European Online Journal of Natural and Social Sciences 2021;
Vol.10, No 4 pp. 629-638
ISSN 1805-3602

Learning Science: Factors and its Relation to Academic Performance

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Received for publication: 28 August 2021.
Accepted for publication: 16 October 2021.

Abstract

Over the years, educators are exerting much effort in achieving the quality education that every student deserves. As important as it is for all courses, Science is a subject that needs attention to be delivered effectively. This study sought to assess the correlation of the different factors affecting the academic performance of Science High School Students in the Philippines. The researchers used the quantitative-descriptive approach to highlight the gathering of raw data focusing on the usage of laboratory equipment, instructional materials, and the Science teacher's competence in the delivery of instruction. Results of the study show that there is no significant relationship between the usage of laboratory equipment, usage of instructional materials, and the teachers' competence in teaching Science to the academic performance of selected Filipino High School Students. Further, it is proposed to upgrade the laboratory facilities in terms of quality and numbers. Continued use of Instructional materials is also encouraged to supplement learning. Likewise, it is suggested that the educational institution must develop programs that will continually enhance the training and development of its educators to further elevate their competence in Science and in other areas of the discipline.

Keywords: Academic performance, instructional materials, laboratory equipment, teacher's competence

Introduction

Quality education is everyone's hope for all our students across the globe. It is an integral path of making the 21st century learning successful. Science as one of the equally important subjects in the basic education is always a part of national and international assessments as bases for quality education. Homden (2017) specified that Science is probably the most long-standing and significant academic discipline which encompasses a wide array of subjects. A significant learning objective of Science as a subject entails utilization of laboratory experience to enhance its mastery, expound scientific reasoning skills, foster comprehension of the intricacy and uncertainty of experiential works, promote functional skills, which thereby cultivate the love of this discipline of study. According to the study conducted by Sabri and Emuas (2016) there is a solid relationship between the number of secondary science laboratory investigations in secondary school and the academic performance of Palestinian students in science theory and laboratory courses.

On the use of instructional materials

With the spiral progression at work in our K-12 Curriculum, Science subject is not limited to one area of discipline anymore. Every year level encompasses at least four modes of discipline the students need to learn and understand. Such that it entails the study of Biology, Earth Science, Che-

mistry and Physics all in spiral progression approach. In the study of de Ramos-Samala (2018), the use of instructional materials showcasing the students' interests helped the students remember the different science concepts taught by their teachers and lead to mastery of the subject matter.

The use of different instructional materials also helps learners to comprehend even more such varied concepts enveloped in this area of discipline. This, coupled with a competent Science teacher, could be the winning formula for a perfect transfer of learning. As per the study conducted by Adalikwu (2013) revealed that students trained with instructional materials did significantly better than those educated without it. In addition, the utilization of instructional materials normally augments students' comprehension of concepts leading to loftier academic performance. Moreover, according to Daehler (2016) an effective Science lesson necessitates planning engaging activities, traversing complex concepts, anticipating, and working with students' prejudices and biases. Good teaching is an art performed by those with specialized understanding and abilities, an attribute possessed by a competent teacher.

Khan (2016) stated that learning can be bolstered with a mix of teaching/learning means because they encourage, excite as well as invigorate learners' attention during the course of instruction. Visual aids provoke the attention of learners and help the teachers to expound the concepts with ease. Visual aids are instructional supports which are utilized in class to enhance the transfer of learning. Other forms of visual aids such as the use of projectors, video tapes, internet links, television, and audio materials are likewise very beneficial to use because they not only motivate the learners but more importantly, they complement the conduct of experiments and other investigative Science activities. What is noteworthy is that instructional materials are great supplements for the inadequacy of laboratory facilities. Such instructional materials include, but not limited to, textbooks, workbooks, modules, articles, activity sheets increase the likelihood that learners will be "pushed" to read and "do" activities even if they are not in the four corners of the classroom. So, the continuity of learning is assured if teachers utilize them as a complement to their classroom learning. Visual aids, pictures, graphs, charts also enhance visual communication and interaction of the learner towards the concept being discussed.

In making Science learning even more interactive, teachers make use of PowerPoint presentations, graphic images and even video presentations as teaching devices via the use of projectors. As per Hitachi Digital Media Group (2016) before projectors became a common device for teaching, educators must be in class beforehand to jot down notes and frequently erase and modify the subject content on the board as the lesson progressed. These eventual interferences often caused students to lose concentration and start conversing with one another as they wait for the succeeding parts of the lecture. This will enable precious times to be wasted instead of being allocated to other important matters that should be done inside the classroom.

The availability of laboratory equipment augments and enriches teaching capabilities as well. Educators who are well-equipped through the support of their institution with adequate facilities can well-explore all possibilities of the Science's teaching-learning processes. The probability that they can better teach and explain scientific facts is not remote and learners tend to appreciate more that information drawn from investigations. However, the problem with most public schools in the Philippines is the lack of equipment for Science experiments. According to an article in The Manila Times (2014) classrooms are insufficient, but the situation for science laboratory equipment is even poorer. The Department of Education (DepEd) in the country reports a serious lack of Science Laboratory equipment in both elementary and high school all over the country. In the national Capital Region alone, the ratio is 3 laboratory equipment for every 10 elementary students.

On Teachers' Competence

In the transfer of learning, the crucial role of the teacher lies not on how fast a student learns during discussion but how effective the teacher is by ensuring that everybody learns, and no one is left behind. Real competence lies in the teacher's ability to make sure each learner copes and deals with the concepts being taught. Competence on the part of the teacher is always a key consideration notwithstanding other factors involved. The expertise and proficiency of the teacher can unlock the cognitive treasure hidden in the learner's mind if the teacher has the ability to do so.

Teaching competencies is defined as "the established expertise, familiarity attitudes, ideals understanding and experience necessary for effective transfer of knowledge" (Katane et al., 2006). Teachers need to foster talent and proficiencies to heighten and boost their teaching performances. In fact, teachers' professional growth should always be redefined through continuous training. Similarly, teachers are responsible architects of learning, and it is a prerequisite that they should always be professionally competent (Azuelo, et al., 2018).

Thus, this study sought to determine the relationship among the usage of laboratory equipment, instructional materials, and the competence of the Science teacher with the academic performance of selected Filipino High School students through a quantitative study. The fact that hands-on demonstration through the utilization of laboratory equipment, availability and use of instructional materials and competent Science teacher is empirical to the success of teaching this subject, does the inadequacy of any of these factors affect the academic performance of the learners? With a vague reality looming in the Philippine academe setting with the scarcity of laboratory equipment, can we really consider public school learners at a disadvantage as far as acquisition of learning and academic performance is concerned in the field of Science? Can other instructional materials compensate for this inadequacy? Do having competent teachers enough to let the students understand Science concepts?

Methodology

Research Design and Participants

This study used Explanatory Correlational Design which sought to extend the relationship two or more variables have towards one another. It reveals that changes in one variable echo the changes in another. In this study, the method used will uncover the degree to which the usage of laboratory equipment, instructional materials and the competence of the Science teacher relates with the academic performance of selected Filipino High School students. Quantitative-descriptive Approach was also utilized to highlight the gathering of numerical raw data in order to clarify a particular phenomenon. This will unravel the relationship between variables with a population. Quantitative research likewise incorporates statistical exploration of data accumulated through various techniques by utilizing a range of computational practices according to USC Libraries (2019).

The participants of the study include 93 Grade 10 Filipino High School students in a state university in the Philippines. Cluster sampling is used in the conduct of this study and is accomplished by subdividing the total population into groups, then randomly selected the respondents. These groups referred to as clusters are utilized when mutually identical, yet internally varied groupings are evident in the statistical population. As such, this research is conducted to establish if usage of laboratory equipment, various instructional materials and competencies of the Science teachers really matter in the academic performance of the participants.

Instruments and Data Analysis

The researchers-made instrument which was tested for reliability has four sections intended for instructional materials, laboratory equipment, distribution of laboratory equipment to the stu-

dents, and assessment for teachers' competence. Relevant data collected were tabulated, analyzed, and interpreted to obtain a reliable basis where significant conclusions were drawn, and recommendations were elicited. Frequency and Percentage Distribution Method was utilized to assess the respondents' demographic information in exhibiting the selected respondents' 1st to 4th quarter grades in Science. The Arithmetic Mean was used to determine the average data gathered.

Pearson correlation was also used to measure the degree of relationship between linearly related variables. This was very functional in answering the relationship of the given variables in the study. To ascertain the correlation between variables, the p-value is related to the significance level (denoted as alpha) of 0.05.

Results

The general results of this study revealed that there is no significant relationship between laboratory equipment, instructional materials and the teacher's competence in Science to the academic performance of selected Filipino High School students in the Philippines.

Table 1. Frequency and Percentage of the General Average in Science

General Weighted Average	Frequency	Percentage	Verbal Interpretation
75 and below	0	0	Poor
76-80	16	17.20	Fair
81-85	30	32.26	Satisfactory
86-90	41	44.09	Very Satisfactory
91 and above	6	6.45	Outstanding
Total	93	100	

The study shows that 44.09% of the respondents performed at an above average level or Very Satisfactory for the four quarters of the academic year when the study was conducted. This implies high comprehension of the Science concepts being taught to them. Meanwhile, 32.26% of the respondents reached satisfactory level in their academic performance likewise implying that they have grasped the concept being imparted by the Science teacher. While 17.20% attained Fair level of performance suggesting that only a few students were gradual in grasping Science concepts. Meanwhile, 6.45% shows slight percentage of students who were very keen in absorbing Science learning. Results show that the respondents belonging to a heterogeneous group of students exhibiting a wide range of learning styles that is beneficial to students' satisfaction in learning (Wang, 2013).

Table 2. Frequency of Usage of Instructional Materials

Instructional Materials	Weighted Mean	Verbal Interpretation
Printed Materials (textbooks, modules, articles, activity sheets, etc)	3.51	Always
Visual Aids (pictures, graphs, charts	3.42	Often
Projectors	3.32	Often
Television	1.65	Rarely
Video Tapes	2.05	Rarely
Audio Materials	2.37	Rarely

Instructional Materials	Weighted Mean	Verbal Interpretation
Internet	2.75	Often
Powerpoint Presentation	3.58	Always
Display board (Whiteboard, Chalk board)	3.80	Always
General Weighted Mean	**2.94**	**Often**

The most frequently used Instructional Material is still the traditional Blackboard/Whiteboard which unveils that despite the advancement of technology as far as Instructional Material is concerned, the traditional method used is here to stay. It has and will always be an effective means to impart knowledge to the learners. According to Yale Poorvu Center (2018) chalkboards and whiteboards are arguably the most popular device associated with teaching. Students learn better by having information presented through multiple modalities, especially through visual means, and boards are perhaps the simplest visual teaching tool.

The use of the more modern Projectors for teaching reveals likewise that it is always used by the teacher in their Science Class. Although the board & chalk may still be the most popular, use of these devices are an excellent supplement in the transfer of learning. According to Panasonic Business (2018) with the use of advanced projectors at Tillburg University, the learning atmosphere that is being fostered in the classroom is enhanced. Students felt increased involvement in the material being discussed. Imagination is heightened and information becomes more vivid resulting in a more inspired learning experience that is lacking in conventional lectures. Consequently, the outcome is increased student satisfaction and successful transfer of learning.

Printed Materials such as textbooks and activity sheets aid in the teaching-learning process. It signifies that these materials are always used. Textbooks, activity sheets, modules and other printed materials will always be an effective means to transfer knowledge. In the study of Onyilagha and Nnajiofor (2016) reveals that in the traditional classroom, there is now the presence of technology. As such, PowerPoint presentations and other technological devices aid in the efficient delivery of instruction in a conventional type of classroom while cultivating the students' comprehension. The same study reveals learning can be established and recalling lessons can be furthered if learners are presented with instructional resources which are specifically designed to conform to the purpose of the lesson and characteristics of the users. Ambiguity should be avoided in the instructional materials specially the printed ones and it should precisely offer the content it intends to deliver.

Table 3. Frequency of Usage of Laboratory Equipment

Laboratory Equipment	Weighted Mean	Verbal Interpretation
Microscope	2.24	Rarely
Weighing Scale	2.25	Rarely
Graduated Cylinder	2.52	Often
Periodic Table Chart	3.29	Often
Mortar and Pestle	1.70	Rarely
Petri Dish	1.55	Rarely
Bunsen Burner	1.53	Rarely
Thermometer	2.23	Rarely
Beaker	2.12	Rarely
Flash	2.04	Rarely

Laboratory Equipment	Weighted Mean	Verbal Interpretation
Watch Glass	1.80	Rarely
Alcohol Burner	1.58	Rarely
Electric Conductivity Apparatus	1.70	Rarely
Iron Stand	1.48	Never
Hooke's Law apparatus	1.60	Rarely
Vernier Caliper	1.57	Rarely
Tuning fork	1.51	Rarely
Compass	2.03	Rarely
Pendulum	1.60	Rarely
Kitchen balance	1.55	Rarely
Lens double concave	1.45	Never
Triple Beam balance	1.51	Rarely
General Weighted Mean	**1.84**	**Rarely**

This study emphasizes the respondents' gauge on the usage of the different laboratory equipment in their Science Class. Even though Science instruction insinuates the use of these laboratory equipment, the teacher facilitator cannot do much due to the scarcity of these materials. The table above shows the rarity on the usage of laboratory equipment during science classes which greatly affects the students' familiarity on the equipment that should serve as aids in their studies. A similar study conducted by Ashebir and Bereket (2016) found that standards of laboratories in Southern Ethiopian schools were inferior. Moreover, there is one common laboratory facility for the entire secondary sections in most of their schools creating an overcrowded and congested laboratory room which results to clashes in laboratory activities and programs, thus, the period to conduct lab activities allotted for each of the Science disciplines is restricted. Therefore, learning can be constrained due to this factor.

Supplemental Materials such as video and audio presentations that mimic procedures and processes done in the laboratory have the potential to be a worthy complement to hands-on laboratory experience but not as a substitute for them according to ACS Chemistry for Life (2017). Hence, they uphold continued investments to furnish the necessary equipment and facilities, support enhancement of curricula and professional growth of teachers needed for efficient laboratory involvement from preparatory grade to tertiary level of education.

Table 4. Distribution of Laboratory Equipment during Science Experiments

Distribution of Laboratory Equipment during Science Experiments	Weighted Mean	Verbal Interpretation
Have the chance to use laboratory equipment alone	2.59	Often
Use of laboratory equipment is allotted by pair	2.94	Often
Three or more students use the laboratory equipment during Science activities	3.03	Often
The leader is the sole user of laboratory equipment	1.73	Rarely
General Weighted Mean		**Often**

This study also revealed the poor distribution of laboratory equipment to the students in the class. Although the general weighted mean generated 'often' as its verbal interpretation, this indicates that there is a shortage of laboratory equipment in most public schools in the Philippines. Visperas (2011) stated that what is even more disgusting is the countrywide ratio of learners to science laboratories which stands at 1,325 students to one laboratory. Due to this, high school students' performance and concentration in science is dismal. According to a Blog on Philippines' Department of Education - DepEd (2017) teaching Science is challenging because of the high costs associated with its laboratory component. With very restricted finances, furnishing schools for science laboratory classes can be absolutely impeded.

DepEd's declaration of changing the face of basic education in the Philippines so that it meets the requirements and challenges of 21st century learning can be properly measured by its actions. This is regrettably the case not only for the laboratory element of science instruction, but also in the curriculum as a whole. The government is miserably besieged by corruption especially by some incompetent leaders in authority. This shows DepEd's ineffectiveness and ineptitude as far as resourcefulness is concerned.

Table 5. Respondents' Perception on the Competence of Teacher in Science Instruction

The Teacher Factor	Weighted Mean	Verbal Interpretation
Gives timely feedback of activities	3.55	Strongly Agree
Uses teaching methods that enhance learning (discussion, demonstration, lectures, etc.)	3.74	Strongly Agree
Makes appropriate use of technology	3.62	Strongly Agree
Maximizes the use of class hours effectively	3.73	Strongly Agree
Explains the lessons in ways students can understand	3.81	Strongly Agree
Makes use of different types of assessment to ascertain learning	3.71	Strongly Agree
General Weighted Mean	3.69	Strongly Agree

Table 6. Significant Relationship Between Laboratory Equipment, Instructional Materials and Competence of the Science Teacher with the Academic Performance of Selected Filipino High School students

Factors	Pearson Correlation	p-value	Decision	Remarks
Instructional Materials	-.070	.505	Accept Ho	Not Significant
Laboratory Equipment	-.097	.356	Accept Ho	Not Significant
Ratio of Laboratory Equipment to Student	-.115	.272	Accept Ho	Not Significant
Teacher Competence	-.036	.729	Accept Ho	Not Significant

As for the competence of the Science teachers, results of the study implied that the they are effective and competent as perceived by the respondents in carrying out the lessons inside the classroom. In the study of Azuelo, Sariana, & Manual (2014) disclosed that it is thereby critical that in

Science instruction, the teacher has the expertise in the different principles involved in its concepts as it underlies competencies that would foster the learners' skills in the subject. The planned professional development to support teachers in applying approaches in learning is therefore essential to continuously nurture their cognitive skills which in effect would prove to be a successful tool in the learning process.

According to Daehler (2016) in the article, "*The Key to Good Science Teaching*," an effective Science lesson necessitates planning engaging activities, traversing complex concepts, anticipating, and working with students' prejudices and biases. Good teaching is an art performed by those with specialized understanding and abilities.

Results of this study made it clear that the above mentioned factors: Instructional Materials, Laboratory Equipment, Ratio of Laboratory Equipment to Students, and Teacher's Competence obtained p-values more than the 0.05 level of significance, thus, accepting the null hypothesis signifying there is no significant relationship between Instructional Materials, Laboratory Equipment, and Teacher Competence to the Science Academic Performance of the respondents.

Thus, this study revealed that despite the scarcity of laboratory equipment and its uneven ratio with its student users, academic performance is still high. This is due to the fact that the inadequacy of equipment is supplemented by other instructional materials which can either be traditional or technological in nature. This, coupled with a competent teacher who is dedicated to her craft and addresses the students' need to acquire vital learning is more than enough to reinforce the academic performance of the learners. Pareek (2018) similarly showed that laboratory facilities are highly inadequate in secondary schools in India, far below the expectation, and in most of the schools, science experiments are not being conducted. This study also revealed that there is no assessment of Science's practical activities, but this does not contribute directly to the measurement of students' academic performance in science. In order to equalize this, it was suggested that Science teachers be more resourceful by providing support materials for Science teaching and learning so that students learn by doing, develop thinking skills, and attempting to do innovations.

Conclusions and Recommendations

The use of Instructional Materials as resources for learning is an effective means to supplement the lack of laboratory equipment. These instructional materials are a combination of both the traditional and technological methods used in classroom teaching. The traditional board and chalk have been proven to still be an effective means of teaching. The insufficiency of laboratory facilities may hamper a student's access to hands-on investigative activities but should not become a barrier to learning the different Science concepts. Results of the confirmed that the competence of the sscience teachers is an effective ingredient in the successful transfer of learning despite the problem in the numbers of laboratory equipment which are supposedly part of the learning process in science. It can be drawn that a teacher who is adept in cognitive skills in this area of discipline compensates for the insufficiency of the materials for hands-on learning. In a nutshell, this study has found out that there is no significant relationship between the usage of laboratory equipment, instructional materials, and competence of the Science teacher to the academic performance of the selected Filipino High School students. Regardless of whether or not students utilized laboratory equipment, they can still show good performance in their Science class with competent teachers who utilize appropriate instructional materials in teaching science ideas. Nevertheless, the researchers strongly recommend for the educational institutions to pay attention on the instructional materials and the upgrade in both number and quality of laboratory equipment to be used by the students and

teachers and invest on quality trainings for science teachers as they continue tracing the path to quality education.

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