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THE MANIPULATIVE SKILLS OF GRADE 8 ST. PETER STUDENTS: BASIS FOR LABORATORY REMEDIATION

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Abstract

This study aimed to assess the science manipulative skills of Grade 8 students as basis for laboratory remediation. Thirty-four grade eight students of St. Peter section in Ozamiz City National High School in school year 2013-2014 were chosen as the respondents. A teacher-made instrument was used with three Science teachers as evaluators. Findings reveal that the students have developing mastery level in identifying the uses of the laboratory apparatus with the mean score of 27 which is equivalent to a grade of 79 and that they are proficient (with a mean score of 3.46) in handling the apparatus, measuring skills (with a mean score of 3.62), in cleaning laboratory apparatus (with a mean score of 3.67) and storing skills (with a mean score of 3.5). It is concluded that the students' Science Manipulative skills do not reach the required competency level in which the standard requirement is 75% of the students have advance mastery level in the basic manipulative skills. Thus, additional exposure and training is needed to further enhance these skills.

Key words: science manipulative skills, scientific skills, laboratory remediation

Introduction

Scientific skills are defined as a set of largely transferable abilities that are suitable to many science disciplines and reflect the manners of scientists. They consist of science process skills and manipulative skills (Padilla, 1990). According to Opong (1981) the scientific process involves some steps or successive operations done by scientists during their investigation. Friedl& Koontz (2005) suggested six process skills – observing, inferring, communicating, classifying, measuring and experimenting. These are the processes performed by scientists. Freisen (in Stephenson, 2007) said that teachers nowadays are challenged with the fact that acquiring knowledge is better when things are done rather than taught. This claim was supported by the National Research Council (2007) as mentioned by Stephenson who said that "The meaning of 'knowing' has shifted from being able to remember and repeat information to being able to find and use it." As further discussed, inquiry-based method is done through hands-on, minds-on and by researching, thereby increasing the intellectual interaction between students and the teachers to build together, examine and reflect on their learning. Inquiry-based learning therefore requires students to have excellent manipulative skills.

Science manipulative skills are psychomotor abilities of using and handling science apparatus and other materials which help students to effectively perform science activities (Bybee *et al.,* 1989). Other than using and handling materials, the manipulative skills include how to keep and clean scientific equipment properly, how to carefully and appropriately handle specimens, as well as how to observe, record and measure accurately (Central Board of Secondary Education, 2005). Moreover, the Malaysian School Science Curriculum added proper storage of the science laboratory equipment as a manipulative skill. (Ministry of Education Malaysia. (2003).

According to Chiappetta & Koballa (2006), scientific skills or science process skills are one of the factors that can produce a scientific society. As further discussed, it is better to help students develop scientific skills because these will help them learn science on their own rather than just teaching them scientific facts. Moreover, the authors added that students who have good scientific skills are capable of keeping them for future use (Chiappetta & Koballa, 2006). Ameh (1991) mentioned that people today are confronted by Science and Technology which makes these scientific skills an urgent need. The fact that people now are already in the technological age, it is very important to know how to attain, assess and use information to

understand and solve problems because these are the requirements for most jobs the students will soon have as adults. That is why benchmarks for science literacy give stresses the importance of skills development so as to prepare students to face the real world wherein challenges are common, be it in the home or work place (Ameh, 1991).

Every school institution shares a common vision and that is to produce scientifically successful graduates. In order to achieve this, teachers must develop their students to have scientific skills. In the K-12 program of the DepEd, the development of scientific skills has given higher importance through the addition of performance standard. Adding up, this program focuses on the achievement of scientific skills and not on the content alone. According to Gardner and Gauld, (1990); Chiappetta and Koballa, (2002), many students enjoy laboratory work and prefer it than the other modes of learning but of course, this is not true to all students at all times. Thus, laboratory work is one of the best methods a teacher can use to enhance scientific skills of students.

To support the program of the Department of Education (DepEd), the researchers will answer the call to determine the level of manipulative skills of the students so that necessary measures can be taken immediately to improve their performance.

Statement of the Problem

The study aims to determine the level of manipulative skills of the Grade 8 St. Peter students of Ozamiz City National High School in the academic year 2013-2014.

Specifically, it seeks to answer the following questions:

1. What is the respondents' mastery level in identifying the uses or functions of the laboratory apparatuses?
2. What is the respondents' mastery level of the following manipulative skills?
    a. handling
    b. measuring
    c. cleaning
    d. storing
3. What remediation program can be designed based on the findings?

Significance of the Study

This study would be beneficial to the following:

Students. Knowing the students' mastery level of manipulative skills will encourage them to learn more in Science especially during laboratory works. This will also enlighten the minds of the students to appreciate Science subject.

Teachers. Teachers will plan on what particular lessons and laboratory experiments to enhance and develop the manipulative skills of the students. Moreover, teachers will be able to encourage or help students to learn more so that their higher order thinking skills and manipulation of laboratory apparatus will be stimulated and boosted.

Parents. This will help them know the status of their children in terms of manipulative skills; consequently, giving information as to what and how much support their children need.

Administrators. This will guide the administrators in imposing and conducting seminars for teachers on the enrichment of manipulative skills. This will help them in formulating policies which will encourage teachers to help students stimulate and improve this skill.

Future Researchers. This will give a baseline data for future researchers to further enhance the study.

Scope and Limitation

This study determined the level of science manipulative skills of the Grade 8 St. Peter students. This was conducted in Ozamiz City National High School for easy accessibility. The study is limited only to one section of Grade 8 to make it done in a short period of time.

The St. Peter students who were officially enrolled in this section in academic year 2013-2014 constituted the population of the study. The study was conducted in the month of January 2014 right after the third grading examination so that there will be no disruption of classes for the preparation of the exam. The manipulative skills assessed were identifying the use of laboratory apparatus, handling, measuring, cleaning and storing of laboratory apparatus only for the reason that these are the only manipulative skills that can be measured from our respondents.

The laboratory apparatus involved in the assessment are limited only to microscope, triple beam balance and glassware since these are the basic apparatus that are available in the school and these apparatuses are common to every experiment performed by the students. Glassware includes the apparatus which are made of glass such as test tubes, beakers, watch glass, graduated cylinder and evaporating dish.

Methodology

Research Design

A descriptive research design was employed in this study to determine and to describe the mastery level of grade 8 students on the Science manipulative skills as basis for future remediation. Specifically, it is a survey collection of data since it revealed summary statistics by displaying responses to all possible questionnaire items and it obtained a more complete and holistic picture of the study.

Respondents

The respondents of this study were the grade 8 students coming from section St. Peter in Ozamiz City National High School consisting of twelve (14) males and thirty (30) females. This section is grouped homogeneously and is considered as the third section in the grade 8 regular curriculum.

Instruments Used

The study used a teacher-made instrument to assess directly and indirectly the manipulative skills of students. To ensure the content validity of the instrument, it was critiqued and was validated by two of the Chemistry teachers in La Salle University. The indirect and direct assessment was then pilot tested using internal consistency to establish reliability and validity with the Cronbach's alpha of 0.72 and 0.90 respectively.

There were two parts of the instrument. First was indirect assessment where students identified laboratory apparatuses given its use and description. Second was direct assessment in which students were given instructions that required them to perform different techniques involved in the laboratory skills. Three evaluators assessed the students directly by observing their performance and rated them individually as they performed the instructions given.

To avoid biases, the evaluators were the Chemistry teachers in the same school. The evaluators rated the performance of the students according to the Likert's scale used below.

Mastery Level

1	B	Beginning
2	D	Developing
3	AP	Approaching Proficiency
4	P	Proficient
5	A	Advance

Scoring

The identification of the uses of laboratory apparatus is a teacher-made quiz with the total score of fifteen (15) items. For transmutation purposes, each item is multiplied by three to make the total points of forty-five. The scores were then graded following the transmutation used by the respondents' school, Ozamiz City National High School in which the passing score is 50%.

In this case, the total score is 45, the passing score is 23.

Score	Grade	Mastery Level
0-22	74 below	**Beginning**. Lacking competence in manipulative skills and require urgent improvement.
23-27	75- 79	**Developing.** Fairly competent in manipulative skills and need further improvement.
28-32	80-84	**Approaching proficiency**. Competent in manipulative skills and need a little improvement.
33-37	85-89	**Proficient.** Very competent in manipulative skills and can support other students in improving the skill.
38-45	90 Above	**Advance.** Having an excellent competence in manipulative skills and can support other students' improvement.

In scoring the handling, measuring, cleaning and storing skills, the Likert scale score was used by the evaluators. To interpret the score, the Table 1 below was used.

Table 1. *The evaluation of manipulative skills*

Range Scale Scores	Mastery Level of Manipulative Skills
1.00-1.80	**Beginning**. Lacking competence in manipulative skills and require urgent improvement.
1.81 -2.60	**Developing.** Fairly competent in manipulative skills and need further improvement.
2.61 – 3.40	**Approaching proficiency**. Competent in manipulative skills and need a little improvement.
3.41 – 4.20	**Proficient.** Very competent in manipulative skills and can support other students in improving the skill.
4.21 - 5.00	**Advance.** Having an excellent competence in manipulative skills and can support other students' improvement.

Data Gathering Procedure

The teacher-made questionnaire was given on the first week of January right after the third periodical examination of the students. The indirect assessment was done in one setting only. However, the direct assessment, which requires the students to manipulate the lab apparatuses

individually, needs an ample time to finish it. Since time is limited, only eleven (11) students were scheduled to perform in each meeting. Thus, the study was conducted in four successive settings. This was done to ensure that the data gathered were based on individual skills that the students perform. The three evaluators rated the students simultaneously. The collected data has two purposes: for this study and for the students' performance grade in the Third Grading Science subject.

Treatment of Data

The information from the questionnaire was the total scores of the respondents; thus, the data were of interval level. Frequency, percentage distribution and mean were used to interpret the data gathered. In the interpretation of data, scales were adapted to measure the variables used in the study. The scales and verbal equivalent of the scores are shown in table above.

Results and Discussion

This section deals with presentation, analysis and interpretation of the gathered data. The data are arranged according to the order of the presented specific problems treated in this study.

Table 2. *Mastery Level of Identifying Laboratory Apparatus*

Mastery Level	Frequency	Percentage%
A (90-100)	4	9.09
P (85-89)	10	22.73
AP(80-84)	5	11.36
D(75-79)	13	29.55
B(65-74)	12	27.27
Total	44	100

Table 2 depicts that 56.82% of the students had beginning to developing level of mastery in identifying the uses of the laboratory apparatus. This finding means that more than one-half of the students cannot identify the functions of these laboratory materials thus, could not use them properly during actual experiments.

It further shows that only 31.82% of them had proficient to advance mastery level. This implies that only few of the students can identify the function of these laboratory apparatus therefore, only few know how to use them.

Moreover, this reveals that the grade eight (8) students are not knowledgeable enough on the functions of common laboratory apparatus. This can affect the teaching-learning process because with the K to 12 curriculums, grade eight (8) science modules no longer include topics about how to handle laboratory apparatus as well as their functions (K-12 Curriculum Guide pp. 39-45). When students do not know the basics, there is therefore a need for the teacher to go back and teach these basic lessons prior to every activity which would consume the allotted time for each activity.

Table 3 *Mastery Level of Handling Technique Skills*

Mastery Level	**Handling Skills**					
	Microscope		**Glass wares**		**Triple Beam Balance**	
	f	%	f	%	F	%
Advance (4.21 - 5.00)	22	50	0	0	0	0
Proficient (3.41 – 4.20)	21	47.73	34	77.27	3	6.82
Approaching Proficiency (2.61 – 3.40)	1	2.27	10	22.73	20	45.45
Developing (1.81 -2.60)	0	0	0	0	21	47.73
Beginning (1.00-1.80)	0	0	0	0	0	0
Total	44	100	44	100	44	100

Table 2 reveals that 97.73% of the students had proficient to advance mastery level in handling microscope, thus they are already expert in it. This is because the use and functions of microscope was already taken up in grade seven (7) science activities (Grade 7 Science Module, pp. 95-102).

Seventy-seven and twenty-seven percent (77.27%) of the students have proficient mastery level of handling glassware. This implies that they are very good already in handling glassware which means that they hold the beaker, bottles and other glassware by the sides and bottom rather than the top part and keeps them away from the edge of the table.

On the other hand, only a few (6.82%) are proficient in handling triple beam balance. Majority (93.18%) are in the developing to approaching proficiency mastery level. This clearly shows that the students still need improvement in handling the triple beam balance. More exposure to this apparatus can also help them become competent in handling it.

Table 3 *Mastery Level of Measuring Techniques Skills*

Mastery Level	Measuring Skills					
	Volume		Temperature		Mass	
	f	%	F	%	F	%
Advance (4.21 - 5.00)	14	31.82	9	20.45	0	0
Proficient (3.41 – 4.20)	29	65.91	35	79.55	6	13.64
Approaching Proficiency (2.61 – 3.40)	1	2.27	0	0	28	63.64
Developing (1.81 -2.60)	0	0	0	0	10	22.72
Beginning (1.00-1.80)	0	0	0	0	0	0
Total	44	100	44	100	44	100

Table 3 above shows that 97.73 % of the students are proficient and advanced in measuring volumes. Meaning, they use suitable cylinder size, does not overfill the cylinder and places their eyes at the height of the meniscus. This means that majority of the students are already very competent and have advanced knowledge and skill in measuring volumes.

Also, 79.55% of the students are proficient in measuring temperature while 20.45% of them are in the advanced level. This simply shows that all of them are already competent and are very knowledgeable in getting the temperature of objects and liquids.

In contrast, only 13.64% of the students are proficient in measuring mass. Mostly (63.64%) are in the approaching proficiency level while 22.72% are still in the developing level. This implies that the students still need to improve their skill in using a suitable container for substances to be measured and adjusting the balance to zero before measuring.

The results further show that students are more knowledgeable in measuring volume and temperature than measuring mass. This is because measuring liquids are usually done in laboratory activities. Also, getting the temperature using thermometer and measuring volume using glassware are much easier to perform than measuring mass using the triple beam balance. Furthermore, students are more exposed to glassware and thermometer compared to triple beam balance, aside from the fact that glassware and thermometer are much handier and accessible. Most public schools only have limited number of triple beam balance. Moreover, laboratory activities in the grade 8 science modules do not require students to measure materials in grams or milligrams but in cups, tablespoons and teaspoons disregarding the use of the triple beam balance.

Table 4 *Mastery Level of Cleaning Techniques Skills*

Mastery Level	Laboratory Apparatus					
	Microscope		Glassware		Triple Beam Balance	
	f	%	F	%	f	%
Advance (4.21 - 5.00)	6	13.64	0	0	0	0
Proficient (3.41 – 4.20)	27	61.36	29	65.91	17	38.64
Approaching Proficiency (2.61 – 3.40)	11	25.00	14	31.82	24	54.54
Developing (1.81 -2.60)	0	0	0	0	3	6.82
Beginning (1.00-1.80)	0	0	1	2.27	0	0
Total	44	100	44	100	44	100

As depicted in Table 4 above, 75.00% of the students are in the advanced and proficient level while only 25% are in the approaching proficiency level in cleaning the microscope. This supports the findings in Table 2 above wherein students are competent in handling the microscope, and thus, they are also competent in cleaning them.

Meanwhile, the results also show that 97.73 % of the students are in the approaching proficiency and proficient mastery level in cleaning glassware which also agrees with the results in Table 2 above with regards to how they handle glassware.

Moreover, 93.18 % of the students are in the approaching proficiency and proficient mastery level in cleaning the triple beam balance. This result is in consonance with the results above regarding the handling and measuring skills of students. Most of the students still need a little improvement in terms of their cleaning skills.

Table 5 *Mastery Level of Storing Techniques Skills*

Mastery Level	Laboratory Apparatus					
	Microscope		Glassware		Triple Beam Balance	
	f	%	f	%	f	%
Advance (4.21 - 5.00)	5	11.36	3	6.82	0	0
Proficient (3.41 – 4.20)	34	77.28	33	75.00	6	13.64
Approaching Proficiency (2.61 – 3.40)	5	11.36	8	18.18	36	81.81
Developing (1.81 -2.60)	0	0	0	0	2	4.55
Beginning (1.00-1.80)	0	0	0	0	0	0
Total	44	100	44	100	44	100

This only proves that students are really competent in manipulating the microscope over glassware and triple beam balance, and they have low mastery level in manipulating, handling and cleaning the triple beam balance which indicates that they are more exposed to microscopes and glassware over the triple beam balance.

As illustrated in the Table above, 88.64% of the students are in the proficient and advanced mastery level in storing microscope. This means that majority of the class knows how to keep and return the microscope into its storing place properly and carefully.

The results in Table 4 wherein students are proficient to advance in cleaning glassware supports the result in the Table above where 93.18%% of students are also in the approaching proficiency and proficient mastery level in storing glassware.

Moreover, results depict that 95.45% of the students are in the approaching proficiency and proficient mastery level in storing the triple beam balance. This matches the results in Tables 2, 3 and 4 with regards to the handling, measuring and cleaning skills of the students of the said apparatus. This indicates that majority of the students are not very competent in manipulating the triple beam balance thus they need to be more exposed to this apparatus to improve further their manipulative skills.

Summary

This study was conducted to determine the level of manipulative skills of the grade 8 St. Peter students of Ozamiz City National High School in the school year 2013-2014. A descriptive research design was used to assess the manipulative skills of the students namely: handling, measuring, cleaning and storing skills. A teacher-made questionnaire which was validated and pilot-tested was used to obtain the necessary data.

Based on the data gathered, it was found out that:

1. The students have developing mastery level in identifying the uses of the laboratory apparatus with the mean score of 27 which is equivalent to a grade of 79;
2. They are proficient (with a mean score of 3.46) in handling the apparatus;
3. They have proficient (with a mean score of 3.62) measuring skills;
4. They are proficient (with a mean score of 3.67) in cleaning laboratory apparatus and
5. They have proficient (with a mean score of 3.5) storing skills.

Conclusion

The students' Science Manipulative skills do not reach the required competency level in which the standard requirement is 75% of the students have advance mastery level in the basic manipulative skills. Thus, additional exposure and training is needed to further enhance these skills.

The researchers recommend that the different science apparatus and their uses is clearly stressed out to the students every time they get to use them; that all available science apparatus in the school be handled and manipulated by the students after the teacher must demonstrate and explain their uses including the do's and don'ts in handling them; that proper handling, measuring, cleaning and storing of science apparatus being used be incorporated in the Science lab activities to improve the manipulative skills of students; that the uses and functions of the different science apparatus be introduced in grade 7 so that improvement and mastery of the manipulative skills will be focused in the next year levels.

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Appendices

Appendix 1. Laboratory Remediation Action Plan

SY 2014-2015

I. Goal: By the end of the school year 2014-2015, 75% of the learners shall have mastered a set of rationally defined *BASIC MANIPULATIVE SKILLS* in *Science and Technology*.

II. Plan of Action

Key Result Area	**Strategies**	**Interventions/ Initiatives**	**Time Frame**
A. Modification of Laboratory Procedure which integrates manipulative skills	Prepares appropriate instructional materials	Photocopy of the materials	April – May 2014
B. Addition of Laboratory Activities	Researches online	Photocopy of the materials	April – May 2014
C. Introduction of Laboratory materials and its uses (Do's and Don'ts in the lab).	Identification of lab apparatus	Quiz	July 2014
D. Posting of Permanent Proper handling, measuring, cleaning and storing skills in the wall of lab room.	1.Students' participation • classroom 2. Evaluation	Making of models and charts	Second day of Laboratory activity
E. Discussion of Proper handling, measuring, cleaning and storing skills	Prepares appropriate instructional materials and teaching aids.	Quiz Direct Assessment	First day of Laboratory activity
F. Summative Direct Assessment of manipulative Skills	Prepares the lab materials involve	Direct Assessment	Every grading period

Appendix 2. Sample Questionnaire

Name: **Gender:**

Age:

I. Indirect Assessment

A. Uses of Laboratory Apparatus

Directions: Identify the apparatus being described in each statement. Choose your answer from the box below.

Beaker	Spatula	stirrer	watch glass		
Alcohol Lamp	dropper	test tube brush		Test	Tube

_____1. measures the volume of liquid.

_____2. measures the mass of objects to be studied.

_____3. measures the temperature of an object.

_____4. holds the test tube in place.

_____5. magnifies the specimen.

_____6. used for heating liquids.

_____7. *used* for the evaporation of solutions and supernatant liquids, and sometimes to their melting point

_____8. *used* to support various *laboratory* glassware over a fire and to spread evenly at the bottom of the material being heated.

_____9. *used* to place under the container holding the liquid, that is being heated

_____10. *used* to take and handle small quantities of solid chemicals.

_____11. *used* to transfer small quantities of liquids.

_____12. a simple container for stirring, mixing and heating liquids commonly used in many laboratories.

_____13. Cleans the test tube.

_____14. places the specimen under observation

_____15. Used to hold solids while being weighed, or *used* as a cover for a beaker.