Increasing Academic Performance on Earth Science Among Grade 9 Learners through Developed Self-Learning Materials

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A B S T R A C T

This study investigated the effectiveness of utilizing self-learning modules as a tool in increasing academic performance in Earth Science among Grade 9 learners. The researcher used purposive sampling, choosing 18 respondents as experimental group that are subjected to the intervention. Using paired t-test and Mean Percentage Scores, the pre-test scores of the students are described as Moving Towards Mastery. The post-test scores of the students may be described as Closely Approximating Mastery by the interpretation of the scores of DepEd (2012) under Memorandum No. 160. It showed that the experimental group for the pre-test and post-test got 0.001 which is lesser than 0.05, this indicates that the students' performance was better than the pre-test after using developed self-learning materials

INTRODUCTION

For the past years, countless studies shown the consideration of making intervention materials in developing deeper understanding in various subject areas, more importantly the science subject. Due to the fact that based on the studies globally shows that majority of students do not have an informed understanding of key aspects of the science subject. These studies revealed there should be more interventions in addressing the difficulty of student that would help them to perform better. Thus, the implementation of self-learning materials in secondary education has necessitated the needs of the students.

This study investigated the effectiveness of utilizing self-learning materials such as self-learning modules as a tool in increasing academic performance in Earth Science among Grade 9 Learners of a public high school. After pre-observation was conducted, a 50-item multiple choices pre-test was administered before the intervention, and a post-test was administered with the same set of questions after the intervention has been used. A purposive sampling technique was used to choose respondents that would answer the questionnaires. There are a total of eighteen (18) students coming from the Grade 9-Pearl that opted online mode of learning. The researcher-made instrument consists of (50) items test. Data were analyzed using the criterion reference test and t-test to get the interpretation of the study. Criterion Reference was used to interpret the students' skill level during the pre-test. On the other hand, Paired Sample T-Test was used to compute the post-test result against the result of the pre-test, to determine whether there was an increase in academic performance in Earth Science among the Grade 9 learners before and after the intervention. Frequency and Percentage were used in gathering the scores of Grade 9 learners. Descriptive statistics of the pre- and post-test results using mean percentage score are also used.

This action research aims to use developed self-learning materials in increasing academic performance of Grade 9 students in Earth Science. Specifically, the researcher sought to answer the following questions as how may the student's academic performance be described in terms of the score in pre-test and score in posttest, is there a significant difference between the scores in pre-test and post-test results of the Grade 9 learners subjected to the developed self-learning materials, what is the implication of developed self-learning materials in increasing the academic performance on Earth Science among Grade 9 learners, and what intervention plan may be developed from the findings of the study.

The main purpose of this study centers on the use of developed self-learning materials such as modules in increasing the academic performance of Grade 9 learners in Earth Science. Data collection would be limited on the pre-test, post-test. It is limited to on the time period of the third grading. This study is conducted at a public high school for Grade 9 students who are currently taking Earth Science subject. Participants shall be selected without considering any factors such as gender, age, and academic stands. The approach utilized is a test-based to determine whether there are significant difference scores in

conducting the pre-test and post-test. This study is limited only to the students who opted online learning modality.

LITERATURE REVIEW
Difficulty in Understanding the Sciences

A study of Prabha (2020) showed the difficulty of students in conceptually understanding science subject among students with a population sample of 920 students across 23 schools in five states of India. They found out on their study that there should be more interventions in addressing the difficulty of students. Moreover, a study by Gyllenpalm et al. (2021) in Sweden to Grade 7 and Grade 12 students shows that majority of students do not have an informed understanding of key aspects of scientific inquiry. The average result for Grade 12 students is 50% lower than average although they are more informed.

Creation of Science Modules

In connection, Budi et al. (2018) made used of SETS (Science, Environment, Technology and Society) to determine feasibility and effectiveness of Natural Science Module. As a result, it showed the achievability of the module development result based on the assessment of experts for the SETS approach for learning to improve students critical thinking ability. Moreover, several studies have shown that, the ability to use technology and information that involves self-thinking and problem solving independently, greatly helps students in terms of developing their critical thinking competencies. Nationally, a study of Cubillas (2020) considered designing a contextualized learning material in developing understanding of Grade 7 students as a teacher support material.

Independent Learning

Hence, a similar study conducted by Acosta (2020) stated wherein he recommended for teachers to formulate strategic intervention materials that will aid the students to study on their own pace and convenience. Locally, the study of Perez (2020) revealed that students and teachers affirm to the effectiveness of teacher-crafted worksheet that will help the students to perform better compared to those who are not exposed to the intervention. Constructivist methods are epistemological positions that consider knowledge to be constructed. These methods are focused on analyzing single processes or functions (Science Direct, 2021). Moreover, students develop their own knowledge and understanding, according to this learning model (IGI Global, 2021).

Thus, the researcher investigated the efficacy of developed self-learning materials among Grade 9 science students in increasing academic performance in Earth Science.

Academic Performance

The word academic performance is closely connected to two words: academic and performance. Academic are "Broad, powerful organizing ideas that have relevance both within and across subject areas" (IBO, 2015). On the other hand, performance is defined as construction of an accurate and stable representation of any situation we encounter; it can be for something concrete, like an item or a phenomenon, or it can be an abstract, like a notion. Therefore, we can say that academic performance are representations referring to a concept, as a group of ideas with regularities or patterns (Meli,2019).

Earth Science

According to Britannica (2022), Earth sciences refer to the study of the solid Earth, its seas, and the air that surrounds it. The geology, hydrologic, and atmospheric sciences are also covered. Earth Science is the study of the Earth's structure, qualities, processes, and four and a half billion years of biotic development is known as Earth science. Understanding these occurrences is critical to the survival of life on Earth (National Science Foundation, 2021).

Self-Learning

Self-learning is defined as a method of garnering information and after processing and retaining it without taking the help of another individual. It is the responsibility of the learner to learn and hold on to the knowledge without the help of another human resource. It is a modern way of learning that helps a person to teach himself skills and knowledge that will prove relevant to his daily activities (Skilling India, 2020). Students who self-learn, essentially teach themselves. Instead of having a concept explained to them, they use instructions, context clues, and examples to figure out the answer on their own. When a student develops the ability to self-learn, they can study any subject confidently (Kumon, 2018). While Olteanu et al., (2014) study formulated an Integrated Science Modules that were carried out in the classroom as a functioning Learning Science Method. Nevertheless, the study of Setiawan et al. (2017) showed that developing science learning module is suitable to refine the ability of science literacy of students. Additionally, it is founded on the premise that students are active participants in their own learning; knowledge is built through experiences (Educational Technology, 2021).

Framework of the Study

The researcher used the Independent-Dependent Variable model. This approach is composed of interrelated elements that served as a guide for the researcher in solving the problem under investigation. The figure below shows that the independent variable is the use of developed self-learning materials (Self-made modules). The Independent variable is who influences the dependent variable. Then the dependent variable is the Grade 9 students who are currently enrolled this year 2021-2022. The Independent variable is the researchers' aim to understand and describe the dependent variable. This utilized the pre-test post-test format in which the same assessment measures are given to participants both before and after they have received treatment or been exposed to a condition, with such measures used to determine if any changes could be attributed to the treatment or condition.

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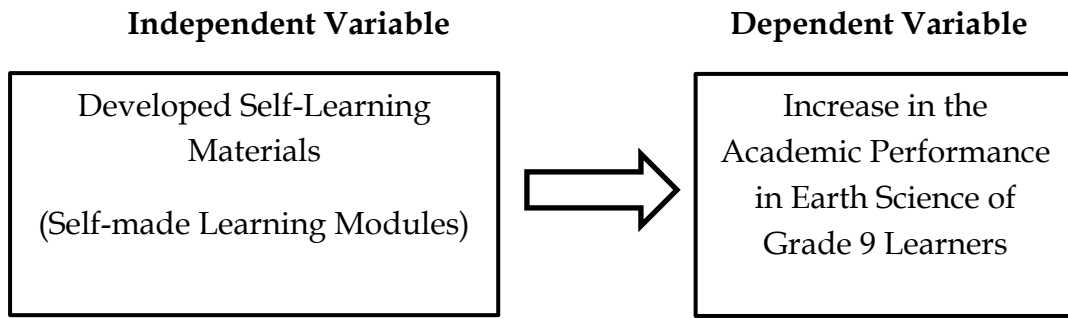
Independent Variable		Dependent Variable
Developed Self-Learning Materials (Self-made Learning Modules)	→	Increase in the Academic Performance in Earth Science of Grade 9 Learners

Figure 1. The Research Paradigm of the Study

Hypothesis

H_0: There is no significant difference between the scores in pre-test and post-test results of the Grade 9 learners subjected to the developed self-learning materials.

METHODOLOGY

Research Design

This study made use of pre-experimental research design, specifically, the one-group pretest-post-test research design. In pre-experimental research design, either a group or various dependent groups are observed for the effect of the application of an independent variable which is presumed to cause change. It is the simplest form of experimental research design and is treated with no control group. This research design combines both post-test and pretest study by carrying out a test on a single group before the treatment is administered and after the treatment is administered. With the former being administered at the beginning of treatment and later at the end (FormPlus, 2021).

Data Gathering Procedure

The researcher made use of a 50-point pre-test to be given at the start of third grading period and post-test before the summative examination to quantify the knowledge learned in class of Grade 9 students in academic performance on Earth Science. The pretest was conducted a week before the intervention was given, intervention lasted for almost 1 month after the pre-test and post-test was administered the week after the intervention. Before administering the pre-test, the researcher sought consent approval from the science teacher and students who would be the respondents coming from Grade 9-Pearl (Online mode of learning) students in a public high school. In terms of the respondents' profile, the researcher gave the Google form link for the questionnaire. The gathered data was then scored, tallied, analyzed, and interpreted. They answered on a Google form provided since it is the means that all students are familiar with. It is a free application that allows you to quickly create and distribute a form to gather information, create surveys and quizzes. Also, it is a Google web-based versatile tool that can allow to easily gather information on the created test and surveys which is convenient and not time consuming after all. The students were given a link to the questionnaire with the profile of respondents.

Respondents

The participants came from the Junior High School Grade 9 students who are enrolled at public high school for the A.Y. 2021-2022 that are taking up Earth Science subject primarily opted for an online modality. A selected number of experimental groups is a total of 18 respondents in Grade 9-Pearl that are using the synchronous online modality setup.

Sampling Method

The researcher used purposive sampling. Purposive sampling, also known as judgmental, selective, or subjective sampling, is a type of non-probability sampling in which researchers choose people from the public to participate in their surveys based on their own judgment (Alchemer, 2021).

In this study, the researchers' experience and knowledge about the population were used to hand pick and select the respondents. The researcher ensures that the selected respondents are knowledgeable, have expertise with online learning and are all eager to answer the questions.

Research Instrument

The researcher utilized a 50-item multiple choice type of test which is about the selected learning competency in third grading Science 9:

Table 1. Learning Competencies

Learning Competencies	LC Code
1. describe the different types of volcanoes;	S9ES –IIIa-25
2. differentiate between active and inactive volcanoes	S9ES –IIIa-27
3. explain what happens when volcanoes erupt	S9ES –IIIb-28

The researcher administered 50–item multiple choice type of test which is created from selected learning competencies that are aligned with the curriculum guide. To ensure the number of items per learning competency's appropriateness, a table of specification is utilized and used in this study. It also means that using a table of specifications ensures that a test or assessment evaluates the material and thinking skills that the test is intended to evaluate. The structured questions for both the pre-test and post-test were derived from the third-quarter Science Learning Modules for Grade 9 Science and were aligned to the statement of the problem to determine the effectiveness of developed self-learning materials in an online modality set-up. The pre-test/post-test were all encoded in Google Forms and were disseminated to the respondents through a system-generated link sent via Messenger chat and Chat Pane of Google meeting platform.

Validation of Instrument

The validation of instrument was checked by the Field Study Adviser, Cooperating Teacher and Head Teacher I of the Science Department of a public high school. Consultation of the questionnaires were sought. The comments and recommendations given by the instructors and other experts to further help the researchers in polishing the survey questionnaire before administering the instrument to the respondents were taken into consideration.

Data Analysis

For the statistical treatment of the data, the researcher made use of the following tools: Microsoft Excel spreadsheet and Statistical Package for Social Sciences Version 20 (SPSS v.20).

a. Frequency and Percentage Distribution were used for pre-test and post-test scores. The mean scores (M) and standard deviations (SD) were employed to determine the level of the performance of students during the pre-test and post-test.

b. Descriptive statistics of the pre- and post-test results using mean percentage score, and;

c. Paired T-test were used for this study. Paired T-test was used to determine the significant relationship between pre-test and post-test scores of Grade 9 Learners before and after utilizing developed self-learning materials (self-learning modules) in the class. A t-test is an inferential statistic that is used to see if there is a significant difference in the means of two groups that are related in some way (Investopedia, 2021).

Based on the total scores, the increase in academic performance in Earth Science among Grade 9 Learners using developed self-learning materials are quantified as follow as per DepEd (2012) under Memorandum No. 160. The assessment results are conveyed to data users in terms of Mean Percentage Scores (MPS) and its descriptive equivalent for data utilization (e.g. intervention) by school, division, regional, and national levels. Specified below is the mastery/achievement level:

Table 2. Mastery/Achievement Level

MPS	Descriptive Equivalent
96-100%	Mastered
86-95%	Closely Approximating Mastery
66-85%	Moving Towards Mastery
35-65%	Average
15-34%	Low
5-14%	Very Low
0-4%	Absolutely No Mastery

RESEARCH RESULT

Table 3. Descriptive Statistics of the Pre- and Post-Test Results of the Respondents

	MPS	REMARKS
Pre-Test	69.56	Moving Towards Mastery
Post-Test	88.66	Closely Approximating Mastery

It could be seen in Table 3 that the pre-test scores of the students may be described as Moving Towards Mastery (MPS = 69.56). The post-test scores of the students may be described as Closely Approximating Mastery (MPS = 88.66) by the interpretation of the scores of DepEd (2012) under Memorandum No. 160.

Developed self-learning materials were found to be efficient and an effective tool in improving the scores of the students. Hence, garnering significant increase in scores when exposed to the intervention material (Perez, 2021). In connection, according to the study of Acosta (2020), spending time and effort in crafting intervention materials to aid students understand the lesson amidst trying times like pandemics, suspension of classes due to typhoons or weather disturbance, holidays and at time when they are inside the comfort of their homes would pave way for the improvement and development of the involved learners.

Table 4. Difference Test on Pre- and Post-Test using Paired Sample T-test

Paired t-test							
Pair	N	Mean	Std. Deviation	Std. Error Mean	t value	Sig≤0.05	Decision
Experimental Group (Pre-test) and Experimental Group (Post-test)	18	-9.556	4.997	1.178	-8.113	<.001	Significant

It could be seen from the data presented in Table 4 that the eighteen (18) students who are the experimental group for the pre-test and post-test got 0.001 which is lesser than 0.05, this indicates that the students' performance was better than the pre-test after using Developed Self-Learning Materials (Self-Learning modules created by the researcher). Thus, the data also shows that there is a significant difference between the scores in pre-test and post-test results of the Grade 9 learners subjected to the developed self-learning materials at a public high school.

Furthermore, the claims of Cubillas (2020) anchor the study of the researcher that by using contextualized learning material in developing conceptual understanding as a teacher support material would deem significant

difference between the pretest and posttest scores of students. The study of Shivarahu (2017) reveals that there was a significant improvement in the learners after post testing them compared to administering pretest. This indicates that students were able to gain more conceptual understanding by the end of the semester. Consecutively, according to Sage Publications (2017), the result of their study deems a higher posttest score compared to the pretest score, which hypothesizes the study was statistically significant.

Since there is a significant difference in this study, it can be said that the developed self-learning Materials, which is in the form of self-made modules by the researcher utilized is functional in the virtual or online mode of learning to be a supplemental or additional means of increasing the academic performance of students. In conclusion, this study implies that developed self-learning materials can be utilized as an effective tool in increasing the academic performance on Earth Science among Grade 9 learners. As per the study of Sudarmin (2017), it only shows that modules that has been developed marks appropriate to be used by science teachers as materials to be an aid for the learning process and has a purpose of improving the skill, more importantly the scientific literacy of junior high school students.

The implementation of developed self-learning materials was successful, and the students' feedback are always there. Some of the feedback was the use of aesthetically well-designed learning materials and entertaining in a way that it catches the attention and interest of the readers by seeing catchy graphical representations and colorful pictures that are related to the lesson proper. This study proved that developed self-learning materials such as self-learning modules helps in increasing academic performance in Earth Science among learners subjected to the intervention.

DISCUSSION

Based on the findings of the study, the Grade 9 students at a public high school showed a positive response in terms of the effectiveness of using developed self-learning materials in increasing the academic performance in Earth Science because based on their pre- and post-test mean percentage scores from *moving towards mastery* it became *closely approximating mastery*. The significant level of 0.001, which is lesser than 0.05 in the Paired Sample T-test showed statistically significant data that describes a significant difference between the scores in pre-test and post-test results of the Grade 9 learners subjected to the developed self-learning materials at a public high school. This meant that using developed self-learning materials such as self-learning modules created by the researcher as a learning intervention for the students to increase their academic performance in Earth Science was effective.

The study has explored the effectiveness of using developed self-learning materials as an intervention material in contributing to the scientific literacy of students at a public high school. The result of the study would be the basis for the formulation of a proposal to implement further formulation of creative and interactive self-learning materials in teaching Earth Science for the enhancement of scientific literacy of Grade 9 students.

CONCLUSIONS AND RECOMMENDATIONS
Conclusions
Based on the findings, the researcher concluded the following:
1. The pre-test result is described as Moving Towards Mastery and the Mean Percentage Score (MPS) of the post-test result may be described as Closely Approximating Mastery by the interpretation of the scores of DepEd (2012) under Memorandum No. 160.
2. The 0.001 significant level, which is lesser than 0.5 in the Paired Sample T-test showed statistically significant data, which mean that there is a significant difference between the scores in pre-test and post-test results of the Grade 9 learners subjected to the developed self-learning materials
3. This study implies that developed self-learning materials can be utilized as an effective tool in increasing the academic performance on Earth Science among Grade 9 learners.
4. The intervention plan that may be developed from the findings of the study is to propose a training for science teachers like seminars/webinars, workshops, pre-service and in-service training programs for teachers' professional learning that would be anchored in the formulation of effective and functional self-learning materials that would help to improve and increase the academic performance of students regarding to the science subject.

Recommendations
Based on the conclusions, the following recommendations are made:
1. For the Grade 9 students, they should always cooperate and participate in the class and use the intervention materials given their science teachers to improve and increase their academic performance in Earth Science, especially in Volcanoes.
2. For the science teachers, they may implement several self-learning materials made by them, using their own creativity and imagination, to create an engaging, interactive and interesting self-learning materials that may help them supplementing knowledge that are also anchored in the Most Essential Learning Competencies (MELCs) and Curriculum Guides.
3. For the administrations of the DepEd schools, they may conduct trainings like seminars/webinars, workshops, pre-service and in-service training programs for teachers' professional learning that would be anchored in the formulation of effective and functional self-learning materials that would help to improve and increase the academic performance of students regarding to the science subject. Also, the paper sought to implement developed self-learning materials as an intervention material to increase the academic performance in Earth Science among Grade 9 learners in a public high school.

ADVANCED RESEARCH

For future researchers, they may conduct a similar study that would make better results prior to this paper with the common goal of improving the scientific literacy of Grade 9 students. They may also implement the study for a longer period to achieve more accurate and expanded results. They may also replicate this study in other schools to further verify, amplify or negate the findings of the study.

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