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A Comparative Analysis on the Status of Laboratory Resources And Science Process Skills of Grade 11 Learners in The Schools Division of Eastern Samar, Philippines

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ABSTRACT

Instructional resources play a significant role in the development of man's scientific thinking. Thus, a hybridized descriptive correlational inquiry was conducted to examine the present availability and utilization statuses of science laboratory resources and the mastery level on integrated science process skills among 274 Grade 11 learners in three secondary schools in the schools' division of Eastern Samar using a researcher-developed questionnaire on the availability and utilization status of basic science laboratory resources, and an adopted integrated science process skills test of Monica (2005) for the school year 2019-2020. Findings revealed a significant difference in terms of availability, utilization, and mastery levels among the three participating secondary schools in the schools division of Eastern Samar. Hence, it is recommended for the education sector to propose and develop a laboratory resource management system so that the availability and utilization of science instruments will be maximized, and an intervention program be provided among students to heighten their present integrated science process skills mastery level.

Keywords: Science Laboratory Resources; Integrated Science Process Skills; Mastery Level.

INTRODUCTION

For more than 60 years now, the Philippine educational system has fully recognized the relevance of science education via various programs such as that of scientific investigatory explorations aimed at the rapid development of a scientific man, society and the environment in terms of the methods, systems and devices used for practical purposes (Nzuanke and Chinaka, 2018). It is common knowledge that Filipinos are outstanding in science and mathematics. However, according to Lin, Lin, and Tsai (2014), "science education in the country cannot be considered as a strength considering annual National Achievement Test (NAT) results and international surveys coming from the Trends in International Mathematics and Science Studies (TIMSS), and the recent 2018 Program for International Student Assessment (PISA)" (p.34).

The National Education Testing and Research Council (2013) disclosed the mastery mean performance of 41.35% on science concepts, which is far below the standard set by the Department of Education at 75%. The Department of Education (DepEd) reported in 2014 that science laboratories were scarce in Regions III, IV-A, X, XI, and XII, with only one in every ten schools possessing a laboratory. The ratio improved in the "National Capital Region, where three laboratories were found for every ten schools; however, the rest of the regions lacked science laboratories," according to the findings (Villar, 2018, p.10).The use of laboratory resources is a distinctive feature of an established science curriculum (Tafa, 2012). Okoli and Egbunonu (2010) described laboratory methods that engage students towards a functional learning approach through available interactive resources and equipment to express ideas and make lessons exciting and easy to understand.

In some studies, learners' non-familiarization with laboratory equipment causes poor performance in examination (Ihejiamaizu and Ochui, 2016; Mamman, Misau, and Agboola, 2018; Andrew-Essien 2021). Similarly, Nwagbo (2012) and Olufunke (2012) opined that inadequacy and non-utilization of laboratory facilities cause students' poor performance. Furthermore, Olufunke's (2012) study discovered that schools that utilized equipment frequently had the highest mean score. Mukami (2009) stated in her readings that most underperforming institutions spent less money on education and learning resources and that access to learning materials has a positive impact on the students' science performance. Colvill and Pattie (2002) postulated that one critical factor in attaining scientific literacy among secondary students is acquiring integrated science process skills. Akinbobola and Aolabi (2010), Andrew (2010) posited that these skill-sets are needed in realizing the potential of Science and Technology to solve societal problems. Also, Feyzioglu (2009) opined that the acquisition of the skills would help the students to become problem solvers; hence confirm the need for learners to combine both of their scientific processes and environmentally-acquired knowledge for them to inculcate the essence of the current educational program ultimately – the K-12 enhance primary education curriculum in practice and understanding.

It is based on this that the researcher came up with this problem. Hence this study assessed and compared the status of science laboratory resources in terms of their availability and utilization and the mastery level on integrated science process skills among Grade 11 learners in three secondary schools in the schools' division of Eastern Samar for the school year 2019-2020. Furthermore, the researcher correlated the status of science laboratory resources and the mastery level of the participants on integrated science process skills to establish the relationship between the two variables under consideration. Specifically, this study was directed with the following research objectives:

1. ascertain if there are significant differences on the status of science laboratory resources of three selected secondary schools in the schools' division of Eastern Samar in terms of: availability, and utilization
2. test the significant difference on the mastery level on integrated science process skills of the students when grouped according to school; and
3. determine the relationship between the mastery level on integrated science process skills and status of science laboratory resources in terms of: availability; and utilization.

CONCEPTUAL FRAMEWORK OF THE STUDY

This study is anchored on the theories formulated by well-known educational researchers and authorities in conventional and modern instructional approaches to education. Prime mover of Instructional philosophy in the persons of Aladejana and Aderibigbe (2007) who believe that it is the responsibility of the educational community to provide a comfortable and conducive laboratory environment which will eventually liberate learners into an open exchange of ideas with respect and thoughtful consideration, hence promoting learner-centered characteristics such as that of promotion of learner's scientific curiosity, provisions of reward mechanism, encouraging healthy questioning, and meaningful understanding. Moreover, fostering human scientific enterprise through existing academic resources enhances aesthetic and intellectual understanding (Omiko, 2015) and enables learners to use meaningful meaning in their environment and develop relevant life skills (Akani, 2015).

Piaget's cognitive constructivist theory proposed that children's progress can be assessed through a child's ability to construct understanding based on his/her environmental experiences. According to Piaget's theory, learning is founded on discovery: to comprehend is to discover or reconstruct through rediscovery, and these requirements must be met if future generations are to produce individuals competent to produce innovations, rather than merely producing repetition (Olaedo, 2018). This means that educators should create learning environments that enable students to discover facts and conduct independent investigations into facts or truth.

The true nature of learning resources is when they are sought, not being told. Dale's Cone of Experience relates related successful transfer of learning to resources. The top of the cone has the abstract strategies that are more teacher-centered and require fewer resources, while at the bottom are the learner-centered strategies that allow for greater learner autonomy and require more resources. The top of the cone begins with verbal symbols, and at the bottom, there is the direct, purposeful experience such as students working with apparatuses in the laboratory (Mukami, 2009). This implies that an educational leader, such as a teacher, should be familiar with various science teaching methods and procedures, as most teachers previously focused on the theoretical rather than the practical.

Lastly, the researcher took on Jerome Bruner's theoretical arguments which posit that learning is an active process in which learners construct new ideas or concepts based on past or present knowledge that knowledge and meaning are created in interaction between experiences and ideas (Obliopas, 2017). These theories have to do with educational approaches that highlight active learning and discovery. Practical experience is therefore necessary for effective skills in scientific processes, and teachers should encourage students to discover principles themselves. In these underlying theories and concepts, an investigation is conducted to examine closely how instructional resources' availability and utilization, such as laboratory resources, capacitate learners' mastery level and acquisition of science process skills.

METHODOLOGY

Research Design

The researcher employed a correlational approach in assessing the statistical relationship between the status of science laboratory resources in terms of its availability and utilization using a three-way and five-point rating scheme via a researcher-developed instrument containing 38 item-basic science laboratory resources and the Grade 11 learners' mastery level on integrated science process skills in the selected schools in the schools' division of Eastern Samar, namely: Oras National High School, Arteche National High School, and Taft National High School during the school year 2019-2020.

Respondents of the Study

The respondents of this study were Grade 11 students who are officially registered in the learners' information system (LIS) in the selected secondary schools offering senior high school programs for the school year 2019-2020. They were proportionately determined by multiplying the respective Grade 11 population with 274 and dividing the product by 934, which is the total research population

Research Instrument

A researcher-developed questionnaire comprising 38 laboratory resources in Biology, Earth Science, Physics, and Chemistry was employed to determine the status of science laboratory resources in terms of their availability and extent of utilization. This instrument was validated among Science Teachers in two non-participating secondary schools in the schools' division of Eastern Samar, who are diploma holders in Teaching Science and teaching the said subjects for more than five years now. The first part of the instrument asked for respondents' profiles, including their name (but not required for ethical consideration) and assigned school.

The second part is a checklist-based questionnaire containing 38 basic science laboratory resources to be responded available/available but not functional/not available for the first part, while a five-point Likert scale will be utilized for the extent of utilization of science laboratory resources. In examining the mastery level of integrated science process skills of Grade 11 students, the researcher adopted a valid Integrated Science Process Skills Test of Monica (2005), consisting of 30 items with four options each. The instrument comprises six items on identifying and controlling variables, six items on stating a hypothesis, six items on operational definitions, nine items on graphing and interpreting data, and three items on experimental design. The said instrument got a 0.81 reliability value. Moreover, the developed instrument could be readily adapted to local use to monitor the acquisition of science process skills by the learners (Monica, 2005).

Data Gathering Procedure

The data gathering was conducted in two different manners: through a three-part survey questionnaire and an integrated science process skills test administered to the respondents in the three selected schools. The data gathering proceeded after the compliance of all the requisite permission from concerned government agencies. Initially, the researcher sought permission to conduct the study from the Dean of the College of Graduate Studies of Eastern Samar State University, Borongan City, through a request letter. Another letter addressed to the Schools Division Superintendent of the Schools Division of Eastern Samar, Department of Education (DepEd), Region VIII, was secured when the said approval was given.

Upon the acceptance of the approval by the Schools Division Superintendent of the Schools Division of Eastern Samar, several letters were addressed to the Secondary School Principals of the three selected schools for their approval of the study. It was only upon their consent that the survey using the test instrument was conducted among 274 respondents.

Data Analysis

The data were tabulated, organized, analyzed, and interpreted using inferential statistical tools, specifically, Kruskal Wallis H-test, One-way Analysis of variance (ANOVA), and Spearman's rank correlation at 0.05 level of significance.

Ethical Consideration

All applicable ethical guidelines for research were followed in this study. Participants' consent was obtained, and a permit for the use of the data they provided. Participants were assured that their personal information would be kept private and not be used against them in any legal proceedings. Numerical codes were assigned to schools such as A for Taft National High School; B for Oras National High School; and C for Arteche National High School. Moreover, the heads in each school were informed about the findings of this study.

RESULTS AND DISCUSSION

One-way analysis of Variance (ANOVA) test of significant difference on the availability of science laboratory resources among the three secondary schools

Table 1 shows the comparison via One-way Analysis of Variance in terms of availability status of basic science laboratory resources in three selected secondary schools in the Schools' Division of Eastern Samar for the school year 2019-2020. Since the data from the three participating schools showed normal distributions, a parametric one-way analysis of variances was utilized. The null hypothesis is deemed to be rejected because the p-value of.000 is less than the significance level of 0.05, based on the analysis results. Hence, it is safe to declare a significant difference in the availability status of science laboratory resources among the three secondary schools.

The finding shows that the selected schools have a huge disparity in distributing basic science laboratory resources. These results are related to the findings of Pareek (2019), who found out that only 25% of teachers have access to laboratory resources in the participating schools. Moreover, the current situation of the inadequacy of laboratory resources would likely cause poor scientific literacy among students in the selected schools. Faize (2011) also stated that the absence, misallocation, and ineffective utilization of science laboratory materials can lead to resource waste, a decrease in the efficiency of the scientific laboratory, and lower academic achievements and that the existence of a science laboratory can have a significant impact on the proper allocation and effectiveness of scientific laboratories per student. Moreover, Hidalgo (2002) firmly believed that students provided with engaging and fruitful scientific activities gain more knowledge and understanding of the topic. The researcher observed that some equipment is not yet displayed and stocked in the logistic offices. As aforementioned, teachers are responsible for converting the science curriculum into concrete learning experiences for students during the instructional process by maximizing laboratory resources.

Table 1: Comparison of science laboratory resources' availability among the three secondary schools.

Availability	**Mean Squares**	**p-value**
Between Groups	658.56	.000[s]
Within Groups	50.07	

α = 0.05, df (between groups) = 2, df (within groups) = 271

Kruskal-Wallis test on the status of science laboratory resources among the three secondary schools in terms of utilization

Table 2 compares the utilization status of basic science laboratory resources in three selected secondary schools in the schools' division of Eastern Samar for the school year 2019-2020. Since the data showed skewed distribution, a nonparametric Kruskal Wallis test was utilized. As reflected in the table, since the p-value of .000 is less than the significance level of 0.05, the null hypothesis is rejected. Hence, there is a significant difference in the utilization of science laboratory resources among the three secondary schools. The findings depict a varying utilization of laboratory resources among the three schools. According to Olajide, Adebisi, and Tewogbade (2017), the majority of teachers do not use the few lab facilities available in their classrooms, while Prabha (2016) claims that experimental work has left a lasting impression on the minds of students and that well-planned experiential learning has great capacity to attracting young people. These findings suggest that DepEd SGOD personnel or the headteacher of schools' science department must closely monitor the use of basic science laboratory resources to ascertain issues that prohibit teachers from using them in their science instruction to assist whence necessary. In the end, students will benefit the most because they will have access to high-quality hands-on and mind-on learning materials and environments.

Table 2: Comparison of science laboratory resources' utilization among the three secondary schools.

School	**Mean Rank**	**p-value**
A	167.34	
B	98.30	.000[s]
C	154.06	

α = 0.05, df = 2

One-way analysis of Variance (ANOVA) test of significant difference on the integrated science process skills mastery levels among the three secondary schools

Table 3 compares the integrated science process skills mastery levels among three selected secondary schools in the schools' division of Eastern Samar for the school year 2019-2020. Since the data from the three participating schools showed normal distributions, a parametric one-way analysis of variances was utilized. Data showed that since the p-value of .001 is less than the significance level of 0.05, the null hypothesis is rejected. Hence, there is a significant difference in the mastery level on the integrated science process skills of the students in the three secondary schools. Bassey and Amanso (2017) discovered the same result in senior secondary students' science process skills acquisition, while Lyon (2008) stated that students with poor science process skills acquisition have difficulty computing and solving basic science problems.

In line with the findings, it is quite apparent that the learners' acquisition of integrated science process skills was very low. Hence teachers and the whole educational stakeholders must work hand-in-hand in developing instructional schemes that are directed towards the improvement of learners' science process skills.

Table 3. Comparison of integrated science process skills mastery levels among the three secondary schools.

	Mean Squares	p-value
Between Groups	83.455	.001[s]
Within Groups	10.960	

α = 0.05, df (between groups) = 2, df (within groups) = 271

Test on the significant relationship between the mastery level on integrated science process skills and status of science laboratory resources

As presented in **Table 4**, results on the test of the relationship between students' mastery level on science process skills and the status of science laboratory resources in terms of availability and utilization. In determining the relationship between availability and mastery level on science process skills among students, a Point-biserial correlation via Pearson r as references was utilized since the availability variable has two categories and followed a normal distribution. The result shows that the two variables have negligible indirect relationships visible with the negative value of r (-.061). On the other hand, a test on the relationship between mastery level and utilization status was run using Spearman rho correlation due to the non-normality of the two variables. Furthermore, the result showed a negligible yet direct relationship between the two variables, as shown by the positive value of rho (.004). However, since the p-values for Availability and Utilization are higher than the significance level set at 0.05, the null hypothesis is retained, and no significant relationship was established on two sets of variables.

The result displays a negated relationship primarily due to the poor performance displayed by the participants and the unavailability and poor utilization of basic science laboratory resources. This finding is in line with Afolabi (2002) and Commeyras (2003), who found no connection between class size and learner academic accomplishment and learning results, and Akani (2015), who has not found a significant difference in learner responses to scientific learning methods and their laboratory skills. However, this result is opposed by available literature such as Rabacal (2016), who found a positive significant and linear relationship between science process skills taught in laboratory applications and efficient laboratory use of the students.

Sanli and Gocmencelebi (2011) have shown that the use of laboratory instruments primarily develops students' capabilities in science and that the findings of Okebukola, referred to by Afolabi (2010), are highly reliant on the faculties' opportunities to gain science. Hanuscin (2007) also said that positive learning influences the space and quantity of learning material in the classroom. Geleta (2018) also highlighted laboratory facilities that increase students' ability to raise scientific issues, develop scientific inferences, conduct scientific and social testing, prepare and revise the information and share scientific arguments and student cohesion (Odutuyi, 2015).

Table 4: Mastery level on integrated science process skills and status of science laboratory resources.

Status of Laboratory Resources	**Grade 11 Students Mastery Level on SPS**		**p-value**
	Result	**Interpretation**	
Availability	r = -.061	Negligible	$.312^{ns}$
Utilization	ρ = 004	Negligible	$.945^{ns}$

α = 0.05

CONCLUSIONS AND RECOMMENDATIONS

Summing it up, the results derived in this study showed that the number of available and not available laboratory resources varied, in which the latter was higher than the former. When their differences were compared to schools, a significant difference was made. Hence, this implies that the Department of Education (DepEd's) logistic division should ensure equal distribution of science laboratory resources to guarantee an almost equal delivery of instruction among science teachers. This study was limited in that it examined a small, relatively homogenous sample of secondary schools whose science performances lie at the bottom based on the DMEA result. The result of this study does not necessarily represent the whole division of Eastern Samar as to the schools' status of laboratory resources and mastery level of the students, specifically the Grade 11 students only. This instrument should continue to be revised until higher reliability is reached.

Based on the findings derived, the use of parametric and nonparametric comparative analyses tools revealed significant differences in the availability and utilization statuses of science laboratory resources among the three participating secondary schools. Also, there is a significant difference in the integrated science process skills mastery levels of the Grade 11 students. Finally, the availability and utilization statuses of science laboratory resources when associated with the Grade 11 integrated science process skills mastery levels have shown no significant relationship.

Hence, the following recommendations are offered. Science supervisors of the Department of Education (DepEd) must regularly monitor schools' availability and use of scientific laboratory resources to provide up-to-date information on their current condition. The education sector must spearhead mass training among secondary teachers on the proper use of laboratory resources and other related pedagogies that will expose learners to such learning tools in the science classroom. The mastery level on integrated science process skills needs to be raised to the average mastery level by providing necessary intervention programs and more exposure to laboratory equipment in teaching practical science concepts. The Department of Education must develop an online management system to update the availability of laboratory resources in each school to provide more resources to schools that need them the most. Lastly, every school must heighten the teaching of integrated science process skills among Senior High School students in a manner enjoyable and easy to catch up with.

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