14	2.60	Moderately Desirable
10	Reading journal articles related to environment	0.83	2.40	Undesirable
11	Reading articles in newspaper or magazine about environment	0.80	2.38	Undesirable
12	Checking the school bulletin for any updates regarding school environment-related activities	0.94	2.33	Undesirable

13	Accessing the website of government agencies for updates on government programs, weather and other information involving environment	0.92	2.32	Undesirable
14	Reading any environment-related management plan of our municipality like Comprehensive Land Use Plan and Climate Change Adaptation Plan	0.93	2.18	Undesirable
<b>Overall level of attitude</b>		<b>0.43</b>	<b>2.72</b>	<b>Moderately Desirable</b>

**Note:** Mean is described as follows: Highly desirable= 4.51-5.00; Desirable= 3.51-4.50; Moderately Desirable= 2.51-3.50; Undesirable= 1.51-2.50; Highly Undesirable 1.00-1.50

Students exhibited moderately desirable attitudes ( $M = 2.72$ ,  $SD = 0.43$ ) overall. This means that the students moderately exhibited desirable attitudes towards accessing environment-related information. It can be observed that students showed desirable attitude only in accessing the internet in doing assignments ( $M = 3.73$ ;  $SD = 0.90$ ). It indicates that student's access internet only when they need to do so. On the other hand, students exhibit undesirable attitude in reading journal articles related to environment ( $M = 2.40$ ;  $SD = 0.83$ ); reading articles in newspapers or magazines news ( $M = 2.38$ ;  $SD = 0.80$ ); checking school bulletins for updates regarding school environment-related activities ( $M = 2.33$ ;  $SD = 0.94$ ); and accessing government website for updates of programs and weather information ( $M = 2.32$ ;  $SD = 0.92$ ); and reading any environment-related management plan of the municipality ( $M = 2.18$ ;  $SD = 0.93$ ). This means that the students fairly exhibit desirable attitudes towards the environment-related information.

Table 11 shows the attitude of students on validating environment-related information they received.

Table 11  
*Attitude on Validating Environment-Related Information*

No.	Item	Standard Deviation	Mean	Description
1	Have read and compared with other sources for its correctness	0.89	2.98	Moderately Desirable
2	Have checked the credibility of the source of any environmental-related information	0.96	3.05	Moderately Desirable
3	Have checked the timeliness (e.g. weather updates; is it updated?)	0.96	3.58	Desirable
4	Have clarified over certain environmental concepts, laws and issues from someone who is more informed	0.96	3.63	Desirable
5	Have compare environment-related information to observe real-life situation	0.93	3.92	Desirable
<b>Overall level of attitude</b>		<b>0.40</b>	<b>3.43</b>	<b>Desirable</b>

**Note:** Mean is described as follows: Highly desirable= 4.51-5.00; Desirable= 3.51-4.50; Moderately Desirable=2.51-3.50; Undesirable= 1.51-2.50; Highly Undesirable 1.00-1.50.

There is desirable attitude in checking the timeliness ( $M = 3.58$ ;  $SD = 0.96$ ), clarifying certain environmental concepts, laws, or issues from someone who is more informed ( $M = 3.63$ ;  $SD = 0.96$ ), comparing the environment-related information to observed real-life situation ( $M = 3.92$ ;  $SD = 0.93$ ). This means that the students exhibit satisfactory attitudes towards accessing environment-related information. Likewise, there is a moderately desirable attitude towards reading and comparing the information they received from other sources for veracity or correctness ( $M = 2.98$ ;  $SD = 0.89$ ) and checking the credibility of the source ( $M = 3.05$ ;  $SD = 0.96$ ) as well as desirability in its timeliness ( $M = 3.05$ ;  $SD = 0.96$ ). This means that the students moderately exhibit desirable attitudes towards validating any environment-related information. Related study was conducted by Ermolaeva (2010) in finding out the different sources of environmental information for students because these avenues can be maximized for more efficient delivery of valid and credible learning. Result showed that internet is the most significant source of information for college students followed by television. This result concurred with Chu and Lee (2006) who noted that students reported the newspaper, magazines, families and field trips are important sources of environmental information for them.

### Students' Level of Civil Responsibility of Students towards Environmental Science

Civil responsibility of the students in taking Environmental Science class is anchored on the idea that they will actively participate in different environmental programs and activities. The activities are divided into two categories: activities which are part of individual initiative and activities that are primarily initiated or led by an agency.

Table 12 shows the level of participation of students in different environment-related activities which call for their individual initiative.

Table 12

#### *Level of Participation in Environment-Related Activities (Individual initiative)*

No.	Activity	Standard Deviation	Mean	Description
1	Properly disposing his/her trash whenever cannot found a nearest trash can or bin	0.56	3.70	Very high
2	Saving electrical energy at home	0.77	3.33	High
3	Bringing own reusable water bottle whenever going somewhere	0.84	3.12	High
4	Harvesting rainwater at home	1.01	2.82	High
5	Practicing the recycling and re-using method	0.51	2.80	High
6	Segregating the waste materials in school or at home	0.62	2.77	High
7	Spending of time weekly in maintaining the cleanliness of surroundings at home	0.79	2.73	High
8	Maintaining a compost pit at home	0.99	2.45	Low

9	Not using plastic straw in drinks when you dining out	0.99	2.45	Low
10	Member of any organization other than student and SK organization advocates environmental protection and conservation	1.15	2.30	Low
11	Not burning garbage at home	0.67	2.01	Low
12	Member of any social media group whose advocacy is geared towards resource management protection and preservation	1.13	1.90	Low
13	Bringing own plastic bag during shopping for groceries or buying something	0.88	1.70	Low
14	Reporting of any illegal or harmful activity related to environment to appropriate authority in the past 12 months	0.65	1.68	Low
<b>Overall level of participation</b>		<b>0.60</b>	<b>2.55</b>	<b>High</b>

**Note:** Mean is described as follows: Very High = 3.51-4.00; High = 2.51-3.50; Low = 1.51-2.50; Very Low = 1.00-1.50.

The overall level of participation of students in environment-related activities which call for individual initiatives was high, which means that the students were moderately participative in the environment-related activities. A very high level of participation in environment-related activities by individual initiatives was observed among students on properly disposing wastes whenever they cannot find the nearest trash can or bin ( $M = 3.70$ ;  $SD = 0.56$ ) which means that the students are highly participative in this environment-related activity. Activities such as participating in saving electrical energy at home ( $M = 3.33$ ;  $SD = 0.77$ ), bringing of own reusable water bottle ( $M = 3.12$ ;  $SD = 0.84$ ), practicing rainwater harvesting at home ( $M = 2.82$ ;  $SD = 1.01$ ), practicing recycling and re-using method ( $M = 2.80$ ;  $SD = 0.51$ ), segregating waste materials in school or at home ( $M = 2.77$ ;  $SD = 0.62$ ) as well as spending time weekly in maintaining the cleanliness of surroundings at home ( $M = 2.73$ ;  $SD = 0.79$ ) were found to have high level of participation among students. This means that the students were moderately participative in the environment-related activities. On the other hand, a low level of participation among students is found in activities like maintaining of compost pit at home ( $M = 2.45$ ;  $SD = 0.99$ ), not using plastic straw in drinks during dine out ( $M = 2.45$ ;  $SD = 0.99$ ) membership to any organization, other than student and Sangguniang Kabataan (SK) organization ( $M = 2.30$ ;  $SD = 1.15$ ), no burning of garbage at home ( $M = 2.01$ ;  $SD = 0.67$ ), as well as membership with any social media group ( $M = 1.90$ ;  $SD = 1.13$ ) whose advocacy is toward environmental protection and conservation, bringing their own plastic bag whenever they shop for groceries or buy something ( $M = 1.70$ ;  $SD = 0.88$ ) as well as reporting illegal environmental-related activities to the appropriate authorities ( $M = 1.68$ ;  $SD = 0.65$ ). This means that the students had poor participation in these environment-related activities.

Table 13 shows the level of participation of respondents in environment-related activities which are led or initiated by certain agencies or institutions.

Table 13

*Level of Participation to Environment-Related Activities (Agency-led or Initiated)*



No.	Activity	Standard Deviation	Mean	Qualitative Description
1	Participating in any school activities other than clean-up drive related to environment-protection and conservation	0.99	3.02	High
2	Attending clean-up drives or do-day activities in school for the last 6 months	0.81	2.53	High
3	Invited and eventually attended a seminar or forum about the environment in the last 12 months	0.85	2.53	High
4	Attending any of the celebration for mother nature which they know like Earth Hour, Ocean and Earth Day	0.72	2.50	Low
5	Participating in clean-up drives initiated by the barangay or municipality	0.57	2.20	Low
6	Joining the conduct of civil society consultation for environment- related programs in the municipality	1.01	2.18	Low
<b>Overall level of participation</b>		<b>0.30</b>	<b>2.49</b>	<b>Low</b>

**Note:** Mean is described as follows: Very High = 3.51-4.00; High = 2.51-3.50; Low = 1.51-2.50; Very low = 1.00-1.50

There was a high level of participation by students in activities except clean-up drives initiated in school which are geared towards environmental protection and conservation ( $M = 3.02$ ;  $SD = 0.99$ ), attending clean up drive or do-day activity ( $M = 2.53$ ;  $SD = 0.81$ ), and attending seminar or forum ( $M = 2.53$ ;  $SD = 0.85$ ). This means that the students were moderately participative in the environmental related activities. In contrast there was a low level of participation in celebration of Mother Nature ( $M = 2.50$ ;  $SD = 0.72$ ), participating in clean-up drives initiated by the barangay or municipality ( $M = 2.20$ ;  $SD = 0.57$ ) and the conduct of civil society consultation for environment-related programs or activities in the municipality ( $M = 2.18$ ;  $SD = 1.01$ ). This means that the students have poor participation in environment-related activities.

This study is in consonance with the study of Sia Su (2008) which attempted to determine the environmental worldviews and concern of 400 college students (private and public) in the Philippines. His results showed that Filipino students recognize that the environment is an important resource that provides the society with all its necessities but has been deteriorated, polluted and wasted. Majority of them believe that man's role is to be a good steward who will take charge and protect the earth's resources. Almost all of them expressed concern with their environment and to sustainably improve it for present and future generations, which is the main reason for getting involved and participating in efforts that help protect the environment. These are significant information for educators to take note of and capitalize on this positive concern of students to inspire them to elevate to the level of action and participation of which the major goal of environmental education. Further he stressed that in relation to reporting of illegal or harmful activity existing in the local community, it was found out that majority of the students cited the cutting of tree or mangrove without permit, emission of dark smoke from vehicles,

throwing of small waste materials anywhere such as cigarette butts and candy wrapper, burning of garbage, scattered waste of dogs on the streets as well as throwing of garbage on riverbanks. Only two for every ten reported that they have reported or shared the said harmful activity to their barangay official. Eight out of every ten of respondents admitted that they did not report the said illegal or harmful activity due to the fear of getting retaliated by the owner or avoid any issue with the person involved in doing it. Also, half of the students did not report the harmful activity because many are doing it in the area and they have no full knowledge of the law regulating such act.

### **Gaps and Barriers Related to Intellectual Capacity, Personal and Civil Responsibility of Students**

Based on the results of the assessment of intellectual capacity, personal and civil responsibility of students, several gaps and barriers were identified which served as bases for the development of learning materials. The result of the study, however revealed that although students were considered to have moderate level of intellectual capacity, they still had inadequate knowledge and competence in content related to environment as well as its components such as biodiversity, ecological concepts, sustaining resources and environmental crises, also environmental management and laws, having the least mastered components among the topics included in the instrument. Adequacy is attributed to disintegrated treatment of lessons. Another gap in the assessment result is that the student's' have lower level of awareness on various environment-related programs and plans of Local Government Unit (LGU) compared to programs initiated by school; lower level of participation in some environment-related activities which are led by agencies, and unexplored potential of sources media as well as internet in enhancing personal and civil responsibility.

### **Development of Instructional Material (Module)**

**Analysis Stage.** Table 14 presents the identified gaps in this study, learning competency, content standard and possible solution as topics to address the gaps and module preparations.

Table 14

*Identified Learning Gaps for the Module Preparation, Learning Competency, Content Standard Possible Solution, and Instructional Material (Modules)*

<b>Identified Gaps</b>	<b>Learning Competency</b>	<b>Content Standard</b>	<b>Module</b>	<b>Specific Lessons</b>
1. Lower level of awareness on various environmental related programs and plans of local government unit compared to programs initiated by school	Identify environmental related programs of the government	Exposure of students to various environmental related programs and activities of the LGU	Module 1 Lesson 2	Philippine initiatives towards addressing environmental issues
2. Presence of low level of participation in some environmental	Identify environmental related programs	Enhancing participation through building	Module 1 Lesson 2	Philippine initiatives towards

related activities which are led by agencies and call for individual initiative	of the government	awareness on environmental related activities		addressing environmental issues
3. Unexplored potential of social media and internet in enhancing personal and civic responsibility	Utilization of social media for advancement of personal and civil responsibility towards the environment	Increasing knowledge on environmental related initiatives by accessing social media	Module 1 Lesson 2	Engaging activity during teaching lesson on Philippine initiatives towards addressing environmental issues
4.Environmental law as the least mastered theme compared to other thematic areas of Environmental Science	Identification of environmental laws and its salient feature	Understanding environmental law and major environmental laws in the Philippines	Module 1 Lesson 2  Module 2 Lesson 2	Philippine initiatives towards addressing environmental issues; Environmental law
5. There are specific topics from other thematic areas of Environmental Science which are only known to less than half of students				
a. Only 22% of students know that harmful consequences of human activities in the natural world are known as human intervention	Identify threats to biodiversity and the importance of environmental management	Understanding biodiversity and conservation and environmental management	Module 1 Lesson 1  Module 2 Lesson 1	Environmental Management Biodiversity and Conservation
b. Only 37% of students know what biodiversity refers to	Describe what is biodiversity	Conceptual definition/ introduction to biodiversity	Module 2 Lesson 1	Biodiversity and Conservation
c. Only 22% of students know the reasons for preserving biodiversity	Explain concepts of biodiversity conservation and understand tools for biodiversity conservation	Integrating purpose of biodiversity conservation with environmental laws	Module 1 Lesson 1 Module 2 Lesson 1	Environmental Management

		Understanding environmental management		
d. Only 33% of students know that Earth's various organisms appear to be concentrated in certain biomes	Describe what is biodiversity	Conceptual definition/ introduction to biodiversity	Module 2 Lesson 1	Biodiversity and Conservation

**Design Stage.** In this aspect and in response to the need, modules were prepared for teachers handling Environmental Science. The modules were designed using 5E Instructional Model by Bybee, et al. (2006) which exemplifies a constructivist paradigm and espouses a student-centered learning environment envisioned by the Commission on Higher Education.

**Development Stage.** The instructional material in the form of module developed to address the learning gaps of the Fourth Year Teacher Education students, was titled, "Understanding Environmental Management and Law: A Module on Environmental Science for Teacher Education Curriculum". It consists of two modules with two lessons on each module. These were designed and developed as output to this study. These are the modules:

Module 1: Environmental Management: Lesson 1: Environmental Management and Its Importance; and Lesson 2: Philippine Initiatives towards Addressing Environmental Issues, and

Module 2: Biodiversity and Environmental Law: Lesson 1: Biodiversity and Conservation; and Lesson 2: Environmental Laws.

The learning material developed was subjected to validation by five faculty members from the Science Department. The materials were revised and all suggestions were incorporated prior to its implementation. Overall result of the evaluation made by the validators on the developed instructional material title, Module for Environmental Science in terms of content, accessibility, organization as well as presentation, instructional design and support was excellent as shown in Table 15.

Table 15

*Validators' Overall Evaluation on the Developed Learning Material*

Areas	N	Mean	Descriptive Rating
Content	5	4.64	Excellent
Accessibility	5	4.79	Excellent
Organization and Presentation	5	4.80	Excellent
Instructional Design and Support	5	4.84	Excellent
<b>Overall Mean</b>	<b>5</b>	<b>4.77</b>	<b>Excellent</b>

Note: Descriptive meaning is based on the following scale. Excellent (4.01- 5.00); Very Satisfactory (3.01-4.00); Satisfactory (2.01-3.00); Fair (1.01- 2.00); and Poor (0.00-1.00)

**Implementation Stage.** The researcher requested one College Science Instructor teaching Environmental Science to enact the developed learning material to the twenty-five (25) Second Year College Bachelor of Science in Information Technology (BS Info Tech) students in one of the Universities in Miagao Campus and five (5) Science Teachers to act as observers. Overall, it took four days to finish the implementations and observations of the four lessons of the two modules developed in which one hour per lesson a day was being scheduled to the students. Observation sheets in terms of the learning outcomes, time management, teaching strategy and assessment tasks for each lesson were assessed by the five (5) Science teacher observers. Overall results of the teacher's observation during the implementation of the module for Environmental Science was excellent as shown in Table 16.

Table 16

*Teacher's Observation during the Implementation of the Module for Environmental Science*

Areas	N	Mean	Descriptive Rating
Learning Outcomes	5	4.75	Excellent
Time Management	5	4.63	Excellent
Learning Activities	5	4.45	Excellent
Teaching Strategy/Approach	5	4.55	Excellent
Assessment Task	5	4.35	Excellent
<b>Overall Mean</b>	<b>5</b>	<b>4.55</b>	<b>Excellent</b>

Note: Descriptive meaning is based on the following scale. Excellent (4.01- 5.00); Very Satisfactory (3.01-4.00); Satisfactory (2.01-3.00); Fair (1.01- 2.00); and Poor (0.00-1.00)

### Personal Reflections of Students in Using the Developed Learning Materials

One way of structuring the continuous experiences and dialogue interaction both with our surrounding and ourselves can be woven in a meaningful story. In this study, personal reflections were solicited from the participants who attended the implementation of the developed learning material for its general acceptability and comments.

Sourced out from the collective personal reflections of the participants, the researcher quoted some of the significant comments and realizations regarding the developed learning material.

*Indeed the government was also taking an initiatives and steps in addressing the environmental issues that the country is suffering.* (Renalyn Mae Talaman)

*That if all of us are taking our part in managing the environment, we will not be suffering these problems intensely today.* (Maria Liza Arevalo)

*It was indeed 'fun' while doing the activity in engage part because it solicits active participation from us specifically it is time bound".* (Richard Talaman)

*It is exciting to work in a group activity because each member of the group cooperated well and a must to contribute any ideas to the given questions.*

(Jelynn Dumaguit)



*That this module is highly recommended for reference because it is practical and based on the real-life situations” and this module made us realize the significance of resources to our lives. (Nikee Silfavan)*

**Evaluation Stage.** One (1) College Science Professor teaching Educational Technology, one (1) College Professor who acted as Chairman of the Instructional Material Development in one of the Universities in Iloilo and one (1) Professor major in Curriculum Development evaluated the developed learning material. The evaluators overall rating using Likert Scale in terms of content, instructional quality, technical quality, presentation and organization, accuracy as well as up-to-datedness of information and assessment was very acceptable with an overall mean rating of 3.47 having 4 as the highest rate.

## Conclusion

### Summary of Findings

Based on the results, the following are the findings of the study:

1. The level of intellectual capacity of students was average; this means that they had a moderate and inadequate knowledge in environment and its components, ecological concepts, biodiversity, sustaining resources and environmental crises, and environmental management and law. On the other hand, the low level of intellectual capacity on environmental management and law means that the students lack basic knowledge on these topics.
2. In terms of the level of personal responsibility of students which includes the awareness on environmental policies, rules and regulations, and different environmental activities and attitudes towards accessing, validating, and sharing of environment-related information, results revealed that the students were “aware” of the environmental policies, rules and regulations, and different environmental activities. This means that the students exhibited a moderate level of awareness of the law and activity towards the environment. On the other hand, the students had an over-all “moderately desirable” attitude towards accessing, validating, and sharing of environment- related information.
3. In terms of the level of civil responsibility of students which includes the participation of the students in environment-related activities which call for individual and agency-led initiatives, results showed that there was a “high” level of participation of students in environment-related activities which call for individual initiatives. This means that the students were moderately participative in environment-related activities. However, the students had a low level of participation in environment-related activities initiated by the agency; this means that the students had poor participation in this aspect.
4. When results of assessment were compared against expected learning competencies, the following gaps were identified:
  - a) Lower level of awareness on various environment-related programs and plans of Local Government Unit (LGU) compared to programs initiated by the school;
  - b) Low level of participation in some environment-related activities which are led by agencies and call for individual initiative;

- c) Unexplored potential of social media and internet in enhancing personal;
- d) Environmental law was the least mastered topic included in the instrument;
- e) Some specific topics in Environmental Science included in the instrument were known to only less than half of the students (i.e. definition of biodiversity and its importance).

The modules prepared were appropriate because they were able to:

- (i) change the classroom scenario from teacher-centered to student-centered;
- (ii) facilitate understanding the basics of natural resources and the environment;
- (iii) provide students with activities to brainstorm and to reflect on their actions towards the environment.

5. The instructional material developed to address the learning gaps of the Fourth Year Teacher Education students, was titled, *Understanding Environmental Management and Law: A Module for Environmental Science for Teacher Education Curriculum*, consisting of two modules: Module 1: Environmental Management with two lessons: Lesson 1: Environmental Management and Its Importance and Lesson 2: Philippine Initiatives Towards Addressing Environmental Issues and Module 2: Biodiversity and Environmental Law with two lessons: Lesson 1: Biodiversity and Conservation and Lesson 2: Environmental Laws.

Based on the findings, the following conclusions were drawn:

The moderate intellectual capacity of the students on topic on the environment and its components, biodiversity, ecological concepts, sustaining resources as well as environmental crises, and environmental management and laws indicates that expected competencies based on the Commission on Higher Education (CHED) Memorandum Order No. 20 series (CHED, 2013) were not fully met, specifically, their competence in explaining phenomena scientifically, evaluating, as well as designing scientific inquiry, and interpret data and evidence.

The moderate level of personal and civil responsibility of the students shows that students were passive in their responses as well as concerns on environment-related activities either led or initiated by specific agency or institution.

Majority of the positive comments of the personal reflections of the students to the developed learning materials after it was implemented claimed that the learning materials provide interesting activities and beneficial experience that improve their knowledge as well as abilities in monitoring their assimilation of information and to contribute to their overall development and upbringing. Hence, the created learning material which were woven directly from their intellectual capacity and attitudes have these following advantages: (1) learner-centered; (2) learners are motivated to become participative; (3) active and collaborative participation in various activities is encouraged; (4) various learning experiences and opportunities for the learners with diverse learning personality and styles are offered.

## Implications

Taking into consideration the aforementioned conclusions, the researcher presents the following implications for theory and practice.

**For Theory.** A holistic approach to learning is what defines learning today, since today's learners have needs of high-level processing abilities and more personal design of instruction.

This study identified the gaps in intellectual, personal and civil responsibility of students in Environmental Science, which then became the basis in formulating learning material in the form of Module. It is in this light that this developed material focuses on students to learn by doing, by using the inquiry method, and by collaborating with others – a microcosm of the real world they will experience once they leave the classroom.

When students see the connection between what they are learning and the real-world issues that matter to them, their motivation soars, and so does their learning. Developing a robust and engaging 21<sup>st</sup>-century curriculum as well as employing 21<sup>st</sup> - century instruction means that both teachers and school leaders need to look outside the school walls as well as seek ideas, resources, and expertise where they are found --- in their community; in professional and educational groups; also in individuals, schools, and organizations around the world.

**For Practice.** There is a shared recognition that the assessment of learning areas as well as learner's preference over medium of instruction is highly valuable in improving or capacitating learners the necessary knowledge, competencies, and life skills set for whatever subject matter with due consideration to the learners' different personalities and learning styles. Time has changed and so have students as well as the tools, requisite skills and knowledge. To teach in the 21<sup>st</sup> century is to shift gears. Teaching in the 21<sup>st</sup>-century is different from teaching in the 20<sup>th</sup> century. Teachers know that they must engage their students in learning and provide effective instruction using a variety of instructional methods as well as technology. To do this, teachers need to keep abreast with what is happening in the field. As lifelong learners, they are active participants in their own learning. They seek out professional development to help them improve both students' learning and their own performance.

To produce quality students adept in the 21<sup>st</sup>-century skills along core academic subject mastery, teachers should design instructional strategies and materials that are task-oriented, performance-based, design-based, problem-based, or project based to help nurture the 21<sup>st</sup>-century skills, the skills students need to succeed in life and work in the future.

In this study, the identified gaps on intellectual capacity, personal and civil responsibility of students on Environmental Science provide sound basis where efforts for improving learning instruction can be aligned and harmonized. It opens more windows of opportunities for exploration as well as adoption of potential learning materials and contents in consonance with the foregoing learning style preferences in a technology-advancing learning environment. The module formulated as an immediate outcome of the gap assessment phase of this research study is a resource augmentation for teachers and other individuals whose interest revolves around the idea of enhancing capacities as well as competencies of students in Environmental Science and raising their social responsibility consciousness towards the environment. While it is

anchored on the ADDIE model and learning contents are weaved together to capture the learning gaps, classroom activities in the module were suited on the preferences of present learners or branded as “millennials” who are inclined to the use of technology in advancing intellectual capacities, personal and civil responsibilities specifically in Environmental Science course, thus creating a more enjoyable learning environment for the said cohort.

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## Appendix 1

### Table of Specification

EMPHASIS	TOTAL NUMBER OF ITEMS/TEST PLACEMENT
<b>I. Environment and its Component</b>	<b>14</b>
A. Physical Constituent	1-4
B. Biological Constituent	5-11
C. Sociological Constituent	12-14
<b>II. Ecological Concepts and Principles</b>	<b>23</b>
A. Nutrient Cycling and Energy Flow	15-20
B. Ecological Pyramids	21-26
C. Levels of Ecological Organization	27-32
D. Principles of Ecological Systems	33-37
<b>III. Biodiversity</b>	<b>20</b>
A. Need for Preservation of Biodiversity	38-39
B. Threats to Biodiversity	40-44
C. Effects of Loss of Biodiversity	45-48
D. Biodiversity Conservation	49-53
E. Value of Biodiversity to Human	54-57
<b>IV. Sustaining Resources and Environmental Crises</b>	<b>15</b>
A. Food, Soil and Pest Management	58
B. Water Resources and Water Pollution	59-61
C. Environmental hazards and Human Health	62-63
D. Pollution (air, land, indoor, noise)	64-66
E. Ozone depletion	67-71
F. Solid and Hazardous Waste	72
<b>V. Sustaining Human Societies</b>	<b>8</b>
A. Environmental Management and Laws	73-80