DEVELOPMENT AND VALIDATION OF MODULE AS INSTRUCTIONAL MATERIALS FOR GREEN TECHNOLOGY EDUCATION 1

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ABSTRACT Modular instruction attempts to individualize learning by allowing students to master one unit of content before moving on to another. As a self-instructional tool, Module can be used as supplementary material to help students improve their mastery and as a means to help the student catch up with the missed lessons. In this study, instructional modules on Green Technology Education were developed and validated. Specifically, module 1 consists of one lesson, module 2 consists of three lessons that cover the prelim, module 3 consists of one lesson, and module 4 consists of 1 lesson divided into four parts for the midterm of Green Technology education. The evaluation results showed that everyone who evaluated the instructional modules agreed that they met the criteria for evaluation and had the potential to be used as supplements. It is recommended that the study be replicated to cover other areas in green technology education and evaluation among students to support further the findings that emerged.

Keywords: Development Instructional modules, Green Technology Education, validation

INTRODUCTION

With the onset of the new curriculum in the Philippine Tertiary Education as the effect of the implementation of the K-12 program in basic education, the Guimaras State College responded with the change implanted in the new setting, one is the addition of the Green Technology Education 1 and Green Technology Education 2.
Based on Board Resolution No. 11-2018 during the 90th BOT meeting of the Guimaras State College last March 15, 2018, the subject Green Technology Education 1 and 2 was offered as additional subject among the new college students of the Guimaras State College in response to the vision which state that Guimaras State College as a Center of Excellence in Education and Green Technology Generation of the college and mission which state Guimaras State College is committed to provide access to relevant and quality education and advocate sustainable development.

The field of "green technology" encompasses a continuously evolving group of methods and materials, from techniques for generating energy to non-toxic cleaning products as defined by the Green Technology Organization. Green Technology is developing and using products, equipment, and systems to preserve the environment and resources, reducing human activities' negative impact (KeTTHA, 2017; Bhardwaj & Neelam, 2015). Green Technology also includes groups with methods and materials obtained from techniques to generate energy for non-toxic products (Green Technology, 2015). According to Abdullah & Ahmad (2014), green technology is one of the alternatives to boost the national economy without affecting nature. This is in line with the study conducted by Yusof, Rosman, Mahmood, Sarip, & Noh (2013), which states that green technology, known as clean technology, is one of the elements of environmental science to preserve nature surrounding and natural resources to minimize the negative effects of human activities. According to Markom & Hassan (2014), green technology is based on the importance of using environmentally friendly equipment and reducing carbon emissions. This is global warming, and ozone depletion can be reduced if carbon emissions are reduced. The present expectation is that this field will bring innovation and changes in the daily life of a similar magnitude to the "information technology" explosion over the last two decades. In these early stages, it is impossible to predict what "green technology" may eventually encompass. As the goals that inform developments in this rapidly growing field include: Sustainability – meeting the needs of society in ways that can continue indefinitely into the future without damaging or depleting natural resources. In short, meeting present needs without compromising the ability of future generations to meet their own needs. "Cradle to cradle" design – ending the "cradle to grave" cycle of manufactured products by creating products that can be fully reclaimed or re-used. Source reduction – reducing waste and pollution by changing production and consumption patterns. Innovation – developing alternatives to technologies – whether fossil fuel or chemical-intensive agriculture – that have been demonstrated to damage health and the environment. Viability – creating a center of economic activity around technologies and products that

benefit the environment, speeding their implementation, and creating new careers that truly protect the planet.

In order to spread out this fast-growing area that supports sustainability and environmental protection, education was identified as the best tool to educate students about Green technology. The subject Green Technology Education was offered to the curriculum of the Guimaras State College as a new subject and offered only by the Guimaras State College, and there is a need in developing a module for students to use as well as to evaluate students understanding of the subject matter. Modules are increasingly being used in many countries as a way of organizing a language curriculum. As a consequence, many course books are now structured on the basis of "modules" rather than "units," and most teachers, when faced with this innovation, wonder whether this is really a new development, opening up new paths for learning and teaching. The concept of "module" is strictly linked to the idea of a flexible language curriculum, which should provide all those concerned with education (primarily learners and teachers, but also parents and administrators, as well as society at large) with a framework to establish clear and realistic language learning objectives. Through this method, the teacher sheds the role of presenter, demonstrator, driller, and questioner and now takes on the role of facilitator, initiator, monitor, coach, and coordinator. More importantly, it provides students with opportunities to direct their learning while constructing meaningful experiences about the concepts being taught. It is a relatively autonomous portion since it is based on a limited number of objectives that the learner is expected to achieve, and the school is expected to be able to assess and certify.

Despite curriculum developments in the past years, there is little in the education literature that explores the reasons modules, or the impact they have on student learning and career choice. In fact, the general expectation is that by understanding the concept through the use of module, the learner will engage with the course content, relating it to their own previous experience and establishing an understanding of its implication. This study was designed with the premise that Green Technology Education can be taught significantly to college students using instructional modules. Specifically, the topics included in the instructional module on Green Technology Education are the following: (1) Introduction to Environmental Education as a basis for Green Technology Education; (2) Environment and Education; (3) Natural Resources; and (4) Man and Biosphere and its Totality. The main purpose of this research study was to develop and validate instructional modules on Green Technology Education. for the establishment of modules, the content of the

Specifically, this study aimed to design instructional modules on Green Technology Education for Prelim and Midterm, establish the content validity and reliability of the designed module, and evaluate the designed module.

METHODOLOGY

Research Design and Process

The present study utilized the design and development research approach to establish an empirical basis for creating instructional products, which are self-instructional modules. In particular, the researcher used the ADDIE (Analysis, Design, Development, Implement, and Evaluate) Model in developing the instructional modules on Green Technology Education, as shown in Figure 1.

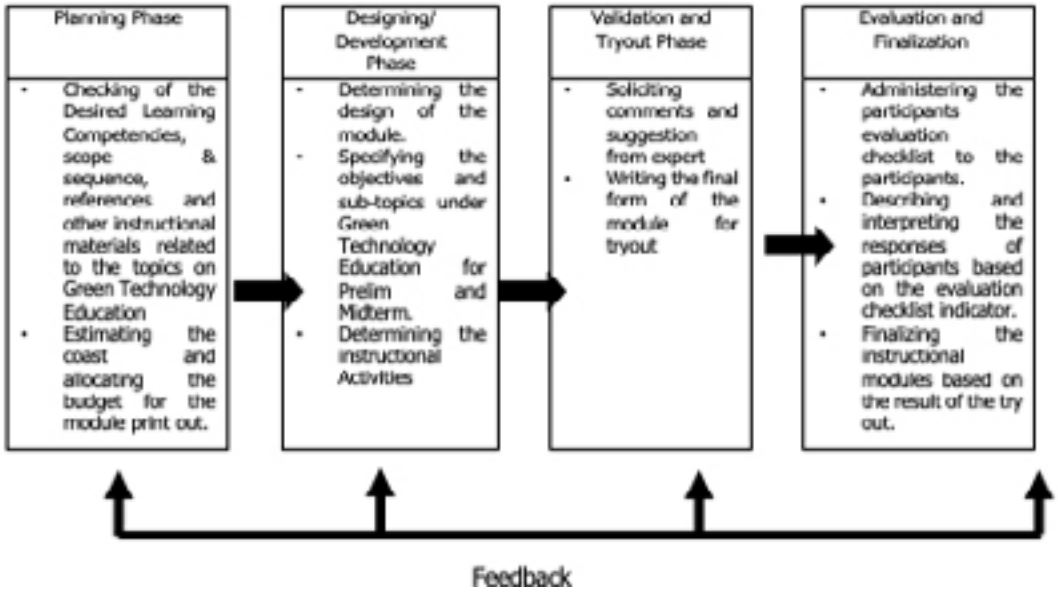

Fig. 1 ADDIE Model of Developing the Instructional Module on Green Technology Education.

Participants

This study's participants were the Guimaras State College faculty teaching Green Technology Education - Salvador Campus. Purposively identified as one of the end users of the module in Green Technology Education.

Instruments

In gathering data relevant to this study, the researcher employed the Experts' Evaluation Checklist of the Instructional Modules and the Participants' Evaluation Checklist of the Instructional Modules.

1. Experts' Evaluation Checklist of the Instructional Modules. In order to have a basis for determining the acceptability of the developed instructional modules, a five-point Likert checklist was adapted from the theses of Marin (2003) and Marasigan (2003). Some modifications to the item format were made to better align them with the purpose of the study.

2. Participants' Evaluation Checklist of the Instructional Modules. This instrument is a five-point Likert checklist adapted from the theses of Marin (2003) and Marasigan (2003). Unlike the expert's evaluation form, the checklist for participants focused only on the content and format of the developed instructional modules, yielding a total of 10 items.

Data Collection

Data collection activities that were done in the present study are described as follows:
Phase 1 – Planning Phase

The researcher examined books and related materials in Green Technology Education, which are the domains of Technology. The researcher also referred to and checked the Desired Learning Objectives and scope and sequence prescribed by the course syllabus. The goal of the researcher at this stage was to create a matrix that would show the essential objectives that must be demonstrated in Green Technology Education. Deciding and determining the specific objectives to be captured in the instructional module was done in Phase 2. Choosing of instructional setting, estimating the cost, and allocating the budget for the module printout were also considered in this phase.

Phase 2 – Designing/Developing Phase

After determining the target learners and the topics to be modularized, the writer structured the modules based on Model V (Take off, Content Focus, Take Action, Self-Check, and Self-Reflect) by Bilbao et al. 2019. In developing the modules, outlined procedures were adopted to achieve the purpose of this study. These are:

Stage 1. Determining the design of the module. The researcher identified the basic parts of the module, and the topics were laid out in the form of a curriculum grid. Basically, each lesson of the modules had the following components:

(1) This gives the students a bird's eye view of the module, and this motivates them to study each lesson in each module. It consists of the target population, prerequisite, objectives, and basic instructions on using the module, including the teacher's and learner's guides.
(2) Objectives: These are the specific competencies that the students should acquire for each lesson.
(3) Take off: Form of motivation
(4) Content Focus: Include all the related content to be studied.
(5) Take Action: Formulation of an analysis or synthesis on the topic learned.
(6) Self Check: An assessment based on the prescribed topic.
(7) Self-reflect: A reflection on what is being learned.

Stage 2. Specifying the objectives and subtopics under Green Technology Education Prelim and Midterm Topic. Specific objectives for each lesson were taken from the course syllabus. In this stage, the researcher decided to make specific objectives based on the topics included in each module. There were four chapters covered by the Instructional Module on Green Technology Education and six (6) lessons covered by four Instructional Modules on Green Technology Education.

Stage 3. Determining the instructional activities. In preparing the instructional activities for each lesson, the researcher ensured that they were written in clear and appropriate language suitable to the level of the target respondents.

Phase 3 – Validation and Tryout Phase

In order to gather evidence that will support the adequacy of objectives, content, format and language, presentation, and usefulness of the instructional modules to its intended users, expert judgments were sought by the researcher. In doing this, the first drafts of the instructional modules were printed and presented to the expert on the development of instructional modules. Then, the researcher revised the modules based on the comments and suggestions.

Phase 4 – Evaluation and Finalization Phase

In evaluating the developed instructional modules in Rational Green technology, the revised instructional modules were validated by 5 Green technology Education Instructors at the Salvador Campus. They examined the modules based on five indicators which include: (1) objectives; (2) content; (3) format and language; (4) presentation; and (5) usefulness of the instructional modules. Finally, the instructional modules were finalized based on the outputs yielded in the evaluation stage.

Data Analysis

The researcher utilized descriptive statistics such as percentages, means, and standard deviations to analyze respondents' evaluation ratings. The textual interpretation was also used in reporting the supporting qualitative data.

RESULTS AND DISCUSSION

Designed Self-Learning Module

Instructional modules on two terms were developed and validated. Specifically, module 1 consists of one lesson, Module 2 consists of three lessons that cover the prelim, module 3 consists of one lesson, and module 4 consists of one lesson divided into four parts for the midterm of Green Technology education. The module consists of the following, listed as follows:

Chapter I: Introduction
Environmental Education: Goals, Basis and Principle

Chapter II: Environment and Education
Environment, Ecology, Ecosystem Man, Environment and Environmental Awareness Biogeochemical Cycle

Chapter III: Natural Resources
Renewable and nonrenewable and its importance and conservation

Chapter IV: Man and Biosphere and its Totality
Man and Nature and Human Impact in the Environment

Evaluation of the Instructional Modules Based on Green Technology Education Instructors.

As presented in Table 1, the evaluators' overall average rating on the developed instructional modules is 4.18, signifying a very good evaluation of the module in five aspects such as (1) objectives; (2) content; (3) format and language; (4) presentation; and (5) usefulness of the instructional modules.

In detail, all evaluators agreed that the instructional modules have objectives which are clearly stated in behavioral form, specific, measurable, and attainable. Also, they strongly agreed that the objectives are well-planned, formulated, organized, and relevant to the topics of each lesson of the modules, and they take into account the needs of the students. Likewise, the evaluators' responses showed that they agreed that the content of each lesson is directly relevant to the defined objectives and is easy to understand. Furthermore, they agreed that the topics of each lesson are fully discussed and supported by illustrative examples and practice tasks suited to the student's level. However, evaluators were undecided in terms of whether each topic was given equal emphasis in the lesson. Also, as shown in the table, the variation in the form of standard deviation of the responses is minimal. With regard to the format/layout of the module, the evaluators agreed that the format/layout is well-organized. Likewise, the language used is clear, concise, motivating, and easy to understand. Regarding the presentation of the instructional modules, the evaluators agreed that the topics are presented in a logical and sequential order. They further agreed that the lessons of the modules are presented in a unique and original form. Lastly, looking at the evaluators' responses on the usefulness of the modules, the evaluators strongly agreed that the developed instructional modules would motivate the students to study Green Technology Education. Furthermore, they agreed that these modules would help the students master the topics at their own pace. Also, they believed that these modules would allow the students to use their time more efficiently and can cater to their needs.

Table 1. Evaluators' Rating on the Developed Instructional Modules

Aspect of the Modules	ITEMS	Mean	Standard Deviation	Interpretations
Objective of Module	The objectives are clearly stated in behavioral form.	4.60	0.55	Strongly Agree
	The objectives are well-planned, formulated, and organized.	4.60	0.55	Strongly Agree
	The objectives stated are specific, measurable, and attainable.	5.00	0.00	Strongly Agree
	The objectives are relevant to the topics of each lesson of the modules.	4.80	0.45	Strongly Agree
	The objectives take into account the needs of the students	4.60	0.55	Strongly Agree
	Overall	4.72	0.24	Strongly Agree
Content of the Module	The content of each lesson is directly relevant to the defined objectives.	4.00	0.71	Agree
	The content of each lesson is simple and easy to understand.	4.40	0.55	Agree
	The topics of each lesson are fully discussed.	4.00	0.71	Agree
	The topics are supported by illustrative example, and the practice task are suited to the level of the students.	3.60	0.55	Agree
	Each topic is given equal emphasis in the lesson.	3.40	0.89	Undecided
	Overall	3.88	0.14	Agree
Format and Language of the Modules	The format/layout is well-organized, which makes the lessons more interesting.	3.80	0.45	Agree
	The language used is easy to understand.	4.40	0.55	Agree
	The language used is clear, concise, and motivating.	3.80	0.84	Agree
	The figure/picture used are clear.	3.40	0.55	Undecided
	The instructions in the instructional module are concise and easy to follow.	4.20	0.84	Agree
	Overall	3.92	0.18	Agree
Presentation of Modules	The topics are presented in a logical and sequential order.	4.40	0.55	Agree
	The lessons of the modules are presented in a unique and original form.	3.60	0.55	Agree
	The learning activities are presented clearly.	4.20	0.45	Agree
	The presentation of each lesson is attractive and interesting to the students	3.60	0.89	Agree
	Adequate examples are given to each topic.	3.80	0.84	Agree
	Overall	3.92	0.20	Agree

Usefulness of the Modules	The instructional modules will motivate the students to study Green Technology Education.	4.60	0.55	Strongly Agree
	The instructional modules will help the students master the topics at their own pace.	4.40	0.55	Agree
	The instructional modules will allow the students to use their time more efficiently.	4.40	0.89	Agree
	The instructional modules will develop the analytical thinking and reasoning skills of students in analyzing problems in Green Technology.	4.40	0.89	Agree
	The instructional modules will serve as a supplementary material that can cater to the needs of the students.	4.60	0.55	Strongly Agree
	Overall	4.48	0.19	Strongly Agree
Overall evaluators' responses on the Module	Objectives	4.72	0.24	Strongly Agree
	Content	3.88	0.14	Agree
	Format and Language	3.92	0.18	Agree
	Presentation	3.92	0.20	Agree
	Usefulness	4.48	0.19	Agree
	Overall	4.18	0.03	Agree

Legend:

Mean Rating	*Interpretations*	
4.50-5.0	*Strongly Agree*	*Excellent*
3.5-4.49	*Agree*	*Very Good*
2.5-3.49	*Undecided*	*Good*
1.5-2.49	*Disagree*	*Fair*
1.0-1.49	*Strongly Disagree*	*Poor*

CONCLUSIONS

The findings demonstrate that the use of a well-designed instructional module can be effective in improving students' knowledge and understanding of the topics on Green Technology Education for Prelim and Midterm. On the basis of the findings, the developed instructional modules on Environmental Education: Goals, Basis and Principle; Environment, Ecology, Ecosystem; Man, Environment and Environmental Awareness; Biogeochemical Cycle; Natural Resources; and Man and Biosphere and its Totality under the domain of Green Technology Education shows potential in terms of its usage based on the evaluators who were identified as one of the end users.

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