Development and Validation of Modules in Zoology

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ABSTRACT

This study developed and validated modules in Zoology to help enhance learning and scientific skills. The descriptive-developmental method of research was used to highlight the development of this modular package. This study had 120 respondents composed of nine experts, who are fishery and biology instructors and 111 student-respondents. The module development consisted of planning, development, evaluation/validation, and revision stages. Checklist questionnaires and interview were used to determine the validity of the proposed modules. A descriptive form of the presentation of data and simple statistics were utilized in validating the content of the modules by experts and students. Based on students' learning difficulties, two modules were developed consisting of: Module 1: Aquatic Invertebrates; and Module 2: Aquatic Vertebrates. Both were found to have instructional and technical quality and observed to be valid as instructional materials to enhance learning and scientific skills. The posttest results of both modules 1 and 2 improved students' performance as compared to the pretest results. Analysis of comparison using independent t-test rejected the hypothesis of no difference in the means of the performance levels in the pretest and posttest in Modules 1 and 2. It is recommended that these modules be reviewed by Institutional Instructional Material Committee and be tried out by other professors inside and outside Sorsogon State College and be mass produced. These may also be used in teaching other areas of science not only Zoology subject.

Keywords: *difficulties of students, planning, evaluation, revision*

INTRODUCTION

In education, different strategies of teaching are applied by teachers to their students in classroom situations to solve teaching and learning problems. As observed, teachers today face a difficult decision when selecting teaching methods for their classrooms. Aside from the burden of having limited textbooks and other resources, most educators have an idea of what methods, strategies and techniques they will utilize only from their own experiences and preferences and not from the learning styles of the students. Ideally, an educator should know the learning styles and preferences of students so that activities given will suit their capabilities and needs. Effective instruction, however, does not happen by chance. It comes as a result of careful planning that follows a transparent process from project idea to evaluation and revision.

To upgrade the standards of education, teachers continue to search for innovations and new instructional strategies that would respond to the needs of the learners. Among these strategies is the modular approach which is now becoming popular especially among college instructors since it provides concrete application of the individual differences in which each student can process at his own rate.

A module is a self-contained unit of learning. Using it would enable both the learner and the teacher to define the level of study and the number of credits that need to be gained. It is a gaining ground not only because it meets individual needs and ability, but more so because it meets the need of the students' growing population. Module provides students with immediate feedbacks so that they can determine their level of mastery.

Informal interview by the researcher with the faculty and students of Sorsogon State College, Magallanes Campus revealed that inadequate textbooks, manuals, and other instructional materials in fisheries is one of the major problems encountered by the college in terms of instruction since fishery references are among those which are sold at high prices in the bookstores. In response to these concerns and knowing the positive results of using modules and modular method of teaching, the researcher came up with the proposed modules. These findings encouraged the researcher to develop and validate a self-learning instructional material specifically in the field of Zoology at Sorsogon State College, Magallanes Campus that offers mostly fishery-related courses. Upon validation, these modules may contribute to the effort of solving this problem. These can also be utilized in other biology subjects in fisheries such as Aquatic Biology, Aquatic Vertebrates and Invertebrates, and Ichthyology, and Biological Science for Education students.

Quality learning outcome is the primary goal of every educational institution. However, one cannot deny the fact that teachers nowadays are facing some problems that hinder the attainment of educational goals. It was noted that one of the problems met by college teachers is lecturing large number of students worsened by the constraint of limited resources, which include facilities, books, and other instructional materials. Because of these, many studies have been conducted on the development and validation of instructional materials, modules and work text, multimedia resources across the different disciplines to support and improve instruction.

Rizaldo and Rosita (2007) studied the effects of modular instruction and traditional methods in teaching analytic geometry. The study was anchored on the modular interactions and the traditional instruction to determine which of these two methods of teaching is a more effective strategy. The pretest and posttest results were used as the basis of the data for the level of competence of the students. Results showed that the modular interaction has the result of highly significant; thus making it a more effective strategy of teaching.

In like manner, Roman (2013) developed and measured the validity of a statistical module for an educational research which can be an input to sustainable quality research among student researchers of Laguna State Polytechnic University. Result showed that developed module in Statistics has very high extent of validity along specific objectives, content, language used, and evaluation activities. The use of the developed module tremendously helped students garner a very satisfactory performance. Their performance showed that they did not only learn the concepts but they could also apply statistics in day to day life situations.

The study of Naval (2014) on Development and Validation of Grade ten (10) Physics Modules on selected least mastered competencies found that the developed modules were acceptable for the Grade ten physics students. There was no significant difference between the evaluation of the students, peers, and experts on the module's acceptability. Additionally, the developed set of modules was proven to be effective in terms of knowledge acquisition. Therefore, it suggests that the developed module can be a useful tool for learning and teaching basic physics.

In the study of Ganiron Jr. (2015) on Development and Validation of Module for architecture students in Physics revealed that the group of students with module materials performed better in the achievement quizzes, tests, midterm and final examinations than the group not taught with the module materials. The first group also exhibited more positive and favorable attitudes toward physics, after the use of the materials.

The cited studies above bear similarity to the present study since they recognized the student needs in analytical geometry, statistics and physics. They differed on the ground that the present investigation searched into the development of modules in general zoology, more specific concern in identifying students' difficulties in learning as basis in the development.

The reviewed studies all have bearing to the present study since they also focused on the development and validation of instructional materials. While they all agree to a common idea of shifting from a teacher-centered to a student-centered teaching style, the emphasis of this study is more specific which is the utilization of the module as a learning material.

This study aimed to develop and validate a module in Zoology. Specifically, it attempted to accomplish the following objectives: Identify the learning difficulties of students in Zoology; Develop modules in Zoology that will enhance the learning and scientific skills of students; Determine the validity of the developed modules in terms of acceptability and agreement and Determine the performance levels of the students and the significant difference between the means of the pretest and posttest results.

The research input includes the difficulties encountered by the students in Zoology, the level of acceptability of the experts and the level of agreement on the presented modules.

The research process as part of the system consists of survey and unstructured interview conducted by the researcher prior to the development of the modules. It also includes the stages of module development which are: planning, development, evaluation/validation, and revision.

The research output is the developed and validated modules in Zoology and the improved performance of the students.

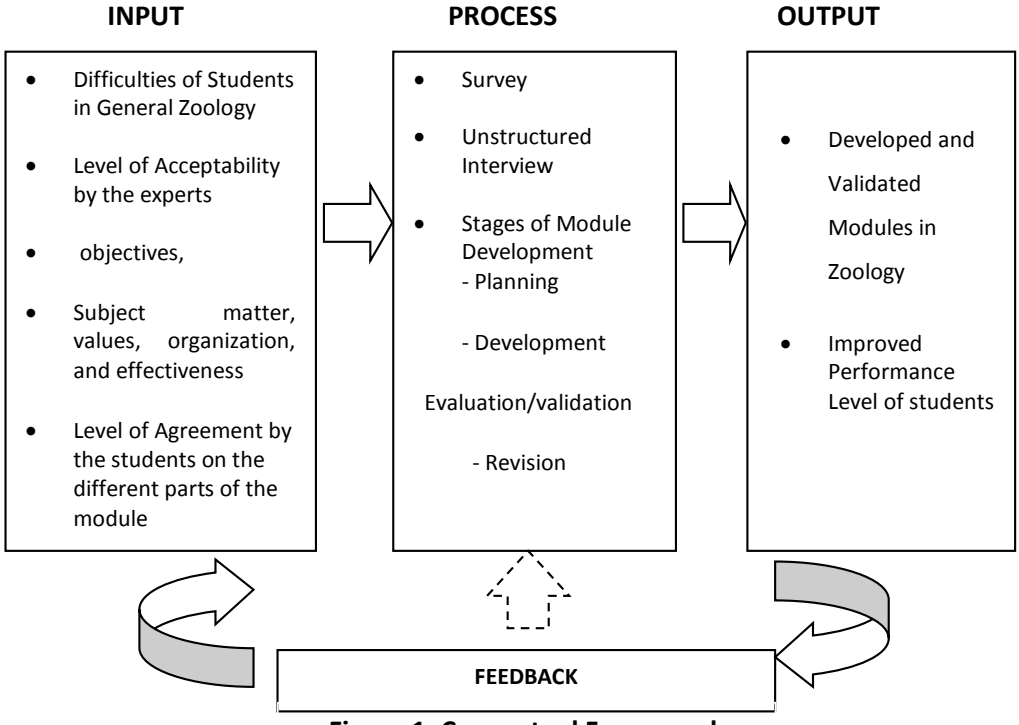

Figure 1. Conceptual Framework

The feedback reflects the results of the questionnaires administered by the researcher and the suggestions of the experts and student-respondents on the proposed modules. This was the basis of the necessary revisions on the modules.

METHODOLOGY

This study employed the descriptive-developmental method of research. It is descriptive since this study determined the difficulties encountered by the students in General Zoology subject, the levels of acceptability by the experts and agreement by the students as to the characteristics and parts of the modules, and the performance levels of the students on the use of the modules. This method is developmental because it highlights the formulation of a modular package in General Zoology based on the identified difficulties.

There were a total enumeration of 120 respondents composed of 38 students for the Zoology difficulty identification, nine experts and 73 student-respondents for the evaluation. The experts were composed of nine individuals: six Fishery instructors and three biology instructors at Sorsogon State College -Magallanes Campus. They have been teaching the subject for five years and above, earned master's degree in the field and conducted research in allied fisheries and biology topics discussed in the modules. Hence, they were tapped to evaluate the characteristics of the modules. The student-respondents on acceptability of the module were composed of 26 second year students of Bachelor of Secondary Education (BSE) major in Fish Biology and 47 first year students of Bachelor of Science in Fisheries (BSFi) enrolled in general zoology subject at Sorsogon State College-Magallanes Campus.

A checklist questionnaire was distributed during the pre-survey conducted by the researcher to determine the difficulties of students in General Zoology. The researcher conducted a pre-survey to the third year BSE (14) and second year BSFi (24) students of SSC-Magallanes Campus who already took the general zoology subject. The topics presented were taken from the regular syllabus in general zoology. Students were asked to identify which of these topics were found difficult when they took general zoology.

For the evaluation of the modules, two sets of questionnaires were prepared for the identified respondents of this study. The first set was given to the experts to evaluate the characteristics of the modules by expressing their extent of acceptability. Likert Scale was used, specifically to evaluate the following parts of the module: (a) objectives, (b) subject matter, (c) values, (d) organization, and (e) effectiveness.

Another set of questionnaires was used to determine the perception of the student-respondents, composed of the first year BSFi and second year BSE students regarding their level of agreement on the different parts of modules such as overview, objectives, subject matter, activity, and evaluation. The student-respondents were also required to answer the pretest and posttest to determine whether there is

knowledge gained after using the modules. Informal interview was done by the researcher to enrich the implications of the study.

Module Development Phase

There are four stages of module development. These include planning, development, evaluation/validation, and revision.

Planning Stage. Regular syllabus in general zoology was reviewed by the researcher. The topics of the modules were based on the difficulties encountered by the students in general zoology which were revealed in the pre-survey conducted by the researcher. In this stage, the researcher also drafted the design and outline of the modules.

Development Stage. The development of the instructional modules was guided by the following general characteristics of modules: (1) self-contained, self-instructional; (2) concern for individual difference; (3) statement of objectives; (4) association, structure, and sequence of knowledge; (5) utilization of different media; (6) active participation of the learners; and (7) immediate reinforcement of response. The modules have the following parts: cover page, overview, objectives, instruction to learners, and pretest. Also included are lessons, self-check, feedback, and posttest.

Evaluation & Validity Stage. To realize a valid and accurate data collection, the modules were carefully validated, corrected and improved. In this study, evaluation was done by six fishery instructors and three biology instructors. Their expertise in the field was necessary in validating and evaluating the proposed modules in terms of its content, subject matter/topic, values, organization, and effectiveness of the modules. The evaluators were provided with an evaluation form to express the extent of acceptability on the proposed modules.

Revision Stage. Revision of the modules was done based on the comments and suggestions made by the experts. After integrating their comments and suggestions, the modules were distributed and tested to the 47 first year students of BSFi and 26 second year students of BSE. Before the distribution of the modules, the respondents were given proper instructions by the researcher. They were required to answer the pretest and posttest, including all the activities of each module. Questionnaires were also distributed to the student-respondents for their final evaluation on the clarity and usefulness, design and attractiveness of the proposed modules.

As to statistical tools used, the data gathered were analyzed and interpreted using frequency count, weighted mean and independent t-test. To solicit quantitative data on the acceptability of the experts and to determine the students' perception

regarding their level of agreement on the parts of the presented modules, two sets of questionnaires were prepared which made use of the Likert Scale.

To determine the degree of acceptability and agreement of the respondents on the modules, the norm given below was used. This was interpreted using the frequency count and weighted mean.

Norm

	Level of Agreement	**Level of Acceptability**	
Mean Range	**Item Descriptive Rating**		**Overall Descriptive Rating**
4.5 – 5.49	Strongly agree	Very much acceptable	Very High
3.5 – 4.49	Agree	Much acceptable	High
2.5 – 3.49	Moderately agree	Moderately acceptable	Average
1.5 – 2.49	Disagree	Less acceptable	Low
0.5 – 1.49	Strongly Disagree	Least acceptable	Very Low

To determine whether there is a significant difference between the pretest and posttest scores of the student-respondents, the researcher made use of the independent t-test.

The hypothesis which states that there is no significant difference in the results of pretest and posttest scores of the students was subjected to empirical test at .05 level of significance.

RESULTS AND DISCUSSION

Difficulties of Students in General Zoology

Among the topics presented, 16 percent of the students encountered difficulties in Class Chondricthyes and Class Osteichthyes. Class Agnatha, Phylum Mollusca, and Phylum Arthropoda were claimed as difficult topics by some (14%). Phylum Porifera, Phylum Coelenterata and Phylum Echinodermata were difficult topics as agreed by eight percent of the students while the topic on human animal was considered difficult by two percent of the student-respodents. The rest were not identified as difficult topics. This can be attributed to the fact that most published laboratory manuals in general zoology were focused on the anatomy of frogs which only represents Class Amphibia. Besides, there are no manuals available that have specific discussions on the other topics in the general zoology syllabus.

Modules in Zoology which may be developed to Enhance Learning and Scientific Skills.

Among the topics presented, the researcher selected eight topics identified as most difficult. These were chosen as the subjects of the modules developed in this study. Module 1 includes Phylum Porifera, Phylum Coelenterata, Phylum Mollusca, Phylum Echinodermata, and Phylum Arthropoda. Module 2 includes Class Agnatha, Class Chondrichthyes, and Class Osteichthyes. The discussion of the modules, however, focused on aquatic animals so that the modules can be utilized not just in general zoology but also in other fisheries related courses such as ichthyology and aquatic biology.

These results imply that there is a need to develop a module in the identified difficult topics to provide a simplified instructional material designed to meet the comprehension level of the students. Informal interview by the researcher with the faculty and librarian of SSC-Magallanes Campus revealed that fishery books are expensive and only limited copies per title can be purchased.

Validity of the Modules in Terms of Acceptability and Agreement

As shown in Table 1.A, the level of acceptability of the modules in terms of objectives is *very much acceptable* as supported by the mean rating of 4.54. The rest of the characteristics of the modules such as subject matter/topic, values, organization and effectiveness were rated much acceptable with mean rates that range from 4.30 – 4.40. The overall mean rating of 4.36 indicates that the modules are highly acceptable for instructional use.

Table 1.A
Validity of the Modules in Terms of Acceptability by the Experts

Characteristics of the Module	**Weighted Mean**	**Level of Acceptability**
A. Objectives of the Module	4.54	Very much acceptable
B. Subject Matter/Topic	4.40	Much acceptable
C. Values developed	4.22	Much acceptable
D. Organization	4.30	Much acceptable
E. Effectiveness	4.32	Much acceptable
Over-all mean	**4.36**	**High**

Table 1.B shows that the level of agreement of the students-respondents strongly agree on the parts of the modules as assessed along overview, objectives, subject matter, activity and evaluation , supported by the mean ratings from 4.56 – 4.62. An over-all mean of 4.59 implies that students have very high level of agreement that Modules 1 and 2 are valid as instructional materials to enhance learning and scientific skills.

Table 1.B
Validity of Modules in Terms of Agreement by the Students

Parts of the Modules	Weighted Mean	Level of Agreement
Overview	4.56	Strongly Agree
Objectives	4.62	Strongly Agree
Subject Matter	4.56	Strongly Agree
Activity	4.61	Strongly Agree
Evaluation	4.61	Strongly Agree
Over-all Mean	**4.59**	**Very High**

Performance Level of Students in the Pretest and Posttest.

Table 2 shows the performance level of the 73 student-respondents on the test scores obtained in the pretest and posttest. The weighted mean and the performance level of the respondents based on the results were also shown.

Table 2
Performance Level in the Pretest and Posttest Results in Modules 1 and 2

Instructional Material	Mean	Mean Difference	Standard Deviation	Performance Level	Adjectival Rating
Module 1 Pretest	7.47	29.17	4.46	5.0	Failed
Posttest	36.64		5.96	1.6	Very Good
Module 2 Pretest	6.41	20.78	4.70	5.0	Failed
Posttest	27.19		1.84	1.7	Very Good

The pretest for topics in Module 1 has a weighted mean of 7.47 which yields to only 5.0 level of performance. The posttest for Module 1 has a weighted mean of 36.64 which gave a 1.6 value in the SSC Student Handbook, 2009. This means that the student respondents have a ***very good*** performance in *Phyla Porifera*, *Coelenterata*, *Mollusca*, *Echinodermata*, and *Arthropoda*.

Similarly, result of the pretest for topics in Module 2 has a weighted mean rating of 6.41 which gave a 5.0 performance level. The posttest for Module 2 has a

weighted mean of 27.19 which gave a 1.7 value or a ***very good*** performance of the student respondents on topics Class Agnatha, Class Chondrichthyes, and Class Osteichthyes. The difference in the pretest of Modules 1 and 2 with that of the posttest reveal that the interventions of the modules helped in the performance of the students. This finding implies that the modules helped in improving instruction. It also helped the professors determine the effectiveness of teaching methodology – that of using a module as an instructional material.

This is further emphasized by Salandanan (2005) when she said that the pretest and posttest are evaluation instruments given to the student-respondents to make judgments, that is, how good one's performance or behavior is, based on predetermined value or standards that would indicate quality. Briefly, it is an interpretation of what has been measured such as what the obtained scores mean. Further, she adds that evaluation or posttest is undertaken to appraise achievement through the development of learning outcomes such as acquisition of knowledge, development of skills and integration of values. This is the very essence why pretest and posttest are given in this study before and after the use of modules.

Difference between the Means of Pretest and Posttest Results.

Analysis of comparison is shown in Table 3 which was done using t-test to find out the difference on students' performance levels before and after using the modules. Results reveal that for Module 1, the t computed (tc=236.6) is greater than the t critical value (t=1.960) df is 144 at 0.05 level. Hence, the null hypothesis is rejected. Likewise, in Module 2, the t computed (tc=246.8) is greater than the t critical value (t=1.960) when df is 144 at 0.05 level. Thus, the null hypothesis for Module 2 is also rejected. This means that there is a significant difference in the performance of students after using the modules. This also indicates that the use of the modules is an effective method for teaching taxonomy in general zoology.

Table 3
The Difference between the Pretest and Posttest Means of Modules 1 and 2

	Statistical Analysis	
Statistical Basis	**Module 1**	**Module 2**
Number of Respondents	73	73
Degree of Freedom	144	144
Level of Significance	0.05	0.05
Tabular Value	1.960	1.960
Computed t value	236.6	246.8
Decision on H_o	Rejected	Rejected
Conclusion	**Significant**	**Significant**

CONCLUSIONS

The students experience difficulties in learning Taxonomy in General Zoology; modules can be developed in teaching zoology to enhance learning and scientific skills; the developed modules are valid in terms of its high acceptability level of the experts and the strong agreement of student-respondents; and the use of the developed modules has increased the performance level of the students from failed in the pretest to very good in the posttest. There is a significant difference between the pretest and the posttest scores of the students before and after the use of the Modules. These are effective in the learning and scientific skills of the students.

RECOMMENDATIONS

Since the modules are found effective for teaching, the researcher recommends further review by the Sorsogon State College Instructional Material Committee for the use of Modules 1 and 2 in the institution and later be mass produced. Researchers may develop modules in other subjects to confirm the effectiveness of this instructional material in teaching and learning process.

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