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DEVELOPMENT AND VALIDATION OF LABORATORY WORKBOOK IN PLANT BIOLOGY

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Abstract

This study aimed to develop and validate the Laboratory Workbook in Plant Biology. It was conducted at Eastern Samar State University during the second semester of school year 2017-2018 with 34 2nd year BSED Biological Science major students and 5 plant biology professors/instructors as respondents. The study used the descriptive-experimental method to describe and evaluate the developed laboratory workbook in Plant Biology using the questionnaire checklist and test results in gathering data. A pretest and posttest was administered to the student users to determine the performance in Plant Biology of the two groups of respondents. They were asked to evaluate the laboratory workbook through the following: format, language, content and evaluation. As to the level of acceptability, science experts rated the laboratory workbook in terms of learning competencies, appropriateness, presentation and organization, accuracy and up-datedness of information. Responses were tallied, tabulated and interpreted with the used of appropriate statistical treatment. Findings of the study showed that the laboratory workbook had a very nice format, very understandable and very appropriate to the target user since it very satisfactorily met the criteria and standard set for its evaluation and assessment. The students exposed to the developed laboratory workbook attained better performance than students taught without the use of the workbook in Plant Biology. The developed workbook contributed to the improvement of students accomplishments in plant biology. It is therefore recommended by the author that the developed laboratory workbook is effective and acceptable for use as instructional material in teaching Plant Biology.

Keywords: Laboratory Workbook, Instructional Materials, Plant Biology

INTRODUCTION

Plant Biology is one of the major subjects for students taking Bachelor of Secondary Education major in Biological Science. The subject carries a five (5) unit, 9 hours a week with three (3) units lecture and two (2) units laboratory. Conducting laboratory without laboratory manual or workbook is not easy for one handling the subject. The necessary competencies and skills must be achieved effectively. The laboratory workbook in Plant Biology could be beneficial to the students because it provides sufficient laboratory activities that will enhance the development of necessary skills and competencies required by the course. This will not replace the lessons prepared by the instructors/professors but designed to supplement and suggest uniformity of instructions.

The University guidelines on instructional materials development, pursuant to Republic Act 8293, encourage full-time faculty members to develop textbook/instructional materials that will develop competencies as required by the subject. Moreover, Presidential Decree No. 6-A, known as the Educational Development Act of 1972, explicitly stated one of the objectives of tertiary education in the following statement: "Develop the high level professions that will provide leadership for the nation, enhance knowledge through research, and apply new

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knowledge for improving the quality of instruction." This objective shall be attained through the design, utilization and improvement of instructional technology and development/production of textbooks and other instructional materials.

(http://www,lawphil.net/statutes/presdecs/pd1972.html).

According to Casiano (2012) the utilization of instructional materials aids to achieve a more effective teaching and learning process. Teachers can better and more easily deliver the goods to their clientele, and in return, their clientele can have the insight and learning more adequate with ease and accuracy.

Hence, the objectives of any educational process determine the contents, methods and materials needed for achieving such objectives. The materials used for enhancing instructional effectiveness are aspects of media employed for achieving the instructional objectives. Bassey (2012), described instructional media as system components that may be used as parts of instructional processes which are used to disseminate information message and ideas or which make possible communicable in the teaching-learning process.

Onasanya (2010) likewise stressed that a professionally qualified teacher no matter how well trained, would be unable to put his ideas into practice if the school setting lacks the materials and equipment necessary for him or her to translate his competence into reality. Onasanya (2010) further explained that teachers have been depending on excessive use of words to express, to convey ideas or facts in the teaching-learning process. This practice is termed the "chalk-talk" method. Today, advances in technology have made it possible to produce materials and devices that could be used to minimize the teachers talking and at the same time, make the message clearer, more interesting and easier for learners to assimilate.

On the other hand, Banzon (2010) pointed out that one of the basic problems affecting the school system is the deterioration in the academic performances by students. Studies by experts have indicated that the average test score of students in all subject areas are potent of the poor quality education. Students cannot read, understand simple direction and solve simple problem. Corral (2007) inferred further that the deterioration in the quality of the students' performance in high school and college is due to low performing inputs of students from elementary to college.

Sibayan (2008) confirmed further that failure of the students to excel in their academic performance is due to a number of factors besetting education in the Philippines. Among the school-related causes are poorly trained teachers, inadequate facilities and equipment and lack of instructional materials in the preparation of the lesson in order for the students to have direct experience in learning. Teacher should develop instructional materials and other devices that maybe helpful in the students especially in the comprehension of concepts.

In developing instructional materials the teacher must include the consideration of his aim of teaching. As teachers, they mediate learning, and make learning possible. This presupposes that a teacher, before he could teach very well, must know how his students learn. If this is so, then instructional materials, as partly teachers, must also mediate learning, or can make

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learning possible. Therefore, it is very necessary for teachers to 1) learn basic principles and concepts of instructional materials development and writing; 2) appreciate the significance of the use of quality Instructional materials both in teaching and students learning; and 3) understand the art and science of developing instructional materials development through research (Articulo, 2008).

Moreover, Salandanan (2005) suggested that teachers of today must be prepared to develop their own instructional material since the demand for competence in this task is increased by the current emphasis on individualized or personalized instruction. Educators have agreed that teaching lends to itself best to an individually-paced instructional program wherein the success of it depends to a large extent on the self-instructional material used.

On the other hand, Articulo (2008) opined that this Learner-Centered Text or Workbooks (LCT/W), work text/modules, have gained wide popularity and they are at present being tried by some well-equipped and highly managed institutions. Drawing expertise from their own research teachers, some of these schools developed their own materials suited to the needs, interests and abilities of their own students.

The fact that students differ from one another in several aspects, they, too differ in their levels of aptitude and achievement. Since each student is a unique individual, it is therefore the teacher's responsibility to understand the needs, interests and capabilities of each learner so that his educational growth and development can be intelligently guided and effectively provided for (Aquino, 2008).

It is in this premise that the researcher is encourage to pursue this study because she believes that with the aid of instructional materials in classroom instructions, will enable to achieve a more effective teaching and learning process and significantly increase students' performance in the subjects and eventually improve the quality of graduates.

But the question is: how could these instructional materials be considered as appropriate, reliable, and valid or be addressed as usable in relation to the implementation of the subject. This is the reason why this study will be conducted; to validate and pilot test the laboratory manual and workbook in Plant Biology as to its validity, appropriateness, organization of content, learning competencies to be developed, accuracy and up-datedness.

According to Dick and Carey (2009), evaluation of this material is usually integrated in the overall designed and development plan. It is considered to be a vital component of a quality assurance strategy and the expectation is that evaluation activities could contribute significantly to the development of quality learning materials. This study aimed to validate the developed laboratory workbook in Plant Biology, at ESSU Main Campus S.Y. 2016-2017.

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Specifically, this study sought answers to the following questions:

1. What is the validity of the laboratory workbook through expert validation in terms of:
    1.1 Format
    1.2 Language
    1.3 Content
    1.4 Evaluation?
2. What is the level of acceptability of the instructional materials in terms of:
    2.1 Learning competencies
    2.2 Appropriateness
    2.3 Presentation and organization
    2.4 Accuracy of information
    2.5 Up-datedness of information?
3. Is there a significant difference in the pretest scores of students taught with the lecture method and those taught with the use of the laboratory workbook?
4. Is there a significant difference in the posttest scores of students taught with lecture method and those taught with the use of the laboratory workbook?
5. Is there a significant difference in the mean gain scores of students taught with the lecture method and those taught with the use of the laboratory workbook?

Scope and Delimitation of the Study

This study was an evaluation of the validity of the developed laboratory workbook in Plant Biology for 2nd year college students major in Biological Science of Education in ESSU Main Campus. Questionnaires adapted from the study of Comte (2012) and Morante (2014) was used to answer the questions formulated in the study and this was conducted from June to October 2018.

Significance of the Study

The outcome of the study will be beneficial to the following groups:

The College of Education: The result of the study will be of significant contribution to the College of Education of Eastern Samar State University so that it can propose the use of the developed instructional material to enhance the performance of biological science major students and will also add to the percentage of developed instructional material of the College.

The Teachers: The Laboratory workbook will aid them in their existing problems regarding the lack of laboratory manual and workbook in Plant Biology. With this study, the instructors and professors handling the same subject can now solve the problem on poor achievement of the students.

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The graduate students and researchers: This study will also prove beneficial to graduate students by replicating the study using other areas of science, mathematics, English and other subjects like focusing their study on different formulas in science and mathematics and on validation studies.

The undergraduate students: It is expected that the result of this evaluation will augment the basic research learning of college students by acquiring "hands-on", "minds-on" and "hearts-on" activities while progressing at their own rate

REVIEW OF RELATED LITERATURE

The study is anchored on the theory of John Dewey, that the acquisition of skills requires "learning by doing." Dewey believed that people learn by doing and reflecting on what they do. The foundation of Dewey's view was the need for direct, rich and meaningful experiences of each learner (Bilbao, et. al. 2008). The philosophy of Dewey is applied in this study wherein the learners gained skills as they are engaged in science practices or exercises and solving problem activities. This theory is concurred by Thorndike (1992) who said that man learns by doing, supported by Jansen (1989) with his theory stipulating that idea can be internalized better if they are put into action.

The study is also anchored on the most common theory applied to the classroom setting popularly known as Operant Learning Theory or the so called Programmed Learning by B.F. Skinner (Lardizabal, et.al. 2005) which stressed that a person behaves in a positive way through positive or negative reinforcement. This is based upon the idea that "learning is a function of change in overt behavior". Changes in behavior of an individual is the result of his response to events (stimuli) happening in the environment (Lardizabal, et al, 2005). It is presumed in this study that performance of students in Plant Biology is greatly affected by the teacher and the kind of instructional materials used.

On the other hand, the principle of connectionism expressed by Edward Thorndike also is applied in this study. This principle formed the Three Laws of Learning. First is the Law of Readiness that plays a vital role in child's learning which states that when a person is prepared to respond to act, giving the response is satisfying and being prevented from doing so, is annoying. Second is the Law of Exercise which involves strengthening learner knowledge and skills with practice. The more frequently they are exercised, the more securely will their knowledge be fixed? The third is the Law of Effect which supplements the law of exercise. This law states that when a response is accompanied or followed by a satisfying state of affairs, the strength of the connectionism is increased. When however, the response is accompanied or followed by an annoying state of affairs, the strength of the bond is decreased (Calderon, 2008).

The present study also takes cognizance on the student performance assessment theories. According to Wilcox as cited by Montecalvo (2002), expanding conception of assessment has entailed reconsideration on what might count as evidence of students' understanding and how to gather information through observing and listening to students as they work on a task, asking, probing questions and examining their work. She further stated that assessment of students can

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be a powerful tool to help teachers monitor the effectiveness of their own teaching, judge the usefulness of learning tasks, and shape their on-going instructional decisions.

On Instructional Material: Articulo (2008) had identified several characteristics of good quality IMs. They should (1) be written to match and specific group of learners; (2) make links with learners' own experience; (3) help learners to develop their own learning skills as well as helping them to learn the content; (4) make clear the particular learning objectives and help learners to set their own objectives too; (5) be structural in a way which is clear to learners, guiding them through the text; (6) build on learners' existing skills or knowledge; (7) keep the learner engaged with the text (by asking questions or providing interesting and useful activities); (8) give feedback within the text (on activities and questions); (9) provide opportunities for learners to develop their own ideas or make choices (not all answers are "right-or-wrong"); (10) provide opportunities for practice, where appropriate; (11) use a lay-out which is attractive and makes reading and learning as easy as possible; (12) present material in short, manageable amount for studying. Magbanua in Tañala (2009) stated that the effectiveness of teaching-learning process can be increased greatly through the proper use of instructional materials, but instructional materials cannot teach by themselves; they need a skilled teacher to make them effective. Devices whether visual or audio-visual are important in the teaching-learning process because this stimulate interest and enrich experiences basic to all learning. Audio-visual materials are aids to thinking about or abstract relationship.

The teacher is still the most important component in the academic performance of the learner. To become effective, the teacher must possess certain qualities that would make him a good teacher. He instils confidence and makes learning a fascinating challenge. He had a fine way of explaining the more complicated things in simple manner. A good teacher encourages students to ask questions when they cannot understand something. He is not aloof but rather friendly. To become a good teacher demands a great deal of self-sacrifice (Woolfolk in Tañala, 2009). According to Tañala (2009) instructional modules are desirable for many students, but especially important for students whom learning to read are difficult. It is for the learners that instructional modules should be geared. For instructional module to be effective, Osborne (2010) insists that they focus on a sequenced review of what has been taught, on the most important content, and on content that needs to be reinforced. Instructional module can provide students with (1) a means of practicing details of what has been taught; (2) extra practice for students who need it; (3) intermittent reviews of what has been taught; (4) ways for students to apply new learning with examples; (5) practice in following directions; (6) practice in a variety of formats that will experience when they take tests; and (7) opportunity for students to work independently and at their own pace. If teachers can teach, with all probability, they too can write. Writing a good textbooks, workbooks, work-texts for that matter is basically finding time to sit down and put in words what, through the years of their professional lives, these teachers have been "lecturing" in class. Like in distance education, the instructional materials are practically their own teachers. And if Instructional Materials are partly teachers, this means that they are, literally speaking, the instructional materials they write or develop (Articulo, 2009).

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On Evaluation/Validation: Since the effectiveness and the usefulness of an instructional material is one of the indicators of an educational quality, it must be subjected to a continuous evaluation process. Aquino (2008) stressed that the process of evaluation includes the procedure, techniques, and criteria involved in the gathering and processing of evidences needed to make decisions and judgments; and these decisions and judgments may be related to the curriculum, teaching strategies, instructional media, students' progress, and other aspects of educational program. Among the purposes served by an effective system of evaluation are: 1) to clarify goals and objectives, 2) to determine the extent to which objectives have been achieved, 3) to assess alternative approaches to instruction, 4) to identify needed changes in the instructional programs, and 5) to gather evidences for the use in reporting student progress.

However, regardless of the object of evaluation, its main concern will focus on the gathering of empirical data of what is being evaluated. According to Best and Kahn (2008), accuracy or consistency of the collected data is an extremely important part of all research endeavors. Further, an inaccurate or inconsistent data eventually is a source of unwarranted or invalid inferences; consequently, a serious element of error is introduced.

Best and Kahn (2008) stressed that the development of a "good" material or instrument usually takes a fair amount of time and effort, not to mention a considerable amount of skill. Marshall and Rossman (2010) added that expertise in the field is of prime importance, that is, aside from the fact that a valid development procedure should be observed.

Programmed learning maybe accomplished either with the use of teaching machine or programmed text. A recent sophisticated development of programmed learning is the Computer Aided Instruction (CAI) which is done by a computer (Bustos, 2010). But in this study, programmed learning will be accomplished through a programmed text or module.

The procedures in the development of any instructional material vary with the type of material and the aims of the users. However, certain procedures in a material construction are the same in all these types of material (Popham, 2010).

Content validation is the most crucial and preliminary step towards material or instrument development. Content validation sets the pace for succeeding validity and reliability measures. Careful planning, determination of objectives, and review of literature should be made at this point in order to be provided with comprehensive knowledge of the nature of the decision to be measured by the material or instrument (Oriondo and Dallo, 2009). Popham (2010) also added that various considerations such as areas to be covered, format, scaling techniques, etc. should also be considered. These procedures lay a foundation for concepts or item generation.

On the other hand, according to Catindig (2007), item generation may be made by soliciting from a sample, by referring to available literature, or from data bank of authorities. Items may also be generated through interview or through evaluation records and policies, library research, and those that come from interaction with people of similar field of discipline.

Catindig (2007) further opined that the appropriateness or suitability of the generated concepts or items, however, needs to be evaluated in order to determine if it fits with the purpose of the

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material or instrument. The evaluators should be composed of a group of experts in the field or the subject matter or any professional who specialized on IM or instrument development. In most cases, consistency of the judgments made by the panel of evaluators need to be tested. Popham (2010) suggested collating the data gathered from the evaluators by conducting an inter-judge consistency estimate. This procedure provides an evidence of the reliability of the judges as well as their judgment on each of the items in the instrument. Once all these procedures are done, the material or the instrument is now expected to possess the so-called content validity.

Another important requisite of a "good" material or instrument is its evidence of reliability. An instrument is reliable to the extent that it measures whatever it measures and yields comparable results on repeated administration (Best and Kahn, 2008).

The study of Selga (2010) focused on the development and validation of work text in Science, Technology and Society in terms of assessing the availability, adequacy of instructional materials and the needed topics in the course, and the level of validity of the tasks and activities in the developed work text along content format and readability. The findings of the study revealed that the average ratings of all validators implied that the work text contributes to the achievement of specific objectives of the subject, provides for the development of higher cognitive skills, was well-organized and well-designed and was suitable to the vocabulary level and ability of the students, hence the researcher concluded that the developed work text was valid.

Castaniares (2010) conducted a study on development, validation and acceptability of work text in Advanced Algebra. Results showed that both the experimental and control groups obtained low performance in the pre-test and high performance in the post test. Based on the findings, performance of the experimental group in the pre-test and the post-test differ significantly to the performance of the control group. However, the pre-test of the two groups have no significant difference while the post-test of the control group differ significantly with the experimental group obtaining better performance in the post-test, due to the utilization of the developed work text in Advanced Algebra. Evaluation of the two groups of respondents on the level of acceptability of the developed work text is similar with respect to content, relevance, language and style, and reinforcement. However, for organization and presentation, evaluation of the two groups differs significantly.

The study of Morales (2006) on the development and validation of work text in Statistics and Probability for Bachelor of Arts in Statistics students showed that the study was very promising in the sense that this research study has developed a work text that is readable although it showed that there are few unclear words, sentences, paragraphs, etc. which have to be addressed and attended to. When these unclear elements were revised and that the comments and suggestions of both teachers and students were incorporated, the work text was confidently replicated and can be used as a prescribed work text for Statistics and Probability for Applied Science use.

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Akpinar (2010) conducted a study on the validation of a learning object review instrument (LORI): relationship between ratings of learning objects and actual learning outcomes. Results showed that the LORI revealed some interactions between those variables. However, the LORI ratings, and the usability assessment did not correlate with the learning gains of students.

Conte (2012) in her study yielded the following findings: Workbook and Work-text in Physics I used in Technological Institute of the Philippines were insufficient. The faculty and the students considered the existing textbooks, reference books and laboratory manuals as insufficient, too.

Another study by Gagarin (2005), found out that modules are instructional materials which really enhance the learning experiences of students. She recommended that modules be used to the whole class not only to selected few to enhance learning. Supervision and monitoring can be done by the teachers and at the same time necessary changes on the module be made to be attuned with the needs of time.

According to the findings of Quiben (2010), the use of instructional work-text could be a great help to both the teachers and students in the attainment of the objectives of their laboratory work and help students in enhancing the mastery of their manual skills. She recommended that all teachers especially science teachers should be encouraged to help themselves to line with the programs on upgrading and updating their know-how on developing instructional materials. It should be designed in accordance with the target need of the learners.

From these studies reviewed, important insights on the evaluation of instructional materials are gained. All studies and literature are relevant which helped the researchers in conceptualizing and laying out framework of her study.

MATERIALS AND METHODS

This validation was an experimental method of research using the pretest-posttest control group design. The design is appropriately used because it assessed the effect of utilizing a laboratory workbook developed on the achievement of students enrolled in Plant Biology or Botany. Two groups of subjects will be used, with both groups measured or observed twice. The first measurement will be the pretest and the second will be the post test. The measurements or observations will be collected at the same time for both groups.

Research Locale

The study was conducted at Eastern Samar State University (ESSU) Borongan Campus offering Bachelor of Secondary Education (BSED and Bachelor of Science in Biology where the prepared laboratory workbook was used by students taking Plant Biology. One section consisting of 17 students was classified as control group who were taught using lecture – discussion method while the other section consisting of 17 students was the experimental group to be taught using the workbook. Both groups were taught with exactly the same subject matters and the same laboratory exercises.

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Research Instruments

The following instrument was used in gathering data of this study.

Questionnaire: A questionnaire was used to evaluate the proposed module in terms of four (4) criteria; format, language, content and evaluation. This was used in reviewing the draft module by the technical panel.

In the process of selecting the test items for the test and the indicators for each criteria in the questionnaires, the researcher did the following steps; (1) tedious planning of tests and questionnaires, (2) validation of the instruments, (3) evaluating the test in terms of reliability and the workbook as to its content analysis. The questionnaire was patterned from the study of Conte (2012) and Morante (2014). This was used to evaluate the laboratory workbook. Upon completion of the first draft of the questionnaire, the researcher showed it to the advisory committee for comments and suggestions.

Achievement Test: This is a teacher-made test to be used as the primary instrument to gather the needed data. It is a 50-item test that covered concepts on Plant Biology. The test is a multiple choice type test which was stated in questions and in statements form followed by four (4) alternatives or options.

In planning the test, the researcher followed the syllabus in Plant Biology as prescribed by the ESSU System for the teacher education course. Table of Specifications which includes the following; (1) content, (2) time allotment for each topic, (3) percentage of time, (4) number of items per topic, was prepared.

The draft of the test was subjected for review and was edited by the Dean of the College of Education as well as by Biology instructors of the said campus. After which, it was shown to the Technical Working Group of Research and Development Services of ESSU for comments and suggestion and for more refinement of the instruments' items.

Validation of Research Instrument

The questionnaire was scrutinized and was presented for critiquing by the members of the TWG to ascertain the appropriateness of the instruments' items. After modification was made, and following the suggestions of the TWG, it was subjected to a dry-run to instructors who are handling Plant Biology in ESSU Maydolong campus.

To determine the reliability of the achievement test a dry-run was conducted. The test was administered to second year students of the College of Education of ESSU Maydolong Campus, Maydolong, Eastern Samar, who were not included in the study. The results was subjected for item analysis for their power of discrimination and index of difficulty as basis for its revision. To determine the merit of any test items, test results was subjected to item analysis to select the best available and appropriate item for the final form of the test and to identify content defects in the item. Therefore, to obtain information concerning item analysis, the following considerations was acted; (1) item difficulty, (2) item discrimination, (3) effectiveness of distracters.

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To determine the difficulty level of items for the final test, it depends on the proportion of the subjects who answered the items correctly. Questions with difficulty of 0.26 – 0.75 was selected. Discrimination index was computed and questions with 0.30 – 0.80 discrimination index was retained. To determine the effectiveness of distracters, complete responses patterns associated with all alternatives or options in each item was studied. Distracters that was selected more frequently by those members of the low scoring group was considered as good distracters. Distracters that was not selected by anyone either high or low group will be deleted (Downie N.M. & Robert W. Heath, 1984).

Sources of Data

Data were taken from the results of the pre-test and post-test of both groups of respondents, students taught using the lecture method and with the use of laboratory workbook, questionnaire used for evaluating the prepared IM by the respondents, and by the panel of experts from Eastern Samar State University.

Respondents of the Study

The respondents of the study are the 34 second year students, who were majors in biological science from the College of Education of the Eastern Samar State University, Borongan City, and Eastern Samar who were enrolled in plant biology during the 2nd semester of school year 2016-2017. The evaluator of the Instructional Materials includes the 5 faculty handling the same subject from the College of Arts and Sciences and the 34 student respondents.

Data Gathering Procedure

Letter permission was sought from the President of ESSU Borongan Campus and the Deans of the College of Education and College of Arts and Sciences. The study was conducted last second semester, school year 2016-2017. The distribution of the questionnaire was done personally by the researcher. The retrieval of the questionnaire was done a week after the distribution. The data collected from the research instruments was carefully tallied, analyzed, studied and interpreted accordingly. Before the start of the experiment, a pretest was conducted to both groups. The two groups was exposed to the same topics and the same set of activities or exercises. Concepts was discussed, and evaluation was done orally or in written form every after each lesson. Finally the posttest was administered after taking up the subject and performing all the eighteen (18) exercises on the laboratory workbook.

Methods of Scoring and Interpretation

As to the reliability of the test, the following reliability index was used: (Orstein, 1990).

Scale	Qualitative Description
0.80 and above	High reliability
0.40 - 0.79	Fair reliability
0.39 and below	Low reliability

The following five-point graduated scale was used to rate the laboratory workbook in terms of format, language, content, and evaluation.

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Weighted Score	Ranges	Qualitative Description
5	4.50 – 5.00	Excellent indicator
4	3.50 – 4.49	Very Satisfactory indicator
3	2.50 – 3.49	Satisfactory indicator
2	1.50 – 2.49	Fair indicator
1	1.00 – 1.49	Poor indicator

RESULTS AND DISCUSSION

Validation of the Laboratory Workbook

By the Technical Committee: One of the objectives raised in the study was to establish validity of the laboratory workbook in Plant Biology through technical panel committee who evaluated the workbook in terms of format, language, content, and evaluation. The committee was composed of five (5) professors, all have taught plant biology subject. These evaluators were from Eastern Samar State University-Borongan Campus, two (2) of whom were CAR in Ph.D. in Education, one was a CAR in Ph.D in Biology and two (2) were pursuing masters' degree. Their ratings are presented in the succeeding tables.

Format: Table 1.1 below presents the ratings of the seven indicators under the format criterion. It was revealed that indicators nos. 1, 2, 3, 6 & 7 obtained a mean score range of (4.6-5.0) and were all interpreted as excellent. The highest indicators was statement number 1,"vocabulary words used in the workbook are within the students' level of understanding and statement number 2 "the sentence structures used in the workbook are varied and understandable". It obtained a score of 4.8 and interpreted as excellent. The other two indicators, numbers 4 and 5 have a mean score of 4.4 rated very satisfactory.

The findings imply that the laboratory workbook have a nice format, very understandable and very appropriate to the target user.

Table 1.1: Ratings on the Proposed Laboratory Workbook in Terms of Format

Indicators	Mean Score	Descriptive Rating
1. Vocabulary words used in the laboratory workbook are within students' level of understanding.	4.8	Excellent
2. The sentence structures used in the laboratory workbook are varied and understandable.	4.8	Excellent
3. The laboratory workbook contains diagrams/pictures sufficient to illustrate ideas and concepts.	4.6	Excellent
4. The tables found in the laboratory workbook are accurate and easy to understand.	4.4	Very Satisfactory
5. The symbols and the abbreviations used in the laboratory workbook are appropriate to target group and enhance learning process.	4.4	Very satisfactory
6. The ideas in the laboratory workbook are developed adequately in a logical manner and easy to follow.	4.6	Excellent
7. The laboratory workbook contributes to the development of critical thinking and creativity.	4.6	Excellent
Over-all Mean Score	**4.6**	**Excellent**

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The data in table 1.2 shows indicators under the criteria of language. It can be gleaned in the table that out of seven indicators, six (6) indicators nos.1, 2, 3, 4, 5 & 7 and yielded a mean score of 4.6 rated as excellent. The other indicator was rated very satisfactory with a score of 4.4 .

The same table revealed that the overall mean score of the laboratory workbook under these criteria was 4.57, with descriptive rating as excellent.

Table 1.2: Ratings on the Proposed Laboratory Workbook in Terms of Language

Indicators	Mean Score	Descriptive Rating
1. The language used in the laboratory workbook is simple and easy to understand.	4.6	Excellent
2. The sentences are simple and concise.	4.6	Excellent
3. The activities indicated in the laboratory workbook are clearly explained.3	4.6	Excellent
4. The definitions of terms found in the laboratory workbook are simple and easy to comprehend.	4.6	Excellent
5. The rules, procedures and meanings of the different activities are easy to follow and apply.	4.6	Excellent
6. The language and/or visuals are appropriate to the maturity level of the learner.	4.4	Very Satisfactory
7. The instruction and learning tasks are well illustrated and made easy.	4.6	Excellent
Over-all Mean Score	**4.57**	**Excellent**

Reflected in table 1.3 is the rating of the workbook in terms of content. The table shows that six out of seven indicators , indicators nos. 1, 2 ,3, 5 & 6 got a mean score of 4.6 to 4.8 rated as excellent. Only indicator no. 4 got a mean score of 4.4. rated as very satisfactory. It has an overall mean score of 4.6 rated descriptively as excellent. The data implies that the laboratory workbook is clear, complete, realistic and correct. Further it implies that the content presents a clear idea and that there is a logical relationship and smooth flow of ideas from lesson to lesson and is relevant to Philippine setting and provide for individual differences for the learners.

Table 1.3: Ratings on the Proposed Laboratory Workbook in Terms of Content

Indicators	Mean Score	Descriptive Rating
1. The content of the laboratory workbook are clear and complete.	4.8	Excellent
2. The content of the laboratory workbook in Plant Biology are appropriate to college level.	4.6	Excellent
3. The content of the laboratory workbook are realistic and correct.	4.6	Excellent
4. The laboratory workbook adequately covers the necessary topics for research.	4.4	Very Satisfactory
5. The content of the laboratory workbook are relevant to Philippine setting.	4.6	Excellent
6. There are evaluation items prepared for the topics in each exercise/activity.	4.6	Excellent
7. The content of the laboratory workbook provide for individual differences (fast & slow, multiple intelligences)	4.6	Excellent
Over-all Mean Score	**4.6**	**Excellent**

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The data in table 1.4 shows that indicators 1 and 5 under this criterion yielded a mean score of 4.6 and rated as excellent, whereas indicators no 2, 3, 4, 6 & 7 were rated very satisfactory with a mean score inclusive at (4.2 – 4.4) scale.

The data implies that the laboratory workbook includes evaluation items in each lesson that could excellently provide better understanding of the topic discussed and appropriate to target group with varying levels of maturity, economic background and learning styles for varied learning environments.

Table 1.4: Ratings on the Proposed Laboratory Workbook in Terms of Evaluation

Indicators	Mean Score	Descriptive Rating
1. Evaluation items found in the laboratory workbook facilitate better understanding of the topic discussed.	4.6	Excellent
2. There are evaluation items in each lesson/topic.	4.2	Very Satisfactory
3. The evaluation items trigger the learning comprehension of the students.	4.2	Very Satisfactory
4. The evaluation items are simple yet challenging.	4.4	Very Satisfactory
5. The evaluation items utilize practical applications and real life situations.	4.6	Excellent
6. The evaluation items are appropriate to target groups with varying level of maturity, economic background and learning styles.	4.4	Very Satisfactory
7. The evaluation items found in the laboratory Workbook are suitable for varying learning environments.	4.2	Very Satisfactory
Over-all Mean Score	**4.37**	**Very Satisfactory**

Summing up the result of the evaluation on the laboratory workbook based from the four (4) criteria. It was revealed that format, language, and content were rated as excellent with an average mean of 4.60 and 4.57 respectively. Evaluation was rated very satisfactory with a mean of 4.37. This means that the laboratory workbook is valid and is accepted as an instructional material in Plant Biology.

Table 1.5: Summary of Evaluation Ratings of the Technical Panel on the Laboratory Workbook

Criteria	Mean	Qualitative Description
1. Format	4.60	Excellent
2. Language	4.57	Excellent
3. Content	4.60	Excellent
4. Evaluation	4.37	Very Satisfactory
Grand Mean	**4.53**	**Excellent**

Level of acceptability of the instructional materials

Table 2.1 revealed the respondents' level of acceptability of the instructional materials in terms of learning competencies, indicators nos. 1, 2, 3,and 4 got a mean score range between 3.5 – 3.8 with a descriptive rating of well developed. Only indicator no. 5 got a mean score of 3.47 and was rated as well developed. The overall mean score was 3.63 rated as well developed.

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This imply that the proposed workbook was appropriate and is sufficient to the development of the learning competencies in terms of cognitive, psychomotor and affective domains for the subject and year level for which the Instructional material is intended.

Table 2.1: Ratings on the Proposed Laboratory Workbook in Terms of Learning Competencies (Knowledge, Skills and Values)

Indicators	Mean Score	Descriptive Rating
1. Using a course syllabus specifying learning competencies (LC) for the subject and year level for which the IM is intended and the correspond ding matrix, check the appropriate column under each LC number in the column on which page of the IM required competency has been developed.	3.76	Well Developed
2. Using the result in number 1 as basis, determine the sufficiency of development of each specific LC.	3.70	Well Developed
3. Specifying the cognitive domain as one of the learning competencies for the subject for which the IM is designed check in the scale column to determine the level of cognitive development.	3.53	Well Developed
4. Specifying the psychomotor domain as one of the learning competencies for the subject for which the IM is designed check in the scale column to determine the level of psychomotor development.	3.70	Well Developed
5. Specifying the affective domain as one of the learning competencies for the subject for which the IM is designed check in the scale column to determine the level of affective development.	3.47	Developed
Over-all Mean Score	**3.63**	**Well Developed**

Table 2.2 shows the respondents ratings on the appropriateness of the laboratory workbook to the learners year level. Indicators nos. 1, 2, 3 and 4 was rated as very appropriate with a mean scores of 3.76, 3.64, 3.53 and 3.70 respectively. Indicator no. 5 which determine whether the material is free from controversial and sensitive issues which may be difficult to discuss in the classroom got the lowest mean score of 3.47 rated as appropriate. This mean that the content, the vocabulary, values integration, text, visuals, illustrations, layout and design were appropriate and is suitable to the level of the target user.

Table 2.2: Ratings on the Proposed Laboratory Workbook in Terms of Appropriateness of Instructional Material

Indicators	Mean Score	Descriptive Rating
1. Content is appropriate to the learner's year level.	3.76	Very Appropriate
2. Vocabulary and length of sentences are suitable to target learner.	3.64	Very Appropriate
3. Material encourages integration of positive values and is mindful of health and safety of learners.	3.53	Very Appropriate
4. Text, visuals, illustrations, layout, and design are interesting and suitable to the target Filipino learners.	3.70	Very Appropriate
5. Material is free of controversial and sensitive issues which may be difficult to discuss in the classroom.	3.47	Appropriate
Over-all Mean Score	**3.62**	**Very Appropriate**

It can be gleaned from table 2.3 that the respondents ratings on the laboratory workbook in terms of presentation and organization were very organized with a mean score of 3.59. Five (5)

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out of eight (8) indicators, indicators nos. 1, 2, 3, 5 and 6 were rated as very organized with a mean score range from 3.53 – 3.82. While indicators nos. 1, 4 and 7 were organized with mean score range from 3.4- 3.47. The over-all mean was 3.59 and was described as very organized. It could be deduced from the result that the respondents are satisfied with the presentation organization of lessons in the laboratory workbook.

Table 2.3: Ratings on the Proposed Laboratory Workbook in Terms of Presentation and Organization of Material

Indicators	Mean Score	Descriptive Rating
1. Topics covered are logically presented throughout the material.	3.41	Organized
2. Units/chapters and lessons are arranged from simple to complex, from observable to abstract.	3.82	Very Organized
3. Exercises contain useful introductions, summaries, and other devices that facilitate smooth progression from one exercise to another.	3.70	Very Organized
4. Development of lessons in the material allows review, comparison, and integration with previous lessons.	3.47	Organized
5. Material promotes development of higher cognitive skills such as critical thinking, creativity, learning by doing, problem solving and other similar skills.	3.64	Very Organized
6. Organization of material allows use of various types of teaching and learning strategies to meet individual differences.	3.70	Very Organized
7. Material provides useful measures and information to help the teacher evaluate learner's progress in mastering the target competencies.	3.47	Organized
8. Material uses strategies that allow for fuller development of social skills such as striving for excellence, being responsible, and working harmoniously with others.	3.53	Very Organized
Over-all Mean Score	**3.59**	**Very Organized**

Table 2.4: Ratings on the Proposed Laboratory Workbook in Terms of Accuracy of Information

Indicators	Mean Score	Descriptive Rating
1. Conceptual Presentations	3.59	Very Accurate
2. Factual Information	3.82	Very Accurate
3. Grammatical Elucidations	3.35	Accurate
4. Computational Presentation	3.53	Very Accurate
5. Illustrations, Diagrams, Graphs and Tables Presentation	3.82	Very Accurate
Over-all Weighted Mean	**3.62**	**Very Accurate**

Table 2.5: Ratings on the Proposed Laboratory Workbook in Terms of Up-datedness of Information

Indicators	Mean Score	Descriptive Rating
1. Conceptual Presentations	3.7	Very Recent
2. Factual Information	3.9	Very Recent
3. Grammatical Elucidations	3.5	Recent
4. Computational Presentation	3.6	Very Recent
5. Illustrations, Diagrams, Graphs and Tables Presentation	3.7	Very Recent
Over-all Weighted Mean	**3.68**	**Very Recent**

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Empirical Validation of the Module

Difference in Pre-Test Scores of the Students. This aspect of the investigation looked into the pre-test scores of the students taught with the lecture method and the experimental method. It can be gleaned from table 4 that the control group yielded a mean score of 18.47 while the experimental group obtained a mean score of 31.52 in the pre-test. The standard deviation of the control group is 2.39 while the experimental group got a standard deviation of 6.21.

To determine the significant difference of the pre-test scores of students taught with the lecture method and those with the use of the laboratory workbook, the t test for independent means was computed. As shown in the same table, the tabular value was 1.697 with a computed value of 1.2478 which was not significant since the value was greater than 0.05 level of significance. Hence, the null hypothesis is accepted which states that there is no significant difference between the pre-test scores of students under the control and experimental groups. This result shows that the performance of students taught under the lecture method and through the use of laboratory workbook did not differ significantly with each other. This means that both groups have the same level of knowledge on the topics discussed.

Table 3: T-test of the Pre-Test Scores of the Control and Experimental Groups

Group	n	X	Sd	tabular value	computed value	Interpretation
Control Group	17	18.47	2.39	1.697	1.2478	Not significant
Experimental Group	17	31.52	6.21			

Difference in Post-Test scores of the Students. In table 4, result of the post-test shows that the control group exposed to the lecture method of teaching yielded a mean score of 35.53 and a standard deviation of 4.3 that reveals that the scores of students of this group were widely distributed from the mean score. On the other hand, the experimental group that used the laboratory workbook yielded a mean score of 51.82 with a standard deviation of 3.6 which could mean that the scores were closely distributed around the mean score. Further, it is shown in the table that the mean score obtained by the experimental group is clearly and significantly higher than the control group.

To determine the significant difference of the post-test scores of students taught with the lecture method and those taught with the use of laboratory workbook, the t test for independent sample means was computed. As reflected in the same table, the tabular value was 1.697 with a computed value of 2.078 which was significant at 0.05 level of significance. Hence the null hypothesis which stated that there is no significant relationship between the post test scores of students under the control group and experimental groups is rejected. This result shows the performance of students taught under the lecture method and through the use of the laboratory workbook in the post test differed significantly with each other. This means that those students who were taught using the laboratory workbook performed better than those taught with the lecture method.

This result conforms to the findings of Bentor (2000) which revealed that those students taught with the laboratory method using films did much better than those students with the conventional-teacher centered. Likewise the findings of Cruz (2011) confirmed that the

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students exposed to the developed worktext in drawing performed better than the students taught with the lecture method.

Table 4: T-test of the Post-test Scores of the Control and Experimental Groups

Group	N	X	sd	tabular value	computed value	Interpretation
Control Group	17	35.53	4.3	1.697	2.078	Significant
Experimental Group	17	51.82	3.6			

Significant Difference Between the Results of the Two Methods. Shown in table 5 is the result of the t test of the main gain scores of students taught with the lecture method and those students with the use of laboratory workbook. The tabular value of 1.697 with a computed value of 0.4062 was not significant at .05 level, thus the null hypothesis which states that "there is no significant difference in the main gain scores of students taught with the lecture method and those taught with the use of the laboratory workbook" is accepted.

This result shows that the performance of students taught under the lecture method and through the use of laboratory method in the post test differed significantly with each other. This means that those students who were taught using the workbook performed better than those taught with the lecture method. The result of the study confirms to the findings of Morante (2014) that the mean gain scores of the students were higher when they used the instructional module than the mean gain scores of students who were taught with the conventional method.

Table 5: t-test of the Mean Gain Scores of the Control and Experimental Groups

Group	N	X	sd	tabular value	computed value	Interpretation
Control Group	17	17.06	3.0189	1.697	0.4062	Not Significant
Experimental Group	17	20.29	4.7745			

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Result of the evaluation on the laboratory workbook based from the four (4) criteria revealed that the format, language, and content were rated as excellent with an average mean of 4.60 and 4.57 respectively. Evaluation was rated very satisfactory with a mean of 4.37. This means that the laboratory workbook is valid and is accepted as an instructional material in Plant Biology. In terms of the level of acceptability of the instructional materials as perceived by the respondents, the criteria on learning competencies has a mean score of 3.63 rated as well developed, very appropriate as indicated by its weighted mean of 3.62, and is 3.59 in terms of presentation and organization described as very organized, 3.62 as very accurate and in terms of up-to-datedness of information.

There is no significant difference between the pre-test scores of the students taught with the lecture method and with the use of laboratory workbook as indicated by its tabular value which is 1.67 and the computed value which is 1.2478. There is significant difference between the post-test scores of the students exposed to the lecture method of teaching and with the use of laboratory workbook. The mean score obtained by the experimental group is clearly and

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significantly higher than that of the control group which was 51.82 and 35.53 respectively. The student who were taught using the developed IM's performed better than those taught with lecture method. The mean gain scores between the control and experimental groups showed that the experimental group yielded a higher mean of 20.29 than the control group which yielded a lower mean gain of 17.06.

Conclusions

Based on the findings of the study, the laboratory workbook had a very nice format, very understandable and very appropriate to the target user since it very satisfactorily met the criteria and standard set for its evaluation and assessment. Students exposed to the developed laboratory workbook attained better performance than students taught without the use of the workbook in Plant Biology. The developed workbook contributed to the improvement of students accomplishments in plant biology. The developed laboratory workbook is effective and acceptable for use as instructional material in teaching Plant Biology.

Recommendations

The following recommendations are hereby offered: 1) utilization of the developed laboratory workbook is strongly recommended in Plant Biology classes, 2) development of laboratory workbook or manual in other Biology subjects may be conducted to make teaching and learning more effective and productive, revision and modification of the developed laboratory workbook should be done regularly to fit the learning needs and abilities of the students; 3) evaluation on the level of acceptability of the developed laboratory workbook may be conducted using other respondents in other ESSU campus; and further study is strongly recommended using other factors and variables.

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