Test of Science Process Skills of Biology Students towards Developing of Learning Exercises

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Abstract - *This is a descriptive study aimed to determine the academic achievement on science process skills of the BS Biology Students of Northern Negros State College of Science and Technology, Philippines with the end view of developing learning exercises which will enhance their academic achievement on basic and integrated science process skills. The data in this study were obtained using a validated questionnaire. Mean was the statistical tool used to determine the academic achievement on the above mentioned science process skills; t-test for independent means was used to determine significant difference on the academic achievement of science process skills of BS Biology students while Pearson Product Moment of Correlation Coefficient was used to determine the significant relationship between basic and integrated science process skills of the BS Biology students. A 0.05 level of significance was used to determine whether the hypothesis set in the study will be rejected or accepted. Findings revealed that the academic achievement on basic and integrated science process skills of the BS Biology students was average. Findings revealed that there are no significant differences on the academic performance of the BS Biology students when grouped according to year level and gender. Findings also revealed that there is a significant difference on the academic achievement between basic and integrated science process skills of the BS Biology students. Findings revealed that there is a significant relationship between academic achievement on the basic and integrated science process skills of the BS Biology students.*

Keywords: *academic achievement, BS Biology, science process skills*

INTRODUCTION

Students need to achieve a wide range of sorts of data [1]. The idea of science process skills is generally recognized in a world of quick expanding of information to develop student capacities to gain and grow such learning [2]. A standout amongst the most essential motivations behind science is to enhance the comprehension of the understudies about the way of science [3].The exploratory strategy, investigative speculation and basic intuition have been terms utilized at different times to portray these science abilities. Today the expression "science process aptitudes" is ordinarily utilized. Promoted by the educational programs venture, Science - A Process Approach (SAPA), these aptitudes are characterized as an arrangement of comprehensively transferable capacities, proper to numerous science controls and intelligent of the conduct of researchers. SAPA gathered procedure abilities into two sorts essential and coordinated. The essential (easier) process abilities give an establishment to taking in the coordinated (more unpredictable) aptitudes [4]. Perception or observation, measurement or estimation, arrangement, forecast and relational abilities constitute fundamental exploratory procedure aptitudes. In the meantime incorporated logical procedure aptitudes contain abilities of recognizing and controlling variables, creating and testing theory, information elucidation, characterizing operationally, making trial and setting a model [5]. Issues on how to improve science education have always been the concerns of many educators and stakeholders. These were supported by the data from the Trends in International Mathematics and Science Study (TIMSS) last 2003 which reveals that, in science for the 9 year old level, the country 332 points average gave the Philippines 23rd place among 25 participants. In the 13 year old level, 377 points average place the Philippines 42nd among 45

participants [6]. These data reflected that science education in the Philippine are far from other nations in the world. These scenario triggered educators and educationist to look for solutions on how to improve the pressing problems. On the other hand, Bajaj (2004) emphasizes that there is a strong belief that child who is properly introduced to science through various skills will find the skills useful throughout life [7]. Akinbobola and Afolabi, [8]stated that it is important that for science learning to be significant and applicable, it should satisfactorily mirror the way of science, procedure situated as well as output oriented .A study done by Ergul, Simsekli, Calis, Ozdilek, Gocmencelebi, and Sanli [9] have demonstrated that the utilization of inquiry- based teaching techniques essentially develop students science procedure abilities.

OBJECTIVES OF THE STUDY

This research aimed to determine the academic achievement on science process skills of Bachelor of Science in Biology Students of Northern Negros State College of Science and Technology as basis for development of learning exercises.

More specifically, it attempted to determine the academic achievement on basic and integrated science process skills of Bachelor of Science in Biology Students; test the difference on the academic achievement on the basic and integrated science process skills of Bachelor of Science in Biology Students when grouped according to year level and gender and test relationship on the academic achievement between basic and integrated science process skills of the BS Biology students.

MATERIALS AND METHODS

Descriptive method of research was utilized in this study. The respondents of the study were the total population of the BS Biology students, 11 are males and 64 are females Bachelor of Science in Biology students of the Northern Negros State College of Science and Technology, Philippines (NONESCOST). They were all selected as respondents or subjects.

Data-Gathering Instrument

To determine the academic achievement on the basic and integrated science process skills of the first year and second year Bachelor of Science in Biology students, the content and face validated instrument was utilized. The test consisted of 30 basic science process skills and 25 integrated science process skills test items. Questions 1-5 are observing; 6-10 are inferring; 11-15 are measuring; 16-20 are communicating; 21-25 are classifying; 26-30 are predicting; 31-35 controlling variables; 36-40- defining operationally; 41-45 formulating hypotheses; 46-50 interpreting data and 51-55 are experimenting. The researcher utilized a multiple choice test with four alternatives for the respondents to choose from. The development of the performance test follows certain phases: These are: 1) planning; 2) preparing the test items; 3) trying-out the test items; and 4) evaluating the instrument.

I. Planning the Test

A. Setting-Up Behavioral Objectives

In this study the following are the objectives which the researcher considered in developing the test: 1) measuring BS Biology students' level of basic and integrated science process skills; 2) diagnosing BS Biology students' strengths and weaknesses in the basic and integrated science process skills.

B. Constructing Table of Specification

From the objectives/purposes of the study, level of performance in the basic and integrated science process skills is the concern of the test. A one – way grid table of specifications was used by the researcher. The content areas, number of test items, item placement, and the percentage of each item composed the one- way grid table of specification prepared by the researcher. Items of the test were distributed to the topics included in the test.

II. Preparing the Test Items

In selecting the appropriate item format, the researcher adapted a multiple-choice test, which consisted of a problem and a list of possible answers. The item was stated either as a direct question or as an incomplete statement. The suggestion answers are the alternatives, or choices, or options - one of which is the key and the rest are distracters. One of the rules in the test construction is that the distracters should be plausible enough.

The multiple choice format was preferred on the basis of its advantages such as: a) its ability to provide for adequate sampling; b) its ability to provide for good item pool; c) the relative ease in the test

administrations; d) the economy of time in scoring; and e) the reliability of scoring.

Writing the Test Items

This stage was devoted to the construction of individual items based on the one-way grid table of specifications. In framing items for the content areas, the researcher read and scan books in science which deals with the science process skills as well as the teaching of it and other related references; informal consultation with science teachers in the high school and college focusing on the questions regarding content areas and degree of difficulty. One hundred ten items with four options were written that is twice than the target of 55 items.

B. Editing the Test Items

Mehrens (1973) contends that very seldom is an item right. A classroom teacher or a professional is fortunate enough to prepare a test item that does not require at least some slight revision. With this purpose, the researcher undertook editing the prepared test items so that she may be able to see some errors that she may have originally missed when she reads the item just after writing it. The researcher's fellow teachers teaching science and the researcher's thesis adviser who has some expertise in test construction does the editing of the test items prepared. They looked into the test for possible suggestions for improving the test items.

III. Trying-out the Test

In the tryout of the test 50 BSE I college students were requested to take the try-out of the test. In the try-out of the test, BSE I college students who have taken biology as a subject were supplied with questionnaire where they are instructed to encircle the letter that corresponds to the correct answer. They were informed that they are not under time pressure.

A. Item Analysis

After scoring the test papers, each item was evaluated by estimating the item difficulty, assessing the discriminating power of each item and the effectiveness of each alternative. Item difficulty and item discrimination are often used as a criterion for the selection and refinement of test items.

The item analysis of the test will follow the Upper-Lower Index Method.

After the item analysis, the following table of equivalent was used in interpreting the difficulty index:

0.00-0.20 = Very Difficult
0.21-0.80 = Moderately Difficult
0.81-1.00 = Very Easy

In this study, marginal items with moderate difficulty will be retained, but improved. Items needed revision and improvement will be retained, while those, which were not good items, were rejected.

IV. Evaluating the Test

After the final form were administered and scored, the researcher proceeded to the evaluation of the instruments by determining the research instruments validity and reliability index.

Validity

Two types of validation, content and face were used to determine the validity of the research instrument. According to Thorndike and Hagen (1983), validity is the stability of the test for its purposes. It must yield the kind of result it needs. A test is valid if it yields scores that help accomplish the purpose for which it was intended.

The same author stated that a teacher's own test has content validity to the extent that wise and thoughtful analysis of scores objectives has been made in the blueprint, and care, skill, and ingenuity has been used in the blueprint.

In constructing this test, the researcher based the test items on the course syllabus, teacher's guide, textbooks and manuals used for this subject. Jury validation was used in this study. Experts in the field of science were asked to evaluate each of the items in the test, whether or not items reflect what it intends to measure.

The jury validation shows that developed science process skills performance test is valid to a very high degree with the mean of 3.62.

B. Reliability

Reliability as defined by Sevilla (1990) is the degree of consistency and precision a measuring instrument demonstrates. In this study, the research instrument reliability was determined using KR 21.

The obtained reliability of the test was 0.72. This shows that the developed test items are reliable to a high degree.

Data-Gathering Procedure

In the conduct of the study, permission from the office of the academic affairs of NONESCOST was asked for the conduct of the research instruments to the target respondents.

After the permit was granted, the researcher reproduced copies of the questionnaires and conducted it to the first year and second year BS Biology students of NONESCOST. The conduct and retrieval of the research instrument lasted for a week. The conduct started from the first year then the second year. After a week, the questionnaires were retrieved and the data were tallied, tabulated, analyzed, and interpreted according to the specific problem, and hypotheses set forth in this investigation.

Analysis of Data

To describe the academic achievement on the basic and integrated science process skills of the BS Biology students, the score and its interpretation below was used.

Score	Interpretation
4.01 – 5.00	Very High
3.01 – 4.00	High
2.01 – 3.00	Average
1.01 – 2.00	Low
0.00 – 1.00	Very Low

However, to describe the academic achievement on the basic and integrated science process skills of the BS Biology students when taken as a whole, the score and its interpretation below was used.

A. Basic Science Process Skills

Score	Interpretation
24.01 – 30.00	Very High
18.01 – 24.00	High
12.01 – 18.00	Average
6.01 – 12.00	Low
0.00 – 6.00	Very Low

B. Integrated Science Process Skills

Score	Interpretation
20.01 – 25.00	Very High
15.01 – 20.00	High
10.01 – 15.00	Average
5.01 – 10.00	Low
0.00 – 5.00	Very Low

Statistical Analysis of the Data

In the process of the data obtained through the questionnaires, the researcher utilized the following descriptive and inferential statistics:

Mean, t-test and Pearson Product Moment of Correlation Coefficient (PPM) was used.

All computation in the statistical analysis of the data was done using computer process statistics.

RESULTS AND DISCUSSION

Table 1. Academic Achievement on Basic Science Process Skills of Bachelor of Science in Biology Students

Basic Science Process Skills	Mean	Sd	Interpretation
Observing	2.45	1.14	Average
Classifying	2.27	1.15	Average
Predicting	2.79	1.28	Average
Inferring	1.95	1.09	Low
Measuring	2.56	1.06	Average
Communicating	4.04	0.78	Very High
Overall Mean	**16.06**	**0.57**	**Average**

Result shows on the table presented above revealed that the academic achievement on basic process skills of the B.S Biology students is average as indicated by the overall mean score of 16.06 with the Sd = 0.57. On the other hand when each of the skills is considered BS Biology students have low academic achievement on basic science process skills in inferring (M = 1.95, Sd = 1.09) while very high in communicating (M = 4.04, Sd = 0.78). Furthermore, the result revealed that they have average level of basic science process skills in observing (M = 2.45, Sd =1.14), measuring (M = 2.56, Sd = 1.06), classifying (M = 2.27, Sd = 1.15), and predicting (M =2.79, Sd =1.28). Generally, the result reflected that BS Biology students have skills in basic science processes, but the skills they developed was far from what are expected of them as BS Biology students. They should have mastery of these skills since these are prerequisites of the integrated science process skills, a more complex skill than the basic science process skills.

However, the very high result in communicating revealed that first year and second year BS Biology students have skills in using spoken and written words, graphs, drawings and diagrams to share information and ideas with others. This means that they know how to read and interpret graphs, drawing and diagrams related science processes. They likewise know how to share these ideas and information to others.

These responses of the respondents were supported by Padilla's idea which opines that scientific findings have little value if they are not shared with others. Padilla added that communicating as a skill serves as a link between science and the language art. It brings observation, classification, and measurement skills together to report to others what has been found by experimentation.

Padilla added that communicating as a skill serves as a link between science and the language art. It brings observation, classification, and measuring skills. Rivas [11] called attention to that Filipino understudies need dominance of the fundamental abilities in subjects like Math, English and Science [10]. In another study by Pontaoe, s refered to by Escano said that the achievement of students in the majority of the abilities were low. She presumed that students ought to be presented to science exercises such a testing, measuring, deciphering information, and so forth that will help in the improvement of the students aptitudes. Besides, as Martin (2006) called attention to, science adapting fundamentally includes acing the procedure. Kids ought to learn science in a way like the way researchers really do science [12].

Result shows that the academic achievement on the integrated process skills of Bachelor of Science in Biology students as a whole was average as indicated by the overall mean score of 11.96 with the standard deviation of 0.53. However, when each of integrated process skills was considered, BS Biology students' academic performance on integrated process skills was average in controlling, interpreting data, and experimenting. This is supported by the obtained mean scores of 2.64, 2.79, and 2.80, with the standard deviations of 1.09, 0.95, and 1.04, respectively.

Table 2. Academic Achievement on Integrated Science Process Skills of Bachelor of Science in Biology Students

Integrated Science Process Skills	Mean	Sd	Interpretation
Controlling variables	2.64	1.09	Average
Defining Operationally	1.73	0.93	Low
Formulating Hypothesis	2.00	1.09	Low
Interpreting Data	2.79	0.95	Average
Experimenting	2.80	1.04	Average
Overall Mean	**11.96**	**0.53**	**Average**

The result presented in Table 2 revealed that their integrated science process skills were not very satisfactory. Their responses were almost the same as the basic science process skills which means that they cannot go far behind integrated science process skills since basic science process skills is the prerequisite of the integrated science process skills. This further means that they need to master basic science process skills because they can use these skills as they go along with the integrated science process skills.

Table 3. Differences on the Academic Achievement on Basic Science Process Skills of Bachelor of Science in Biology Students when Grouped According to Year Level

Basic Science Process Skills	Respondents	Mean	Sd	t ratio	p-value	Interpretation
Observing	1st Yr	2.41	1.2	0.08	0.94	Not Significant
	2nd Yr	2.39	1.10			
Inferring	1st Yr	1.92	1.1	-0.53	0.60	Not Significant
	2nd Yr	2.06	1.07			
Measuring	1st Yr.	2.67	1.15	1.13	0.26	Not Significant
	2nd Y	2.39	0.96			
Communicating	1st Yr	4.18	0.68	2.01	0.05	Significant
	2nd Yr	3.83	0.81			
Classifying	1st Yr.	1.95	1.21	-2.82	0.01	Significant
	2nd Yr	2.69	1.06			
Predicting	1st Yr	3.03	1.37	2.15	0.04	Significant
	2nd Yr	2.42	1.05			
As a Whole	1st Yr.	**16.15**	**3.75**	**0.43**	**0.63**	**Not Significant**
	2nd Yr	**15.78**	**2.9**			

Result demonstrates that there is no significant differences on the academic achievement on the basic science processes of the BS Biology students when each of the basic science processes was taken as a whole. This is supported by the t-ratio of 0.43 at p = 0.63. This obtained probability ratio is smaller than the 0.05 level of significance; a hypothesis which expresses that there is no significant difference on the basic or fundamental science process skills of the first year and second year BS Biology students is therefore accepted. This means that the two groups of respondents do not differ significantly in the academic achievement.

However, when each of the basic science process skills were considered, significant differences were noted between the academic performance on basic science process skills of the first year and second year BS Biology students in terms of communicating, classifying, and predicting as shown by the t-ratios of 2.01, -2.82, and 2.15 at probability values of 0.05, 0.01, and 0.04, respectively which means that the two groups of respondents differ significantly in communicating, classifying, and predicting. Differences were in favor for the first year in communicating and predicting but not in classifying. The result of this study negates the findings of the study of (Ozgelen, 2012), which indicates huge contrasts between 6th (age of twelve) and seventh (age of thirteen) students evaluation at private and government funded schools. This distinction can be clarified by essential understudies' formative levels as indicated by Piagetian hypothesis. Piaget asserted a positive relationship between's kids' mental limit for preparing data and their ages. [13].

As presented in Table 4, no significant differences on the academic achievement on basic science process skills of the BS Biology students when grouped according to gender. This is supported by the t-ratio of 0.18 at p = 0.85. This obtained probability value is smaller than the 0.05 level of significance; hypothesis which states that there is no significant differences on the academic achievement on the basic science process skills of the first BS Biology students when grouped according to gender is therefore accepted. This means that the gender of the respondents do not differ significantly in the academic performance on their basic science process skills.

Result shows that when t-test for independent mean was used to determine significant differences on the academic achievement on the integrated science process skills of the first year and second year BS Biology students, the test yielded a t-ratio of 1.27 at p = 0.21. Since the obtained p-value is lesser than the 0.05 level of significance, hypothesis which states that there is no significant differences on the academic achievement on integrated science processes of the first year and second year BS Biology students is therefore accepted which means that first year and second year BS Biology students do not differ significantly in their integrated science process skills. The same result of no significant differences was obtained when each of the integrated science process skills was considered. The results of no significant differences of the first year and second year BS Biology students possess the same academic performance on skills.

Table 4. Differences on the Academic Achievement on Basic Science Process Skills of the BS Biology Students when Grouped According to Gender

Basic Science Process Skills	Respondents	Mean	Sd	t-ratio	p- value	Interpretation
Observing	M	2.41	1.20	0.08	0.94	Not Significant
	F	2.39	1.10			
Inferring	M	1.92	1.10	-0.53	0.60	Not Significant
	F	2.06	1.07			
Measuring	M	2.67	1.15	1.13	0.26	Not Significant
	F	2.39	0.96			
Communicating	M	4.18	0.68	2.01	0.05	Significant
	F	3.83	0.81			
Classifying	M	1.95	1.21	-2.82	0.01	Significant
	F	2.69	1.06			
Predicting	M	3.03	1.37	2.15	0.04	Significant
	F	2.42	1.05			
As a Whole	**M**	**16.15**	**3.75**	**0.43**	**0.63**	**Not Significant**
	F	**15.78**	**2.09**			

Table 5. Differences on the Academic Achievement on Integrated Science Process Skills of Bachelor of Science in Biology Students when Grouped According to Year Level

Integrated Science Process Skills	Respondents	Mean	Sd	df	t-ratio	p-value	Interpretation
Controlling Variables	1st Yr	2.72	1.30	73	0.74	0.46	Not Significant
	2nd Yr	2.53	0.88				
Defining Operationally	1st Yr	1.92	0.96	73	1.86	0.07	Not Significant
	2nd Yr	1.53	0.88				
Formulating Hypothesis	1st Yr.	2.10	1.19	73	0.85	0.40	Not Significant
	2nd Y	1.89	0.98				
Interpreting Data	1st Yr	2.95	1.05	73	1.18	0.24	Not Significant
	2nd Yr	2.69	0.79				
Experimenting	1st Yr.	2.69	1.03	73	-1.15	0.26	Not Significant
	2nd Yr	2.97	1.08				
As a Whole	1st Yr	**12.38**	**2.56**	**73**	**1.27**	**0.21**	Not Significant
	2nd Yr	**11.61**	**2.70**				

Table 6. Differences on the Academic Performance on Integrated Science Process Skills of Bachelor of Science in Biology Students when Grouped According to Gender

Integrated Science Process Skills	Respondents	Mean	Sd	df	t ratio	p-value	Interpretation
Controlling Variables	Male	2.45	0.82	73	-0.50	0.61	Not Significant
	Female	2.64	1.15				
Defining Operationally	Male	1.72	1.10	73	-0.73	0.94	Not Significant
	Female	1.75	0.92				
Formulating Hypothesis	Male	2.18	0.98	73	0.47	0.63	Not Significant
	Female	2.01	1.09				
Interpreting Data	Male	3.18	0.75	73	1.48	0.14	Not Significant
	Female	2.73	0.94				
Experimenting	Male	3.09	0.83	73	1.10	0.27	Not Significant
	Female	2.71	1.06				
As a Whole	**Male**	**2.52**	**0.52**	**73**	**0.89**	**0.37**	Not Significant
	Female	**2.37**	**0.53**				

Result shows that when t-test for independent mean was used to determine significant differences on the academic performance on the integrated science process skills of the BS Biology students when grouped according to gender, the test yielded a t-ratio of 0.89 at p = 0.37. Since the obtained p-value is lesser than 0.05 level of significance, hypothesis which states that there is no significant differences on the academic achievement on integrated science process skills of the BS Biology students when grouped according to gender is therefore accepted which means that male and female BS Biology students do not differ significantly in their integrated science process skills. The same result of no significant differences was obtained when each of the integrated science process skills was considered. The results of no significant differences of the male and female BS Biology students possess the same academic performance on skills. Findings of this study affirms the result of the study conducted by Chaguna and Yango, (2008), which indicates that the analysis of variance shows that the computed F-ratio of 0.010 is less than the tabled F-value of 4.41 at .05 level of significance. This means that there are no significant differences in the level of science process skills proficiency according to gender. This suggests both male and female show the same capability level in science process abilities [14].

Table 7. Relationship Between BS Biology Students' Basic and Integrated Science Process Skills

Variables Correlated	N	t-value	p-value	Interpretation
Basic Science Process Skills and Integrated Science Process Skills	75	0.58	0.001	Significant

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Results revealed that there is a significant correlation between the basic science process skills and the integrated science process skills as indicated by the r-value of 0.58 at P-value = 0.001. Hypothesis which states that there is no significant relationship between basic and integrated science process skills is therefore rejected. This means that BS Biology students' academic performance on basic science process skills is related to their integrated science process skills.

CONCLUSION AND RECOMMENDATION

The BS Biology students are average academic performers in basic and integrated science processes. Year level and gender do not affect the basic and integrated science process skills of BS Biology students. The basic science process skills of BS Biology students contribute to their performance in integrated science process skills. The academic performance of the BS Biology students between basic and integrated science processes yielded significant relationship.

It is recommended that instructors/professors handling biology subjects must design programs, activities, and exercises that will help improve students' basic science process skills. Worthwhile exercises in integrated science process skills will be developed so that BS Biology students will be helped in developing their skills. Instructors/professors handling biology subjects were encouraged to put equal emphasis on these two science process skills. Learning exercises should be developed to enhance the science process skills of the first year and second year BS Biology students.

Other researches on development and evaluation of science process skills modules may be conducted to validate the findings of the current study.

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