Acquired Basic and Integrated Science Process Skills and Academic Performance in Earth Science of Grade 11 Students in a Philippine Public High School

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ABSTRACT. The Philippine Department of Education requires Science Process Skills (SPS) to be incorporated into studying or teaching science at all levels of learning in basic education. This study investigated the relationship between the level of acquired basic and integrated Science Process Skills (SPS) and academic performance in Earth Science of Senior High School STEM students. Through descriptive and inferential analyses, the result showed no significant relationship between acquired integrated science process skills and academic performance in Earth Science. However, a significant relationship between acquired basic science process skills and academic performance in Earth Science was yielded. The findings revealed that students must first develop a strong foundation in basic science process skills to develop more advanced science process skills. Hence, the task cards, as supplementary instructional materials, may provide students with a structure to focus their search and strengthen their independent learning skills.

1.0. Introduction

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) highlighted science as the most important channel of knowledge as it generates solutions for everyday life (Lewis et al., 2021). Scientific literacy enables the public to make informed decisions and keeps science in line with society. This is also in line with the K-12 Science Curriculum's goal of empowering science and technology students to holistically develop their scientific, environmental, and technological literacy to meet the country's needs for better science and technology human resources (Department of Education [DepEd], 2016). Learning science enables the growth and enhancement of students' aptitudes, focusing on acquiring knowledge and competencies that enable students to articulate and assess scientific knowledge (Heitmann et al., 2017).

Learning the fundamental ideas and methods of research is crucial to studying science as a learning area. The activities that scientists engage in while researching and investigating are called science process skills (SPS). Scientists, teachers, and students all use certain ways of thinking when they do science, such as perceiving, categorizing, conversing, assessing, making judgments, and predicting outcomes (Maranan, 2017). The growth of students' cognitive abilities and their capacity for active participation in the instructional process are significantly aided by acquiring skills related to the scientific method. It gets students interested in learning how to think and shows them how important it is to teach process skills (Batisla-Ong, 2021).

These process skills are crucial factors that may impact the success of students. SPS is essential for enhancing students' cognitive growth and supporting active engagement in teaching and learning, especially in science subjects (Firmansyah & Suhandi, 2021). The International Student Assessment (PISA) of the Organization for Economic Co-operation and Development (OECD, 2018) reported that Filipino students ranked the lowest in science and mathematics among 79 countries (DepEd, 2018). The test examined how well a 15-year-old can use scientific knowledge to ask questions, learn new information, explain scientific phenomena, and conclude about science-related issues based

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on evidence. The outcome demonstrated the critical need to overcome issues and gaps to provide Filipino students with a quality education at the most fundamental level.

In 2019, according to an international survey conducted by Trends in International Mathematics and Science Study (TIMSS), 13% of Filipino students met the low benchmark, indicating that they had a limited understanding of scientific concepts and limited knowledge of foundational science facts, while 87% did not even reach this level. Similarly, based on the result of the National Achievement Test (NAT), the performance of Filipino students gravitates toward low proficiency levels, especially in Science and Mathematics (Batisla-Ong, 2021). This is also evident in Grade 11 entrants, who got below-average scores, based on the Department of Education (DepEd, 2016), in the Qualifying Exam for aspiring STEM students in one of the Senior High Schools of a very large secondary school in a component city in Central Philippines. The aptitude of students in STEM programs shall be measured to ensure that they have the potential to complete the program. Students' mastery of science concepts and SPS must be evident. They must become independent learners by developing their process, logical, and critical thinking skills (DepEd, 2016). As educational systems resume operations after the pandemic crisis and two years of remote learning, there must be a shift in how learners learn and perceive learning (Cahapay, 2020).

Recent studies on SPS focus more on students' cognitive performance that may be improved by fostering basic SPS and a positive attitude toward science (Maranan, 2017), SPS and student attitude toward physics (Kimba et al., 2021), the relationship between students' SPS and scientific attitudes toward technology pedagogical subject knowledge (Juhji & Nuangchalerm, 2020), a comparison of the current state of laboratory resources and SPS (Noroña, 2021), and acquisition of SPS by students in senior secondary school through alternative learning modalities (Gastar & Linaugo, 2022). However, a handful of studies have delved into the relationship between SPS level and academic performance of Grade 11 STEM students in Earth Science.

Hence, this study investigated the relationship between acquired SPS in the basic and integrated skills and academic performance in Earth Science of Grade 11 STEM students. Also, the findings of this study may provide a basis for a proposed supplementary instructional material.

2.0. Framework of the Study

This study theorizes that the level of acquired basic and integrated science process skills is associated with the academic performance in Earth Science of the students and may differ in terms of their sex and family monthly income.

This study is primarily anchored on Cognitive Development Theory by Piaget (1936). Mainly, it emphasizes learners' active engagement in building their worldview via interactions with their surroundings. It suggests giving students tangible, contextually significant experiences. This learning opportunity lets students find patterns, ask questions, model, analyze, and defend their ideas and techniques. It also proposes tailoring education to learners' cognitive ability at each step. Science educators may help students acquire meaning and skills by giving them the right learning experiences.

Relating the theory to the present study, cognitive development, in which students actively engage in their learning tasks by doing and experiencing, is the main focus of the science curriculum. Students are expected to comprehend the fundamental scientific principles relevant to everyday life. In this kind of education, the duties of teachers include not only instructing students in scientific concepts but also concentrating on the development of expertise in SPS (Hirca, 2015). Furthermore, this theory can be a basis for creating a framework for creating helpful classroom strategies and materials that could positively impact the acquisition of science process skills of students and their academic performance.

3.0. Methodology

This study used a quantitative research design utilizing descriptive, comparative, and correlational research approaches to determine the level of acquired basic and integrated science process skills and academic performance in Earth Science in a public senior high school. The descriptive-comparative approach described and compared the level of acquired basic and integrated science process skills and academic performance in Earth Science when participants were grouped according to sex and family monthly income. On the other hand, the correlational approach was used to determine the relationship between the acquired science process skills and academic performance.

The participants of this study were a total of 205 Grade 11 students taking the subject Earth Science under the Science, Technology, Engineering, and Mathematics (STEM) strand of the Senior High School of a very large secondary school in a component city in Central Philippines for the School Year 2022-2023. The researcher identified the participants through stratified random sampling to get a sample representative for each section in the STEM strand. Table 1 shows the distribution of the participants.

Table 1
Distribution of Respondents

Grade 11 STEM Students	N	n	%
Atom	52	34	25.37
Cell	52	34	25.37
Feldspar	50	33	24.63
Vector	51	33	24.63
Total	*205*	*134*	*100*

Science Process Skills Test. Rabacal (2016)'s 55-item Science Process Skills Test (SPST) is used to assess basic and integrated SPS. The questionnaire consists of two sections. Section I is a 30-item test on basic science process skills, including five questions for each of the following skills: observing, inferring, measuring, communicating, categorizing, and predicting. Meanwhile, section 2 consists of a 25-item test on integrated science skills, with five questions for controlling variables, operationally defining, forming a hypothesis, analyzing data, and conducting experiments.

In ensuring the instrument's validity, content, and face validity were utilized. The test consisted of 30 basic science process skills and 25 integrated science process skills. This multiple-choice test allows the respondents to choose one of four possible answers. It is intended to give sufficient sampling, a decent item pool, relative ease in administering the test, and an economy of time reliability in the scoring process. It went through the planning step, the preparation of the test items phase, the period of testing out the test items, and finally, the evaluation of the instrument phase.

To construct the table of specifications, a one-way grid was used. The test items were divided up according to the topics that were covered. To make the test questions for the content areas, the researcher read and scanned science books about the science process skills, how to teach it, and other related topics. This was done in concurrence with conversational consultations with the teachers who are considered experts in the field from high school and college and who concentrated on the instrument's content and degree of difficulty. The upper-lower index method was used to evaluate the test item. The marginal items that had a moderate level of difficulty were kept and given improvements, while those not-good items were rejected. The jury validation with a mean of 3.62 shows it is very valid. Creswell and Creswell (2017) say that reliability is a measurement tool's consistency. The reliability of the KR 21 research instrument was used to get a score of 0.72, which shows a high level of reliability.

The distribution of the SPS are as follows: basic SPS of observing (items 1-5), inferring (items 6-10), measuring (items 11-15), communicating (items 16-20), classifying (items 21-25), predicting (items 26-30) and integrated SPS of controlling variables (items 31-35), defining operationally (items 36-40), formulating hypothesis (items 41-45), interpreting data (items 46-50), experimenting (items 51-55)

A scale was used to assess both the level of acquired basic and integrated SPS: 0.00-6.00 Very Low, 6.01-12.00 Low, 12.01-18.00 Average, 18.01-24.00 High, 24.01-30.00 Very High. Meanwhile, the following scale was used to ascertain the level of SPS acquired for basic and integrated skills: 0.00-1.00 Very Low, 1.01-2.00 Low, 2.01-3.00 Average, 3.01-4.00 High, 4.01-5.00 Very High.

Academic performance questionnaire. STEM Earth Science students' academic performance was assessed using a researcher-made questionnaire. The questionnaire has two sections. The first section included respondents' names, sexes, and family monthly income. The forty-item test question followed. The framing of the test questions started with constructing a one-way grid table of specifications. The test items were arranged according to the number of days that the Most Essential Learning Competencies (MELCs) covered. The test questions for the content areas were based on the questions from the modules and books used in Earth Science.

In ensuring the validity of the instrument, the researcher-made test questionnaire was subjected to an evaluation by ten jurors. The instrument utilized content validity to determine the essential items needed based on the specifications table. The researcher prepared 80 questions for this test. Each item will be classified as "essential," "useful but not essential," or "not necessary." Only essential ratings were included in computing the Content Validity Ratio (CVR) of each item. Items that reached the minimum value of 0.62 were retained. Those items below the minimum value were rejected. A total of 57 items were retained, and with the content validity index of 0.88, the jury validation shows that it is valid since the acceptable content validity index is 0.78.

The researcher established the reliability index of the research instrument using KR20. KR 20 was appropriate since the research instrument has dichotomous data, such as correct and wrong answers, coded as 1 and 0, respectively. The questionnaire, with 57 questions, was given randomly to 30 Grade 11 STEM senior high school students who were not considered participants in the study. The reliability index of the questionnaire using KR20 is 0.75, which is considered reliable since it surpassed the ideal 0.70 score. According to Salkind (2010), a KR20 of 0.7 is appropriate for short tests (less than 50 items) and 0.8 for long tests (more than 50 item-test).

Moreover, these 57 questions of the research instrument went through item analysis. Test items were examined in Microsoft Excel for difficulty, p-value, and discrimination index (DI). Good items were retained, whereas very easy and difficult items were rejected. Negative and poor discrimination items were reconstructed (Quaigrain & Arhin, 2017). 28 items were retained. Retained items have a discrimination level index of 0.20-0.80, whereas rejected items are below 0.20 and above 0.80 (Kheyami et al., 2018).

The second reliability test used the same 30 students since the researcher requires 40 items. The researcher tested 22 revised questions with KR20. The result yielded 0.73 as the reliability index, which is an acceptable value. Also, the researcher conducted another round of item analysis. Twenty items were retained, and only two items were rejected. The researcher completed the 40-item test question and table of specifications after validity and reliability testing.

In interpreting the data for the academic performance in Earth Science, a scale was used: 0-8.00 Did Not Meet Expectations, 8.01-16.00 Fairly Satisfactory, 16.01-24.00 Satisfactory, 24.01-32.00 Very Satisfactory, 32.01-40.00 Outstanding.

The descriptive analysis used mean and standard deviation to assess the level of acquired science process skills in the basic and integrated skills and academic performance in Earth Science.

Mann Whitney U test was used to determine the significant difference in the level of acquired SPS of Grade 11 STEM students in the basic and integrated skills and the level of academic performance in Earth Science when grouped according to sex and family monthly income. Spearman rank correlation was used to determine the significant relationship between acquired SPS and academic performance.

To ensure the study's ethical value, the participants were given informed consent and parents' assent to concur. Also, the categorical and context vulnerability of the research participants were secured, and their consent was made without coercion, influence, or the probability of being wrong. Refusal to participate in the study does not result in penalties or benefits loss. Hence, participation in the study does not affect their academic performance in Earth Science.

4.0. Results

Level of Acquired Basic SPS of Grade 11 STEM Students

Generally, Table 2 shows that the Grade 11 STEM students have a "very high" level of acquired basic science process skills (M=26.16, SD=1.57). This suggests that students have learned the basic SPS of observing, inferring, measuring, communicating, classifying, and predicting to demonstrate deep analytical processing of information and perform with great competence (DepEd, 2016) in adherence to the mandate of the DepEd. It also means that students possess fundamental science skills necessary to achieve integrated SPS. These students' great competence in these areas implies they comprehend and can apply scientific principles. It also indicates a solid foundation for STEM studies and job success.

The result offers support to the claim of Gastar and Linaugo (2022) that Grade 11- STEM students' acquired basic science process skills are high based on the Science Framework for Philippine Basic Education set by the Department that aims to develop an empowered individual in science and technology who will holistically develop its scientific, environmental, and technologically literate and become productive members of the society. This indicated that the DepEd successfully strengthened the delivery of quality education.

Notably, students' measuring skill (M=3.92, SD=0.96) is high in processing information and collecting and recording quantitative data about objects and phenomena The nature of Earth Science requires a high degree of measuring skill to make accurate observations and gather reliable data. This is critical to advancing our understanding of the Earth and its processes,

Table 2
Level of Acquired SPS in the Basic Skills of Grade 11 STEM Students

Variable	Observing			Inferring			Measuring			Communicating			Classifying			Predicting			Basic Science Process Skill		
	M	SD	Int	M	SD	Int	M	SD	Int	M	SD	Int	M	SD	Int	M	SD	Int	M	SD	Int
Sex																					
Male	4.52	0.73	VH	4.45	0.68	VH	4.02	0.95	VH	4.79	0.45	VH	4.16	0.74	VH	4.24	0.63	VH	26.17	1.57	VH
Female	4.74	0.53	VH	4.51	0.58	VH	3.84	0.97	Hi	4.72	0.45	VH	4.01	0.79	VH	4.33	0.57	VH	26.16	1.58	VH
Family Monthly Income																					
Lower	4.65	0.64	VH	4.46	0.62	VH	3.94	0.93	Hi	4.80	0.40	VH	4.11	0.75	VH	4.23	0.57	VH	26.19	1.55	VH
Higher	4.63	0.62	VH	4.52	0.64	VH	3.89	1.00	Hi	4.69	0.51	VH	4.02	0.81	VH	4.39	0.63	VH	26.13	1.61	VH
Whole	*4.64*	*0.63*	*VH*	*4.49*	*0.62*	*VH*	*3.92*	*0.96*	*Hi*	*4.75*	*0.45*	*VH*	*4.07*	*0.77*	*VH*	*4.29*	*0.60*	*VH*	*26.16*	*1.57*	*VH*

Mean Scale: (5-point scale) 0.00-1.00=Very Low (VL), 1.01-2.00=Low (Lo), 2.01-3.00=Average (Av), 3.01-4.00=High (Hi), 4.01-5.00=Very High (VH), *(30-point scale)* 0.00-6.00=Very Low (VL), 6.01-12.00=Low (Lo), 12.01-18.00=Average (Av), 18.01-24.00=High (Hi), 24.01-30.00=Very High (VH)

as well as developing effective strategies for managing and protecting our planet's natural resources.

The result confirms the study of Inaya et al. (2020) found that the ability of students who tend to be low in measuring possibilities is due to a lack of learning that involves the measurement process. Students often utilized pre-measured or prepared ingredients while experimenting. Inquiry learning improves students' measuring skills. Good measuring abilities help make quantitative observations, categorize and compare things, and communicate them.

In terms of sex, students got a "very high" level of acquired basic SPS for both males (M=26.17, SD=1.57) and females (M=26.16, SD=1.58), respectively. Both male and female students have learned the basic SPS of observing, inferring, measuring, communicating, classifying, and predicting. The result emphasizes STEM diversity and inclusion. Recognizing that both male and female students can learn fundamental SPS motivates schools and educators to provide both sexes the equal opportunity to succeed in STEM subjects.

Notably, this result is corroborated by Gastar and Linaugo's (2022) study, which revealed that the acquired basic SPS level of Grade 11 STEM students is not sex-specific. Male and female students utilize the same level of fundamental SPS skills.

In terms of family monthly income, students got a "very high" level of acquired basic SPS for both lower family monthly income (M=26.19, SD=1.55) and higher family monthly income (M=26.13, SD=1.61), respectively. Both lower and higher-family monthly income students have learned the basic SPS of observing, inferring, measuring, communicating, classifying, and predicting. This implies that students have mastered the basic skills of facilitating learning in science, allowing them to be active, developing a sense of responsibility, and increasing the permanence of learning regardless of the differences in income levels.

The result negates the study conducted by Güven and Yılmaz (2020) that found that the paired comparisons made using Mann Whitney U Test to determine the meaningful differences indicate a significant difference between the lower and upper socioeconomic levels as well as between the middle and upper socioeconomic level in favor of children at the upper socioeconomic level in all subscales.

Level of Acquired Integrated SPS of Grade 11 STEM Students

As a whole, the findings show that the Grade 11 STEM students have a "very high" level of acquired integrated SPS (M=21.45, SD=1.35). This indicates that Grade 11 STEM students can demonstrate deep analytical processing of information and can perform with great competence the integrated SPS in controlling variables, defining operationally, formulating a hypothesis, interpreting data, and experimenting. Their problem-solving and critical thinking skills strengthened, and their ability to apply them in a real-world context. It also implies that they have developed a strong foundation in the integrated SPS required for success in STEM fields. Furthermore, they are well-equipped to tackle the challenges of more advanced STEM subjects and are prepared for further academic and career success in these fields.

The result is supported by the study of Batisla-Ong (2021) which found "accomplished/high" integrated SPS in 161 students. Those with "accomplished/high" integrated SPS are prepared for the next level of their education. Expectedly, the educational reform on lengthening the number of years in Basic Education will produce students who are fully equipped, innovative, and competent in gaining knowledge in SPS in the 21st century. Inaya et al. (2020) observed that most acquired integrated scientific processes are good. It was also noted that good SPS helps students grasp learning topics.

In terms of sex, both males (M=21.53, SD=1.45) and females (M=21.38, SD=1.28) developed a very high level of competence in using integrated scientific process skills required for conducting scientific investigations. Furthermore, the finding reveals that female students achieved a high level of formulating hypothesis skills, but not as high as male students

Table 3
Level of Acquired SPS in the Integrated Skills of Grade 11 STEM Students

Variable	Controlling Variable			Defining Operationally			Formulating Hypothesis			Interpreting Data			Experimenting			Integrated Science Process Skill		
	M	SD	Int	M	SD	Int	M	SD	Int	M	SD	Int	M	SD	Int	M	SD	Int
Sex																		
Male	4.19	0.83	VH	4.21	0.59	VH	4.38	0.81	VH	4.66	0.51	VH	4.10	0.77	VH	21.53	1.45	VH
Female	4.46	0.72	VH	4.29	0.75	VH	3.82	0.89	Hi	4.76	0.46	VH	4.05	0.76	VH	21.38	1.28	VH
Family Monthly Income																		
Lower (Php 24,451 and below)	4.41	0.69	VH	4.29	0.70	VH	3.96	0.99	Hi	4.76	0.43	VH	4.06	0.79	VH	21.49	1.34	VH
Higher (above Php 24,451)	4.24	0.89	VH	4.20	0.66	VH	4.20	0.74	VH	4.65	0.55	VH	4.09	0.73	VH	21.39	1.38	VH
Whole	*4.34*	*0.78*	*VH*	*4.25*	*0.68*	*VH*	*4.06*	*0.90*	*VH*	*4.72*	*0.48*	*VH*	*4.07*	*0.76*	*VH*	*21.45*	*1.35*	*VH*

Mean Scale: (5-point scale) 0.00-1.00=Very Low (VL), 1.01-2.00=Low (Lo), 2.01-3.00=Average (Av), 3.01-4.00=High (Hi), 4.01-5.00=Very High (VH), *(30-point scale)* 0.00-6.00=Very Low (VL), 6.01-12.00=Low (Lo), 12.01-18.00=Average (Av), 18.01-24.00=High (Hi), 24.01-30.00=Very High (VH)

who achieved a very high level. The formulation of hypotheses depends directly upon questions, inferences, and predictions. This implies that female students fairly developed the skill of making an educated guess about a potential cause-and-effect relationship between variables compared to their male counterparts.

The finding is partly supported by the study of Saban et al. (2019) which found that the female students were observed to be less keen compared to the male students at the beginning depending on the activity types. However, the finding contradicts Karar (2011) as cited in Kaymakci and Can (2021), who found that seventh-grade pupils' SPS differ greatly by gender. Female students were better at identifying and controlling variables, formulating and defining a hypothesis, and drawing and understanding graphs.

In terms of family monthly income as a whole, both lower (M=21.49, SD=1.34) and higher (M=21.39, SD=1.38) family monthly income yielded a very high level in the acquisition of integrated science process skills. These skills demonstrate that students comprehend scientific principles and can apply them to real-world problems regardless of socioeconomic class. To generate a hypothesis, one must first develop research questions, and make inferences and predictions based on observations and data. Moreover, the finding also implies that students with lower family monthly income attained only high level in the skill of formulating hypotheses than the students with higher family income who got a very high level in the given area.

Only a few studies have examined family monthly income hypothesis formulation. Most studies utilizing family monthly income as demographics only examine integrated science process skill acquisition as a whole. A study conducted by Aydınlı (2007) as cited in Güven and Yılmaz (2020) stated that students' basic and scientific process skills change significantly according to family income. This is also confirmed by a study conducted by Hazır and Türkmen (2008) as cited in Güven and Yılmaz (2020) with 5th-grade students in primary education, as a result of the evaluation based on the socioeconomic environment of the schools, it is found that the scientific process skill levels of children in the schools with higher socioeconomic level differed significantly from other schools.

Level of Academic Performance in Earth Science of Grade 11 STEM Students

As a whole, the result shows that the respondents have an outstanding level of academic performance (M=33.29, SD=1.96) in Earth Science. The finding implies that students exceed the core requirements in terms of knowledge, skills, and understandings in Earth Science and can seamlessly and adaptively utilize acquired knowledge and skills in practical, real-world situations. It indicates that students are well-prepared to apply their Earth Science knowledge in real-world situations, such as in the field of environmental science or natural disaster mitigation and management. The ability to apply Earth Science knowledge in real-life contexts is essential for students to be successful in their future careers and to contribute meaningfully to society.

This is supported by the study conducted by Morados (2020) which found that STEM students with good Earth Science grades are more prepared for their chosen careers. STEM students' skills match their strand. Similarly, a study by Arzaga (2020) found that using cooperative learning to teach Earth Science boosted student achievement and motivation.

In terms of sex, both males (M=33.34, SD=1.89) and females (M=33.25, SD=2.02) yield outstanding academic performance in Earth Science. This could mean that both received similar opportunities for learning, access to resources, teaching quality, and motivation. It could also be because Earth Science is a subject that both sexes find interesting and engaging, leading to similar levels of academic performance.

This is corroborated by a study by Sharma (2016) wherein male students scored 238.97 and female students 237.41. The "F" test showed no significant differences between the two groups (F =.015). The low F-ratio did not confirm that sex

Table 4
Level of Academic Performance in Earth Science of Grade 11 STEM Students

Variable	M	SD	Interpretation
Sex			
Male	33.34	1.89	Outstanding
Female	33.25	2.02	Outstanding
Family Monthly Income			
Lower (Php 24,451 and below)	33.21	2.23	Outstanding
Higher (above Php 24,451)	33.41	1.47	Outstanding
Whole	*33.29*	*1.96*	*Outstanding*

Mean Scale: 0.00-8.00=Did not meet expectation, 8.01-16.00=FairlySatisfactory, 16.01-24.00=Satisfactory, 24.01-32.00=Very Satisfactory, 32.01-40.00=Outstanding

affects students' performance.

In terms of family monthly income, an outstanding level of academic performance in Earth Science is shown for both lower family monthly income (M=33.21, SD=2.23) and higher family monthly income (M=33.41, SD=1.47), respectively. It suggests that a high quality of education and support has been provided to students across different income levels. It also denotes that students from lower- and higher-income families have demonstrated a high understanding and mastery of Earth Science.

The result is supported by the study of Marks and O'Connell (2023) which discovered that parental education and income did not affect students' test scores. Parental ability, socioeconomic class, and genetic transmission explain much of the socioeconomic status-test result relationship. Without these relationships, socioeconomic status has no effect.

Difference in the Level of Acquired SPS in the Basic and Integrated Skills of Grade 11 STEM Students

As shown in Table 5, there was no significant difference in the level of acquired SPS of Grade 11 STEM students in the basic skills when grouped according to sex [U=2186.500, p=0.935] and family monthly income [U=2129.500, p=0.885].

The findings show, in comparison to sex, that sex does not affect the level of basic SPS acquired. Sex is not a significant factor in determining the level of acquired basic SPS of Grade 11 STEM students. Both male and female students are equally capable of acquiring and developing these basic SPS.

The result affirms the study conducted by Rabacal (2016*)*, which found a t-ratio of 0.89 at p=0.37, and Ekon and Eni's (2015) study, which found an x^2 value of 1.02, which is less than 7.81 at a 0.05 chance level and 3 degrees of freedom. This means that there is no big difference between males and females in how well they acquire basic SPS. This shows that male and female students have similar basic SPS. Grade 11-STEM students' basic SPS are gender-neutral

When grouped according to family monthly income, the level of acquired basic SPS is similar for students from different family monthly income levels. Notably, family monthly income is not a significant factor in determining the level of acquired basic SPS of Grade 11 STEM students.

The result contrasts with the study conducted by Dogan and Kunt (2016), which found a significant relationship between the family's income level in acquiring the SPS. It is also stated that the income level will be determined by the parents' occupation. Students from higher-income families have more opportunities, particularly in school.

Furthermore, there was no significant difference in the level of acquired SPS of Grade 11 STEM students in the integrated skills when they were grouped according to sex [U=2119.000, p=0.693] and family monthly income [U=2040.500, p=0.575], as shown in Table 5.

The finding demonstrates that Grade 11 STEM students' proficiency in the integrated SPS is not based on sex. Male and female Grade 11 STEM students perform equally well in understanding and applying integrated SPS. The success of the students in this area cannot be attributed to their sex.

Similarly, Saban et al. (2019) discovered that males and females acquire and utilize SPS equally when given equal opportunity. SPS acquisition and usage were unaffected. Scientific research must be gender-neutral. Hence, gender-neutral scientific activities should provide male and female students equal responsibility.

Contrastingly, Bassey and Amanso (2017) found that gender affects SPS like calculation and problem-solving among science students. In addition, Yamtinah et al. (2017) found gender differences in students' scientific attitudes and investigation of students' SPS utilizing testlet instrument refutes the findings that male students have higher SPS than female students.

When students are grouped according to their family's monthly income, the level of integrated SPS they have acquired is comparable. The family's monthly income does not significantly determine the level of integrated SPS acquired by Grade 11 STEM students. Whether a student comes from a high-income or a low-income family does not significantly affect their ability to acquire integrated SPS. It is further suggested that factors other than family income, such as the quality of teaching, the level of student engagement, the availability of resources, and the support provided by schools and families, may have a greater influence on the acquisition of integrated SPS.

This study's findings contradict the study of Özturk et al. (2010) which indicated that parents' income greatly affects students' SPS. High-income parents are favored over low-income parents. Hence, when parents' income rises, students' SPS rise.

Table 5

Difference in the Level of Acquired SPS in the Basic and Integrated Skills of Grade 11 STEM Students

Variable	Basic Skills			Integrated Skills		
	U	z	p	U	z	p
Sex	2186.500	-0.082	0.935	2119.000	-0.395	0.693
Family Monthly Income	2129.500	-0.144	0.885	2040.500	-0.561	0.575

Note: the difference is significant when $p \leq 0.05$

Difference in the Level of Academic Performance in Earth Science of Grade 11 STEM Students

As shown in Table 6, there was no significant difference in the level of academic performance in Earth Science of Grade 11 STEM students when they were grouped according to sex [U=2021.500, p=0.402] and family monthly income [U=1896.000, p=0.221].

In terms of sex, the findings reveal that students' academic performance in Earth science is not determined by sex. Both males and females are equally capable of performing well in Earth Science. The differences in average performance are likely due to factors other than sex, such as individual differences in motivation, interest, and educational experiences. Thus, the hypothesis that Grade 11 STEM students' Earth Science academic performance does not differ significantly by sex is accepted.

The findings of this study affirm the result of the study conducted by Adigun et al. (2015), which showed that male students performed slightly better than female students but not significantly. The private school with the best male brains in the study performed better. Parents should encourage their children to get the best education they can afford, regardless of gender. Contrastingly, a study by Hadjar (2019) shows gender-based academic performance inequalities. Females outperform males in cumulative GPA. Females have an excellent 3.58 GPA, whereas males have 3.48. (good). Although having higher GPAs than men, females had more homogeneous GPAs (SD =.23 and SD =.26).

In terms of the family's monthly income, the level of academic performance of the students is not affected by their family's income level. The finding further implies that family income does not determine academic performance. Students have different abilities, interests, and learning styles that can all impact their academic success. While family income may play a role in academic performance, it is just one of many factors that can influence student outcomes. The null hypothesis, which states that there was no significant difference in the level of academic performance in Earth Science of Grade 11 STEM students when grouped according to family monthly income, is accepted.

The findings of this study are corroborated by a study conducted by Adzido et al. (2016) which found that a student's cumulative grade point average (CGPA) showed a mixed correlation between their family income and how well they performed in school. Family financial status affects students' performance to some extent, but it is not an essential predictor of higher academic performance.

Table 6

Difference in the Level of Academic Performance in Earth Science of Grade 11 STEM Students

Variable	U	z	p
Sex	2021.500	-0.837	0.402
Family Monthly Income	1896.000	-1.224	0.221

Note: the difference is significant when $p \leq 0.05$

Relationship between SPS and Academic Performance in Earth Science

As shown in Table 7, there was no significant relationship between acquired integrated SPS and the academic performance in Earth Science [$r_s(132)=0.114$, $p=0.191$] of Grade 11 STEM students.

The finding implies no significant correlation between the acquired integrated SPS and the academic performance of Grade 11 STEM students. The level of integrated SPS acquired by the students does not appear to significantly impact their academic performance. The study may have focused on integrated SPS involving critical thinking, problem-solving, and scientific reasoning. While these skills are important for success in science, they may not be the only factors that influence academic performance. Other factors, such as motivation, study habits, and content knowledge, may also play a role. Thus, the null hypothesis, which states that no significant relationship exists between acquired integrated SPS and the academic performance of Grade 11 STEM students, is accepted.

Table 7

Relationship between SPS and Academic Performance on Earth Science

Variable	U	z	p
Basic SPS	0.247*	132	0.004
Integrated SPS	0.114	132	0.191

Note: *correlation is significant when $p \leq 0.05$

The result of this study negates the study conducted by Batisla-Ong (2021), which found a strong correlation between SPS and academic achievement among Grade 10 STE students as an entire group. This suggests that SPS improves academic performance.

On the other hand, there was a significant relationship between acquired SPS and the academic performance in Earth Science [$r_s(132)=0.247$, $p=0.004$] of Grade 11 STEM students. The null hypothesis, which states that no significant relationship exists between acquired basic SPS and the academic performance of Grade 11 STEM students, is rejected. Students with better basic SPS will likely perform better academically. When students develop a deep understanding of basic SPS, they are better able to engage in scientific inquiry and experimentation. They can collect and analyze data more effectively, make predictions based on evidence, and draw meaningful conclusions. This enhanced understanding leads to better performance in scientific tests, exams, and assessments. Moreover, basic SPS build on each other. Predictions and experimental design depend on measurement. Students grow more confident and motivated to pursue science as they master these skills.

Gurses et al. (2015) observed that only SPS differed between 10th- and 11th-graders. Eleventh-graders may have lower SPS because they apply knowledge to solve issues for university admission tests. It is further suggested that teachers may also employ effective materials and activities to assist students acquire SPS. A similar result is also found in the study conducted by Rabacal (2016). The t-ratios of 2.01, -2.82, and 2.15 at chance values of 0.05, 0.01, and 0.04, respectively, show that the first-year and second-year BS Biology students have differed significantly on basic SPS in explaining, identifying, and predicting. This further concluded that the academic performance of the BS Biology students in the SPS yielded a significant relationship.

5.0. Conclusion

Acquisition of science process skills significantly enhances cognitive development among students and encourages an active involvement during instruction. To develop more advanced science process skills, students must first develop a strong foundation in basic science process skills. These skills scaffold other cognitive skills, such as logical thinking, reasoning, and problem-solving. Supplementary instructional material in the form of task cards, may provide students a structure to focus their search and just the right amount of direction to ensure success and, at the same time, strengthen their independent learning skills.

6.0. Limitations of the Study

A limitation was recognized that might affect the general result of the study since the scope of this study is only a public secondary school in a component city in Central Philippines. The result may differ if the study was conducted in all senior high schools in the chosen division. Another perceived limitation is that the study was conducted right after resuming face-to-face classes after two years of remote learning due to COVID-19. If there were no school year breaks, the outcome might be different. Interpretation of findings was limited to the method used in gathering data and statistical tools employed in the data analysis.

7.0. Practical Value of the Paper

This paper has value to the Basic Education Department, specifically on a public senior high school institution. It will be useful to deepen the understanding of the teachers and students on the important role plays of the acquisition of science process skills in the teaching-learning process. The results of this study were utilized in formulating a proposed supplementary instructional material, specifically the task cards. Furthermore, the study's results added a new body of knowledge vital to the scientific society.

8.0. Directions for Future Research

The current study suggests that future researchers may explore other demographics not covered in this study, such as school of origin, school type, senior high school strands, and parents' educational attainment. Future researchers can also undertake similar studies utilizing qualitative research design.

9.0. Declaration of Conflicting Interests

No potential conflicts of interest were disclosed by the authors regarding the research, authorship, or publication of this article.

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