Assessment of Science Process Skills: Basis for The Development of Laboratory Manual in Physics

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***Abstract*: This study was conducted to assess the level of science process skills and will be the basis for the development of Laboratory Manual in Physics for Grade 9 students of Anilao National High School, Anilao, Iloilo for the school year 2016 – 2017. A total of 48 grade 9 – 1 students was utilized as respondents. Developmental research design was employed conducted during the fourth grading period of SY 2016 – 2017. Data were gathered using pretest and posttest. The data were analyzed using the mean, Standard deviation and t-test. Pretest result showed that the level of Basic Science Process Skills of 48 grade 9 – 1 students were categorized as poor. Laboratory Manual in Physics was developed and implemented. After the implementation, post test was administered. Post test result showed that the level of SPS of 48 grade 9-1 students were categorized as Very Good. It further revealed that there is a significant difference on the level of SPS of 48 Grade 9-1 students before and after the implementation, as also reflected during the interview and focus group discussion when respondents were asked and agreed about the implementation. The 0.05 % alpha level was used as criterion for acceptance or rejection of the alternative hypothesis. SPSS was used for statistical computations.**

Keywords

I. INTRODUCTION

The beginning of the 21st century marked a new era of reform in science education (Hofstein & Mamlok-Naaman, 2007). Both the content and pedagogy of science learning and teaching were being criticized and new science education standards that were intended to shape and revitalize science education emerged (Hofstein & Mamlok-Naaman, 2007). Students, in this 21st century, need to be able to use technology to collect and process data and to present and disseminate the results (Rhoton & Shane, 2006). But in the teaching of science concept, it is most essential for the teacher to arouse the students' curiosity. Unless the students wants to know what the teacher has to say, it is most likely that time and effort in trying to teach the student would have been completely wasted. The first task of the teacher is to attract the attention of the student. This goes for all levels of learning, whether it is primary grade, high school or college. A student without interest is the desperation of any teacher. In fact, the main objective of formal education is the arousing of the students' interest, if nothing else. Once curiosity is aroused, the student will learn much more on his/her own than the teacher can ever teach him/her. Learning only takes place if the student wants to learn. A point of concern that dedicated teachers will sooner or later face in their career, is how to arouse the students' interest in the subject matter that he or she is teaching. This is the age old problem that will confront every single teacher. It is a problem of motivation. An eager want to learn science can be created in the student by showing the student that doing science can be very enjoyable. Unless there is a need, or a want in the

person, or a reward for the other person, we cannot turn anybody on to do anything. Science teachers' first task is to establish a need to know. A need to determine what the students ability to understand the concept of science. So it goes with learning science, in order to get students fired up about something, teachers should have to be enthused about the subject matter. Like in wood fire, in order for the teacher to give others a spark, they must have to be aglow and burning. Thus showing enthusiasm, to be dealt with under science characteristics, is one of the conditions for good teaching.

As a whole, the K to 12 Curriculum is a learner – centered and inquiry based, and there is a need to note of the Science Process Skills possessed by every student in the science class. It is in this curriculum that students from Grade 7 to grade 10 must be equipped with the basic science process skills and after grade 12, students must be equipped with the Integrated Science Process Skills in preparation in facing the more complex science activities in college. Students must be aware that in performing science activities, they must possess the basic Science Process Skills needed to attain its goal.

Framework of The Study

This study was anchored on John Dewey's Learning by doing.

"Why is it that, in spite of the fact that teaching by pouring in, learning by passive absorption, are universally condemned, that they are still so entrenched in practice?

That education is not an affair of "telling" and being told, but an active constructive process, is a principle almost as generally violated in practice as conceded in theory. Is not this deplorable situation due to the fact that the doctrine is itself merely told? But its enactment in practice requires that the school environment be equipped with agencies for doing ... to an extent rarely attained." (John Dewey, 1916).

There are two important reasons why learning by doing isn't our normal form of education (Schank, 1995). First, it is quite difficult to implement without "doing devices." How can we teach history by doing? What does it mean to teach literature by doing? In many cases, it is difficult to define

what *doing* might mean with respect to a given subject and to attempt to implement a realistic sense of doing in a classroom setting. When there are "doing devices" available, it is easier to implement learning by doing. Driving can easily be taught in a learning-by-doing manner, for example, because students can reasonably be placed behind the wheel of a car. This can be done because cars are relatively inexpensive and relatively safe. They suppose that it teaches real life skills, but what about facts, the darlings of the "drill-them-and-test- them" school of educational thought? In "Experience and Education" Dewey argues that children need assistance from teachers in developing a concrete understanding of the world (Hoxie,Emily, 2012). In order to effectively assist students, teachers must first observe children and from those observations determine the types of experiences they maintain and are have an interest in. For Dewey, the path to quality education requires that learning build on previous knowledge and experiences, presented in a highly structured and well planned manner. This requires a strong base of general and societal knowledge, teachers to invest time in both observation and planning, and a devotion to leading students to a greater understanding of their world.Teachers must then foster a classroom environment that encourages students to play a central role in creating their own knowledge through experience. Allowing students to take place in this social process will develop a deeper understanding of the curriculum and their world simultaneously. The Teacher's Role In addition to deepening their understanding of their children's individual place in the world, teachers must be willing to tap into their own understanding of the world. Dewey believed this to be an essential component of making sense of the world for students. Taking students knowledge into consideration is important, however teacher's posses a greater knowledge of the world and should create classroom environments with ample opportunity to grow from this greater knowledge, thus expanding student's base knowledge. They aim to understand the manners in which experiences – whether first or second hand – motivate learners and promote their learning. Therefore, learning is about meaningful experiences – ineveryday life – that lead to a change in an individual's knowledge and behaviors.

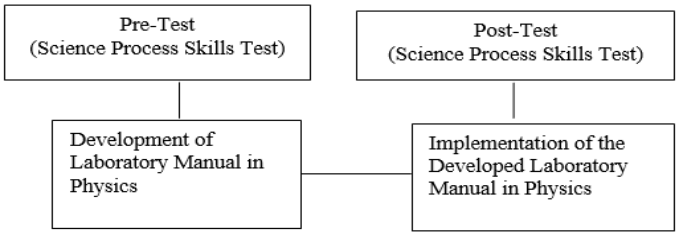

Fig. 1 The Paradigm of the study

The paradigm of the study showed that Pre- Test was administered using the adapted Science Process Skills Test to assess the level of Science Process Skills of respondents. The level of Science Process Skills of respondents was the basis for the Development of Laboratory Manual. The developed Laboratory Manual was implemented to respondents during the fourth quarter of the current school year. After implementation of the developed Laboratory Manual, Post-test was administered to assess the effect to the level of Science Process Skills of respondents.

Objectives of The Study

The purpose of this study was to assess the Science Process Skills of 48 Grade 9-1 students of Anilao National High School, Anilao, Iloilo, school year 2016 - 2017 and it will be the basis in the Development of Laboratory Manual in Physics with the intention of comparing an ideal picture of the actual practices of science process skills before and after it was implemented. More specifically, the study will address the following research questions:

1. What is the level of Science Process Skills of the 48 Grade 9-1 students of Anilao National High School, Anilao, Iloilo, school year 2016 - 2017 before the implementation of the developed Laboratory Manual in Physics.
2. What is the level of Science Process Skills of the 48 Grade 9-1 students of Anilao National High School, Anilao, Iloilo, school year 2016 - 2017 after the implementation of the developed Laboratory Manual in Physics.
3. Is there a significant difference in the level of Science Process Skills of the 48 Grade 9-1 students of Anilao National High School, Anilao, Iloilo, school year 2016 - 2017 before and after the implementation of the developed Laboratory Manual in Physics.
4. What are the expectations of Grade 9 – 1 students of Anilao National High School, Anilao, Iloilo after the implementation of the developed Laboratory Manual in Physics.

II. MATERIALS AND METHODS

Research Design

This study made use of the Developmental research design. The level of the science process skills of grade 9-1 students of Anilao National High School, Anilao, Iloilo SY 2016-2017, was assessed and developed Laboratory Activities was implemented to students to determine the level of science process skill before and after the implementation.

Locale of the Study

The study was conducted at Anilao National High School, Anilao, Iloilo.

Subjects of the Study

The respondents of the study were the 48 grade 9-1 students enrolled at Anilao National High School, Anilao, Iloilo School Year 2016 – 2017.

Sampling Technique

Purposive sampling technique was used in this study. The intact group of 48 grade 9-1 students of Anilao National High

School, school year 2016-2017 was utilized. The group that was involved in the research was as they were naturally found in the school. It was difficult to reorganize students in a class, since school authorities cannot permit any reorganization of intact classes for research purposes once they were constituted.

Research Instrument

The researcher utilized two instruments in this study, the Science Process Skills Test and the Developed Laboratory Manual.

A. Science Process Skills Test.

To determine the level of Science Process Skills of students, the researcher adapted a test instrument, the SCIENCE PROCESS SKILLS TEST , revised version of Cherry Dely and Prof. M.B. Hojillia and used and adapted by Suzanette A. Solano in her study of the Level of science Process Skills of Grade 9 students in the Division of Negros Occidental in her unpublished Master's Thesis at West Visayas State University and was conducted to grade 9-1 students of Anilao National High School for school year 2016-2017. The result was the basis for the development of Laboratory activities to be implemented in the Module 4 of the Learners Manual of Grade 9 in the K to 12 curriculum. The SPST was implemented before and after the implementation of the Developed Laboratory Activities.

The Science Process Skills test covered the Six Basic Science Process Skills namely Observation, Communication, Classification, Measurement, Inference and Prediction.

To determine the level of student's science process skills, the researcher utilized the following scores and corresponding weights and description.

Mean	Description
3.01 - 4.00	Very Good. You are using the skills you need to be successful in your activity.
2.01 - 3.00	Good. You know a few skills to work on, and you are well on your way to be successful in your activity.
1.01 - 2.00	Poor. You need to practice more until you are using most of the skills.
0.00 - 1.00	Very Poor. You are having difficulty in practicing the skills. Make yourself do all the practicing.

The Basic Science Process Skills of students that fall under the score of 2.00 and below or having the description of poor and very poor were considered to be the skills that needs to be developed. The development of the Laboratory Manual was based on the result of the pre-test.

B. Developed Laboratory Manual

The researcher developed a Laboratory manual based on the result of the Science Process skills. The topic covered was Unit 4 as presented in the Learner's Manual of the K to 12 textbooks. The generalization of the findings was limited to the Physics lessons contained in the laboratory Manual developed in the study rather than Physics as a subject.

The proposed study covered the 48 Grade 9-1 students of Anilao National High School, Anilao, Iloilo. Emphasis was on the use of Science Process Skills on the topic for Unit 4 of Science 9 Learners Manual of the K to 12 Curriculum which is composed of 4 modules:

1. Module 1: Forces and Motion
2. Module 2. Work, Power and Energy
3. Module 3: Heat, Work and Energy
4. Module 4: Electricity and Magnetism

Eight (8) Laboratory activities was developed, each with Basic Science Process Skills namely Observation, Communication, Classification, Measurement, Inference and Prediction.

a. Activity No.1 – UNIFORMLY ACCELERATED MOTION helped in improving observation, prediction and communication skills.
b. Activity No.2 – FREE FALL helped in improving observation, measurement and inferring skills.
c. Activity No.3 – BUMP HERE, THERE AND EVERYWHERE (MOMENTUM) helped in improving observation, measurement and inferring skills.
d. Activity No.4 – TRANSFER SOME ENERGY! helped in improving observation, Communication and predicting skills.
e. Activity No.5 – ON TRAIL OF ENERGY helped in improving observation, communication and classification skills.
f. Activity No.6 – HEAT TRANSFER helped in improving observation, communication and measuring skills.
g. Activity No.7 – SPONTANEOUS AND NON-SPONTANEOUS helped in improving observation and classification skills.
h. Activity No.8 – RENEWABLE AND NON-RENEWABLE SOURCES OF ENERGY helped in improving observation and classification skills.

The developed Laboratory Manual undergone content validity by five experts in the field of teaching Physics.

C. Interview and Focus Group Discussion

For the Interview Schedule, the researcher had prepared three (3) main questions then it was followed up by sub-questions to simplify the responses of the respondents.

The answers to the questions were tape recorded, transcribed and categorized according to the manner the students answered the questions which were discussed in detailed manner. A total of ten (10) respondents participated in the interview.

Focus Group Discussion (FGD) Guide has also three (3) questions that were asked by the researcher. These questions were broken down to sub-questions for ease in answering the said topic.

The group interview during the FGD was taped recorded, transcribed and categorized according to the manner the students answered the questions. Again ten (10) respondents volunteered in the FGD and the conduct of asking question was by group.

Data Gathering Procedure

Permission was asked from the Principal of Anilao National High School to conduct the developmental research among the 48 Grade 9-1 students of Anilao National High School. After granting the official request, the researcher was ready to conduct the study.

Adapted Science Process Skills Test was administered to all 48 Grade 9-1 students of Anilao National High School. After the administration of the test, the level of Science Process skills was determined. After determining the level of Science process skills of 48 grade 9-1 students, the researcher developed Laboratory manual focusing on the skills that belongs to poor and very poor based on the result of the pre-test. The researcher set the whole fourth grading period (January 16 to March 10, 2017) in the implementation of the developed activities. During this period, students were exposed to the different developed laboratory activities as part of the actual class.

After implementation of the developed Laboratory Activities, the adapted Science Process Skills test was again administered to the respondents to test whether there were improvements on the level of science process skills of respondents.

The researcher conducted the Interview and Focus Group Discussion after the administered post test on the level of science process skills of students

Data Analysis Procedure

After the assessment of the science process skills of grade 9 students before and after the implementation of the Laboratory Activities, the researcher validated the results and was subjected to the following statistical treatments.

Mean. The mean is widely used in statistics because it is simple and most reliable measure since it is required as a basis for the computation of higher statistical methods.

In this study, the mean was used as basis to determine the level of science process skills of students, before and after the implementation of the developed Laboratory Activities. The mean was used for further statistical computation.

Standard Deviation. The standard deviation is the most useful index of variability. It is a single number that represents the spread of a distribution. In this study, like the mean, standard deviation was used to determine how students scored in science process skills deviated from the mean. *t*-test. The t-test is a parametric statistical test that will be used whether a difference between the means of two samples is significant. In this study, t-test for paired samle statistics was used to determine if there was a significant difference in the level of science process skills of 48 Grade 9-1 students of Anilao National High School school year 2016-2017 before and after the implementation of the developed Laboratory Activities.

All statistical computation used the Statistical Package for the Social Sciences (SPSS) software at 0.05 level of significance, one – tailed.

III. RESULTS AND DISCUSSION

Quantitative Analysis

Level of Science process skills before the implementation of the Developed Laboratory Manual Table 1 presents the level of Science Process skills of 48 grade 9-1 students of Anilao National High School Year 2016 – 2017 before the implementation of the Developed Laboratory Manual in Physics. During the Pre-test, study shows that the level of students when taken as an entire group had a mean score of 1.722 and a standard deviation of 0.267. The obtained values indicate that the 48 grade 9-1 students of Anilao National High School were *poor* in their level of Science Process Skills.

The study revealed that in Observation, the group had a mean score of 1.333 and a standard deviation of 0.996. The obtained values indicate that the 48 grade 9-1 students of Anilao National High School were *poor*in their level of Science Process Skills in Observation.

The Pre-test also revealed that in measuring, the group had a mean of 2.125 with the standard deviation of 0.936. The obtained values indicate that the 48 grade 9-1 students of Anilao National High School were *good*in their level of Science Process Skills in Measuring.

In Communication as one of the Basic Science Process Skills, the group obtained a mean of 1.729 and a standard deviation of 1.180. The obtained values indicate that the 48 grade 9-1 students of Anilao National High School were *poor*in their level of Science Process Skills in communication. In Classifying, the group obtained a mean of 1.854 and a standard deviation of 0.850. The obtained values indicate that the 48 grade 9-1 students of Anilao National High School were *poor*in their level of Science Process Skills in classifying. In Predicting, the respondents obtained a mean of 1.583 and a standard deviation of 0.895. The obtained values indicate that the 48 grade 9-1 students of Anilao National High School were *poor*in their level of Science Process Skills in Predicting. And in making Inferences, the respondents obtained a mean of 1.708 and a standard deviation of 0.743. The obtained values indicate that the 48 grade 9-1 students of Anilao National High School were *poor*in their level of Science Process Skills in Inferring.

Table 1. Mean Scores and Standard Deviations of the Level of Basic Science Process Skills before the Implementation of the Developed Laboratory Manual in Physics.

Skills	Mean	SD	Description
Observing	1.3333	0.99645	Poor
Measuring	2.1250	0.93683	Good
Communicating	1.7292	1.18033	Poor
Classifying	1.8542	0.85207	Poor
Predicting	1.5833	0.89522	Poor
Inferring	1.7083	0.74258	Poor
Over-All	1.7217	0.26716	Poor

Mean	Description
3.01 - 4.00	Very Good
2.01 - 3.00	Good
1.01 - 2.00	Poor
0.00 - 1.00	Very Poor

Level of Science Process Skills after the implementation of the Developed Laboratory Manual Table 2 presents the level of Science Process skills of 48 grade 9-1 students of Anilao National High School School Year 2016 – 2017 after the implementation of the Developed Laboratory Manual in Physics.

The result of the Post-test revealed that in Observation, the group had a mean score of 3.500 and a standard deviation of 0.505. The obtained value indicate that the 48 grade 9-1 students of Anilao National High School were *Very Good*in their level of Science Process Skills in Observation after the developed Laboratory manual was implemented. The Post-test also revealed that in measuring, the group had a mean of 3.438 with the standard deviation of

0.501. The obtained values indicate that the 48 grade 9-1 students of Anilao National High School were *Very Good*in their level of Science Process Skills in Measuring after the implementation of developed Laboratory Manual in Physics. In Communication as one of the Basic Science Process Skills, the group obtained a mean of 3.375 and a standard deviation of 0.489. The obtained values indicate that the 48 grade 9-1 students of Anilao National High School were *Very Good*in their level of Science Process Skills in communication after the implementation of developed Laboratory Manual in Physics. In Classifying, the group obtained a mean of 3.250 and a standard deviation of 0.438. The obtained values indicate that the 48 grade 9-1 students of Anilao National High School were *Very Good*in their level of Science Process Skills in classifying after the implementation of developed Laboratory Manual in Physics. In Predicting, the respondents obtained a mean of 3.354 and a standard deviation of 0.483. The obtained values indicate that the 48 grade 9-1 students of Anilao National High School were *VeryGood*in their level of Science Process Skills in Predicting after the implementation of developed Laboratory Manual in Physics And in making Inferences, the respondents obtained a mean of 3.188 and a standard deviation of 0.532. The obtained values indicate that the 48 grade 9-1 students of Anilao National High School were *VeryGood* in their level of Science Process Skills in Inferring after the implementation of developed Laboratory Manual in Physics.

The result of the post test also revealed that the level of the over-all Basic Science Process Skills of 48 grade 9 – student of Anilao National High School has a mean of 3.35 and a standard deviation of 0.120 and was categorized as *Very Good*.

Table 2. Mean Scores and Standard Deviations of the Level of Basic Science Process Skills after the Implementation of the Developed Laboratory Manual in Physics.

Skills	Mean	SD	Description
Observing	3.5000	0.50529	Very Good
Measuring	3.4375	0.50133	Very Good
Communicating	3.3750	0.48925	Very Good
Classifying	3.2500	0.43759	Very Good
Predicting	3.3542	0.48332	Very Good
Inferring	3.1875	0.53221	Very Good
Over-All	3.3483	0.11514	Very Good

Mean	Description
3.01 - 4.00	Very Good
2.01 - 3.00	Good
1.01 - 2.00	Poor
0.00 - 1.00	Very Poor

Comparison of Students' Level of Science Process Skills before and after the implementation of the Developed Laboratory Manual To test if there is a significant difference between students' Science Process Skills before and after the implementation of the Developed Laboratory Manual in Physics, t-test for paired samples statistics was used. Result revealed that there is a highly significant difference in the Science Process Skills of students. This indicates that the Students' Science Process Skills after the implementation of Developed Laboratory Manual In Physics is significantly better the before the implementation. The results were shown in Table 3.

Table 3. t –test Results for comparison of Students' Science Process Skills before and after the Implementation of the Developed Laboratory Manual in Physics.

Category	Mean	t-value	df	sig.
Pretest	1.7217	-12.742	5	0.000
Posttest	3.3483			

*Significant at α = 0.05

This suggests that the activities included in the Developed Laboratory Manual in Physics were effective in developing the Science Process Skills of these students.

The result of this study provides additional support to some studies related to. Adeyegbe (2005) in Yara (2010) listed laboratory adequacy as one of the factors that affect the learning outcomes of students. In terms of academic achievement, Adeniran (2006) in Yara (2010) that laboratory instructional strategy gives a new approach to science teaching and learning because it provides a non- threatening, realistic and concrete approach to learning of science as opposed to the difficulty encountered in learning the formal, abstract treatment of the typical textbook. Oyedeji (2000), discovered that students taught with science Laboratory Instructional Strategy performed significantly better than use of traditional lecture and text book method. Thus, study in a laboratory is an integral and essential part of science courses. (Odubunni, and Balagun, 1991).

The result of this study also conforms to the theory of Learning by Doing by John Dewey. In "Experience and Education" Dewey argues that children need assistance from teachers in developing a concrete understanding of the world (Hoxie,Emily, 2012). In order to effectively assist students, teachers must first observe children and from those observations determine the types of experiences they maintain and are have an interest in.

Qualitative Analyses

Expectations of students after the implementation of the Developed Laboratory Manual in Physics.

An interview was undertaken by the researcher with ten (10) respondents in the Grade 9 – 1 students of Anilao National High School to find out whether the developed laboratory manual in physics had an impact in the development of their science process skills. The interview also aimed to solicit student ideas and other needs in order for them to better understand the concepts in physics through laboratory activities.

Moreover, Focus Group Discussion (FGD) was conducted among ten (10) respondents inside the classroom. It is the researcher itself who conducted the focus group discussion.

The responses of students only suggests that there is a great need for teachers teaching science subjects in the secondary school to develop a laboratory activity that suits their ability and needs and letting students to do more science activities for them to better understand the concepts of science.

IV. CONCLUSIONS

Before the implementation of the Developed Laboratory Manual in Physics, results revealed that students' Science Process Skills in observing, communicating, classifying, predicting and inferring are described as poor but their measuring skills is described as good. Further, their over-all Science Process Skills level is considered poor. After the

implementation of the Developed Laboratory Manual in Physics, results revealed that students' Science Process Skills in observing, measuring, communicating, classifying, predicting and inferring are described as very good. Further, their over-all Science Process Skills level is considered very good.

Studies revealed that students' Science Process Skills after the implementation of the Developed Laboratory Manual in Physics is significantly better compared before the implementation.

Based on the results of the study, it can therefore be concluded that Developed Laboratory Manual in Physics was very effective in improving the Science Process Skills of Students.

V. RECOMMENDATIONS

On the basis of the aforementioned conclusion derived from the findings of this study, the following recommendations are advanced:

1. Since the result of the study is very effective, it is therefore highly recommended to use the Developed Laboratory Manual in Physics in teaching science in grade 9.
2. Since Science Process Skills of students in conducting laboratory activities is an important factor for them to learn the concept in science, it is recommended that teachers can use the result of this study and design their own activities based on the level of science process skills of students and starting in grade 7. Teachers need to make use of more interactive approaches that actively involve learners in the teaching-learning process. This would ensure effective acquisition of science skills and concepts. The use of conventional methods, for example, lecture method or writing notes, cannot adequately achieve a meaningful learning. The classroom learning used, benefits mainly the bright students, weaker students are disadvantaged since they are not able to master the concepts taught, they need more time and remedial.
3. Assessing the level of science process skills would cater for all groups of learners, the higher achievers and low achievers.
4. Teachers should participate in different sets of training scheduled by proper educational groups.
5. School Administrators should take into account the need of assessing the science process skills of every student enrolled so as to make sure that learning process will be attained. It is always the desire of every school administrators that they will produce quality graduates who are globally competitive.
6. Curriculum Developers, Policy Makers and Textbook Writers may also use the result of this

study as basis for the development of the curriculum. They may incorporate the need for the assessment of Science Process Skills that may start from the lower grade level to ensure responsive students when it comes to laboratory activities.

7. Further researches is highly recommended that would include learning styles of students; different groups of students to included cases of high achievers, average learners and low achievers; and the applicability of the developed laboratory activity in the lower sections.

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