

Science Process Skills, Research Competence, and Performance of First-Year College Students in Panay

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ABSTRACT

The primary purpose of the study was to assess the science process skills, research competence, and academic performance of first-year college students enrolled in State Universities and Colleges (SUCs) in Panay Island, Philippines, and to determine the relationships among these variables. A descriptive-correlational research design was used in the study. Data were gathered through a validated researcher-made questionnaire composed of science process skills self-assessment inventory, research competence instrument, and the respondents' final grade in Inorganic Chemistry gathered at the end of the first semester. A total of 157 first-year college students from six participating SUCs served as respondents. The data were

analyzed using frequency count, percentage, mean, t-test, One-Way ANOVA, and Pearson's r. The findings showed that the respondents had a high level of science process skills and a highly competent level of research competence. The respondents' academic performance was rated as very good. No significant differences were found in science process skills, research competence, and academic performance when respondents were grouped according to age and sex. On the other hand, several variables showed significant differences across senior high school academic tracks, school location, and university affiliation. Furthermore, there is a significant relationship between science process skills and research competence, indicating that students with a high level of science process skills also tend to have highly competent research competence. However, no significant relationship was found between these variables and academic performance. The study concludes that the respondents generally possess strong foundational skills and competencies, and institutional factors and prior academic preparation appear to have a greater influence than demographic characteristics. To improve students' competencies and academic performance, higher learning institutions are encouraged to enhance instructional approaches, research, and student support systems.

Keywords: *Science Process Skills, Research Competence, Performance, First-Year College Students, University*

INTRODUCTION

In the 21st century, in the education sector, developing scientific literacy and science process skills (SPS) is becoming increasingly important. Science process skills include observing, classifying, inferring, and experimenting. Students use these skills when they engage in inquiry-based learning and apply their scientific knowledge to real-world scenarios. The development of these skills is important, as they assist first-year students in adjusting to learning more complex skills that involve greater autonomy and

necessitate more critical and creative thinking and problem-solving (Karamustafaoglu, 2021). Despite being required to have these skills, many students enter the university with subpar skills due to insufficient or no exposure to the aforementioned learning strategies, resulting in a lack of ability to meet the analytical and practical demands of scientific subjects. Research competence is another important yet underdeveloped skill that many first-year university students possess. While university instructors expect first-year learning students to possess the skills of area competency identification, methodology design, result and analysis of the overall data interpretation, and dissemination of the findings, the reality is that many of them are still developing these abilities that consequently have an impact on their performance in Science and other research-related subjects (Surapranata & Wahyudin, 2023).

In the Philippines, the enhancement of critical thinking, problem-solving, and research skills is defined in the CHED Memorandum Order No. 20, Series of 2013. Because of this, the burden falls on colleges and universities to bolster students' Science Process Skills and Research Competence early in their education. However, the study of these skills has not yet been explored beyond this limitation, and the influence of integrating these two skills on the performance of first-year college students in this context has not yet been examined. To fill the gap, this study aimed to measure the science process skills, research competence, and performance of first-year students in State Universities and Colleges (SUCs) in Panay Island, Philippines. Thus, one of the advantages of this study is that it centers on the first-year students, who, in the majority of studies, are the research participants who are the least examined, and who, in the majority of studies, have undergone the highest level of transition from the Senior High School to the Tertiary Level of the Education System. Based on the study's results, this will provide higher education institutions with the information needed to enhance curricula, learning methods, and student service systems.

Statement of the Problem

This study aimed to determine the science process skills, research competence, and performance of first-year college students among State Universities and Colleges (SUCs) in Panay Island, Philippines, for the Academic Year 2025-2026. Specifically, this study sought to answer the following questions:

1. What is the level of science process skills of first-year college students when taken as a whole and when classified according to age, sex, senior high school academic track, school location, and university?
2. What is the level of research competence of first-year college students when taken as a whole and when classified according to age, sex, senior high school academic track, school location, and university?
3. What is the performance of first-year college students when taken as a whole and when classified according to age, sex, senior high school academic track, school location, and university?
4. Are there significant differences in the level of science process skills of first-year college students when classified according to age, sex, senior high school academic track, school location, and university?
5. Are there significant differences in the level of research competence of first-year college students when classified according to age, sex, senior high school academic track, school location, and university?
6. Are there significant differences in the performance of first-year college students when classified according to age, sex, senior high school academic track, school location, and university?
7. Are there significant relationships among science process skills, research competence, and performance of first-year college students?

Conceptual Framework

This study determined how age, sex, senior high school track, school location, and universities in Panay may influence the science process skills, research competence, and academic performance of first-year college students. These background factors were considered important because they may shape students' readiness, access to learning resources, prior academic preparation, and approaches to scientific inquiry and research tasks. This framework also acknowledges the association between science process

skills and research competence. When harnessed together, they can lead to both improved academic performance and a solid foundation for formulating and assessing hypotheses. The paradigm for this study is provided in Figure 1.

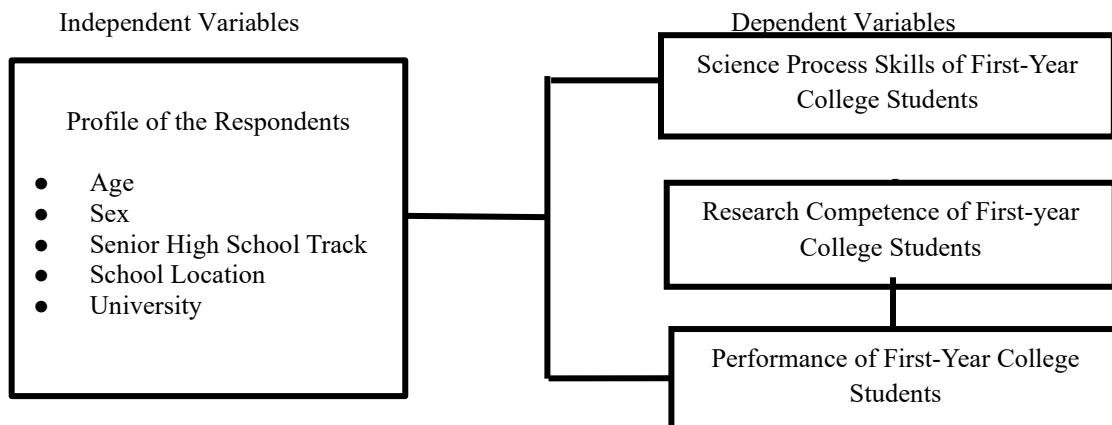


Figure 1. Schematic diagram between independent variables and dependent variables.

METHODS

Research Design

This research used a descriptive–correlational research design. A descriptive research design involves observing and describing the various facets of a specific individual or group, and summarizing the results using descriptive statistics. These design tools include frequency distribution tables, average graphs, and correlation graphs, which help the reader understand the research results. (Creswell & Creswell, 2023; Fraenkel et al., 2022). Also, this research-built patterns from the database for analysis using various associative-correlational tools to determine the significance or strength of the proposed Respondents of the Study. The study involved respondents who were first-year Bachelor of Secondary Education students majoring in Science from six (6) State Universities and Colleges in Panay, selected randomly for the Academic Year 2025-2026.

As shown in Table 1, respondents across the different universities exhibit varying participation rates. The low participation from University B can be attributed to the smaller number of students enrolled in the Bachelor of Secondary Education major in Science at this university during data collection, which explains the lower participation compared to other universities with more students in the program. Despite differences in enrollment across programs, the number of students in the study from all six universities is deemed sufficient to allow comparisons across institutions. The number of participants from different universities clearly shows students’ enrollment in academic programs from various state universities and colleges located in Panay, and this portrayal will help the study capture a range of first-year college students.

Table 1. *Distribution of Respondents*

University	N	n	%
A	46	28	17.8
B	14	9	5.7
C	50	30	19.1

D	51	31	19.7
E	56	34	21.7
F	41	25	15.9
Total	258	157	100

Research Instrument

The study utilized a researcher-made questionnaire as the research tool. The instruments was divided into four sections. Part I dealt with structuring respondent profiles. Part I captured demographic and academic background data, including age, sex, senior high school (SHS) academic track, school environment, and university affiliations, among other variables that were important for comparison. Part II comprised a 20-item Science Process Skills Self-Assessment Inventory designed to assess respondents' research skills. Part III consisted of a 20-item Research Competence Questionnaire that evaluated respondents' proficiency in fundamental aspects of the research process, including problem articulation, literature review, data collection, data analysis, and reporting. Lastly, Part IV captured the respondents' final grade in Inorganic Chemistry as a measure of their academic performance.

Data Gathering Procedure

Before the survey was conducted, the researcher obtained the necessary permissions. This involved obtaining the Program Chair's agreement. The researcher also requested the consent of the University President and the Campus Administrators of the various State Universities and Colleges in Panay. The researcher was able to administer the questionnaires in person in all the Universities in Panay after these permissions were granted. To ensure the survey accurately reflected the study's intent, the researcher gave the questionnaires to the program chair for clarification. The participants were informed of the study's purpose and assured that respondents' personal information would not be disclosed and that it would be protected. Respondents were notified that the data would only be used for research. After the data collection period, the questionnaires were collected. Using the Statistical Package for the Social Sciences (SPSS) software, the collected data were analyzed using appropriate statistical tools.

Data Analysis Procedure

In the analysis of data, descriptive and inferential statistical tests were used. The descriptive statistical tests applied were frequency count, percentage, and mean. For inferential analysis, t-tests for independent samples and One-way Analysis of Variance (One-Way ANOVA) were used; in cases of significant F, the LSD (Least Significant Difference) test was used for mean comparisons, and Pearson's r was used for correlation. The 0.05 alpha level of significance was used as a criterion for the acceptance or rejection of the null hypothesis. All the gathered data were computer-processed using the Statistical Package for Social Sciences (SPSS) software

RESULTS AND DISCUSSION

Science Process Skills of Freshmen College Students when taken as a whole and as to variables

Table 2 presents the level of science process skills of first-year college students when taken as a whole and when classified according to age, sex, SHS academic track, school location, and university. The results showed that the science process skills of first-year college students, when taken as a whole ($M = 2.69$), were interpreted as "High". This means the respondents generally demonstrate a high level of proficiency in basic science process skills. It simply shows that the students are capable of conducting important scientific work, such as observing, classifying, measuring, and interpreting data, skills fundamental to scientific inquiry and research. The finding indicates that most first-year students already

possess the basic competencies needed to engage in science-related hands-on activities. This result supports earlier studies, which found that science process skills play a vital role in developing higher-order thinking, problem-solving, and inquiry abilities among learners (Susilowati et al., 2020; Putri et al., 2021). In terms of age, respondents aged 20–22 years old obtained a slightly higher score ($M=2.93$) than those aged 17–19 years old ($M=2.67$). However, both groups demonstrated a “High” level. The result implies that regardless of age group, the respondents generally demonstrate a strong level of science process skills. However, older students may exhibit slightly better proficiency, possibly due to increased academic exposure and experience.

When grouped according to sex, male respondents obtained ($M=2.69$), while female respondents had ($M=2.67$). Both are interpreted as “High,” indicating that science process skills are consistently developed across sexes, with only minimal variation. The results imply that sex does not significantly influence the level of science process skills among the respondents. In terms of the SHS academic track, ABM respondents obtained the highest ($M=2.81$), followed by the non-academic track ($M=2.78$), STEM ($M=2.71$), HUMSS ($M=2.67$), and GAS ($M=2.53$). Despite these variations, all groups demonstrated a “High” level. This implies that, regardless of academic background, respondents were able to develop science process skills. However, those from ABM and non-academic tracks showed slightly higher levels, which may be attributed to transferable analytical and problem-solving skills developed in their respective strands.

Regarding school location, respondents from external campuses reported slightly higher scores ($M=2.73$) than those from the main campus ($M=2.66$). Both are described as “High,” indicating that science process skills are consistently evident across different school locations. This implies that location does not create a significant disparity in skill development among the respondents. In terms of university affiliation, respondents from University B recorded the highest ($M=2.81$), followed by University C ($M=2.73$), University E ($M=2.71$), University D ($M=2.69$), University A ($M=2.66$), and University F ($M=2.51$). Despite differences in mean scores, all universities were rated as “High” level. It suggests that students across institutions generally possess positive science skills, with minor differences that may be due to diverse teaching methods, resource availability, or academic priorities. Therefore, the respondents indicate that science process skills appear quite prominent. As a result, first-year college students can demonstrate some basic skills. These include their ability to observe, analyze, and interpret data, which are critical skills for undertaking academic research and for an understanding of scientific research. Nonetheless, minor differences among the student groups demonstrate the need for appropriate and sustainable enhancement programs to address these science skills deficits and, to a great extent, create uniformity in skill deficiencies across the various student groups.

This finding is supported by recent studies, such as Susilowati et al. (2020), which emphasized that science process skills remain a critical foundation for developing students’ higher-order thinking and inquiry abilities in modern science education. Similarly, the results align with those of Putri et al. (2021), who reported that students with well-developed science process skills tend to perform better on research-related tasks and problem-solving activities. The consistently high ratings across variables in the present study suggest that these competencies are being developed regardless of students’ demographic characteristics. Lastly, the findings support the study by Suryaningsih and Nisa (2021), which found that inquiry-based and student-centered learning approaches significantly enhance learners’ science process skills. This may explain why respondents across different academic tracks and institutions exhibit similarly high levels of competence.

Table 2. *Science Process Skills of First-Year College Students When Taken as a Whole and When Classified as to Variables*

Variables	Mean	Description
As a whole	2.69	High
Age		
17-19 years old	2.67	High
20-22 years old	2.93	High
Sex		
Male	2.69	High
Female	2.67	High
SHS Academic Track		
GAS	2.53	High
STEM	2.71	High
ABM	2.81	High
HUMMS	2.67	High
Non-Academic Track	2.78	High
School Location		
Main	2.66	High
External	2.73	High
University		
University A	2.66	High
University B	2.81	High
University C	2.73	High
University D	2.69	High
University E	2.71	High
University F	2.51	High

Scale of Means: 3.00-2.34, High; 2.33 – 1.67, Moderate; 1.66-1.00, Low

Research Competence of First-Year College Students when taken as a whole and when classified as to variables

Table 3 presents the level of science process skills of first-year college students when taken as a whole and when classified according to age, sex, SHS academic track, school location, and university.

The results revealed that the research competence of first-year college students, when taken as a whole ($M = 3.48$), was interpreted as “Highly Competent,” indicating that the respondents possess a strong level of research competence. This indicates that respondents are well-equipped with the necessary skills to conduct research tasks such as problem identification, data analysis, and interpretation. This finding supports previous studies that emphasize that students who develop strong foundational skills are better able to perform research-related activities effectively (Fitriani et al., 2022; Putri et al., 2021). In terms of age, both groups (17–19 and 20–22 years old) respondents obtained ($M=3.29$) and ($M=3.28$), respectively, both interpreted as “Highly Competent.” This shows that age did not affect most respondents’ research competencies. The data also show that respondents had equal levels of exposure to academic and research development regardless of age. Based on the data broken down by gender, female respondents ($M=3.30$) reported higher research competencies than male respondents ($M=3.26$), both of whom fell in the “Highly Competent” level. This shows that research competencies are developed with equal consistency across both genders. The slight edge the female respondents had can be explained by their greater participation in academic and interactive activities.

Regarding the academic tracks in the SHS, ABM had the highest mean ($M=3.37$), followed by HUMSS ($M=3.32$) and STEM ($M=3.31$). All can be considered “Highly Competent.” Gas ($M=3.18$) and non-academic tracks ($M=3.23$) were interpreted to be “Competent.” This shows that students in specialized tracks have greater research competencies than their peers in non-academic tracks. This can be explained

by the balanced instruction across these strands, which focuses on research exposure and analytical and critical thinking. Based on the location of the school, the respondents from the main campus (M=3.31) were seen to be “Highly Competent,” and their counterparts from the external campus (M=3.18) were seen to be at the “Competent” level. This means that the respondents from the main campus had greater access to scholarly materials, research facilities, and support instruction. Regarding university affiliation, respondents from university A (M=3.48) were also rated “Highly Competent,” the highest among the universities sampled, followed by university D (M=3.32) and university E (M=3.30).

In addition, the data from University B (M=3.19), University C (M=3.18), and University F (M=3.16), all with a rating of “Competent”, allude to students’ research competence. While these differences highlight that the level of research skills varies from participant to participant, the possible differences between the institutions, namely curricula, staff with different areas of expertise, and the level of research competence of the director or staff, might be reasons for the relatively differing levels of research skills of the students.

It is also worth noting that students exhibit a significantly higher level of research competence (with differences across demographic and academic profiles), and that most respondents are sufficiently skilled for research tasks. It is believed that greater effort is needed to improve the skills of students from external campuses and the general streams, as well as those from certain universities. It is therefore recommended to improve the research-integrated teaching and learning process and to increase the proportion of independent, self-directed student research to raise students’ research competence (Putri et al., 2021; Rahman et al., 2023).

Table 3. *Research Competence of First-Year College Students When Taken as a Whole and When classified as to Variables*

Variables	Mean	Description
As a whole	3.48	Highly Competent
Age		
17-19 years old	3.29	Highly Competent
20-22 years old	3.28	Highly Competent
Sex		
Male	3.26	Highly Competent
Female	3.30	Highly Competent
SHS Academic Track		
GAS	3.18	Competent
STEM	3.31	Highly Competent
ABM	3.37	Highly Competent
HUMMS	3.32	Highly Competent
Non-Academic Track	3.23	Competent
School Location		
Main	3.31	Highly Competent
External	3.18	Competent
University		
University A	3.48	Highly Competent
University B	3.19	Competent
University C	3.18	Competent
University D	3.32	Highly Competent
University E	3.30	Highly Competent
University F	3.16	Competent

Scale of Means: 4.00-3.26, Highly Competent; 3.25-2.51, Competent; 2.50-1.76, Not Competent; 1.75-1.00, Highly Not Competent

Performance of First-Year College Students when Classified According to Age, Sex, SHS Academic Track, School Location, and University

Table 4 presents the attributes of the respondents and the performance indicators of 1st-year college students across different classifications, including age, sex, SHS academic track, school location, and university. Among the characterized respondents, the majority achieved high academic performance across all demographic responses, as evidenced by the “Very Good” category, which has a grand mean of 88.86. This is as expected of students who, in their SHS, are equipped with study preparation and self-direction in college, as supported by the findings of Rahman et al. (2023) and Putri et al. (2021). Based on age, both groups in the 17–19 years ($M=89.14$) and the 20–22 years ($M=87.29$) are included in the “Very Good” category. This illustrates that age difference alone has little effect on freshman academic performance. This supports the view of Rahman et al. (2023) that academic adjustment, rather than age differences, has a remarkable impact on early college performance. In the male and female characterization, female respondents achieved higher results ($M=89.37$) than male respondents ($M=88.16$), maintaining both in the “Very Good” category. This indicates increased female academic performance driven by high engagement and self-direction, as evidenced by balanced learning discipline. This is reinforced by various recent studies indicating that female students demonstrate persistent academic motivation and higher self-regulation (Fitriani et al., 2022; Susilowati et al., 2020).

Regarding the SHS academic track, each group received a rating of “Very Good.” Still, there were notable differences in the average scores across groups. The highest scores were noted in the STEM ($M=90.66$) and ABM ($M=90.21$) groups. Both of these groups showcase their preparation for the collegiate level and the development of analytical, quantitative, and problem-solving skills. In comparison, the scores of the GAS ($M=87.99$), HUMSS ($M=88.16$), and Non-Academic ($M=87.25$) groups were still “Very Good,” but were relatively lower. All academic tracks provide comparable preparation for the collegiate level. Still, these scores suggest that STEM and ABM tracks offer students more structured opportunities for critical thinking and applied learning, which, in turn, positively impact academic performance. This is supported by the research of Putri et al. (2021), which examines the impact of academic specialization on college preparedness and success. When comparing by respondents’ campus location, those from the Main campus ($M=89.89$) obtained a “Very Good” rating, while those from the External campus ($M=85.78$) obtained a “Good” rating. This shows that some school-related factors do affect the participant's academic performance. Main campus respondents are likely to have a more developed academic environment with greater faculty support. This observation aligns with the findings of Susilowati et al. (2020), who showed that resource-rich academic environments positively impact student success.

Lastly, differences across universities demonstrate the influence of the institutional context. Among all participants, those from University D ($M=92.55$) and University B ($M=92.31$) showed the best performance, earning a “Very Good” rating, which may be attributed to strong academic systems, effective teaching methods, and perhaps more developed instructional support systems. Conversely, respondents from University C ($M=85.78$) reported the “Good” category, which may be due to differences in curriculum implementation, faculty guidance, or available resources, among other factors. University A ($M=89.39$), University E ($M=88.34$), and University F ($M=88.36$) also obtained “Very Good” standing, with very strong performance in the same range. These differences corroborate the findings of Fitriani et al. (2022) and Rahman et al. (2023), which show that the quality of institutions, particularly mentoring, design, and the learning environment, impacts student performance most. Hence, participants scored highly across the variables. Still, the research found that institutional support, academic preparation, and the learning environment were more influential than age and sex differences, the demographic variables. The results suggest that more work is needed to ensure that academic resources are plentiful, that teaching systems are efficient, and that students are well prepared in all aspects from high school to college.

Table 4. *Performance of First-Year College Students When Classified According to Age, Sex, SHS Academic Track, School Location, and University*

Variables	Mean	Description
Age		
17-19 years old	89.14	Very Good
20-22 years old	87.29	Very Good
Sex		
Male	88.16	Very Good
Female	89.37	Very Good
SHS Academic Track		
GAS	87.99	Very Good
STEM	90.66	Very Good
ABM	90.21	Very Good
HUMMS	88.16	Very Good
Non-Academic Track	87.25	Very Good
School Location		
Main	89.89	Very Good
External	85.78	Good
University		
University A	89.39	Very Good
University B	92.31	Very Good
University C	85.78	Good
University D	92.55	Very Good
University E	88.34	Very Good
University F	88.36	Very Good
Grand Mean	88.86	Very Good

Scale of Means: 100-98.80, Excellent; 98.79-92.85, Superior; 92.84-86.90, Very Good; 86.89-80.95, Good; 80.94-75.00, Fair

Significant Differences in the Science Process Skills of First-Year College Students When Classified According to Age, Sex, SHS Academic Track, School Location, and University

Table 5 shows a significant difference in the science process skills of first-year college students across age, sex, and school location, as determined by a t-test for independent samples.

Results revealed no significant difference in the science process skills of respondents across age groups; the t-value was 1.559, and the p-value was 0.121. The p-value was greater than 0.05, indicating no significant difference in science process skills across age groups. Therefore, the null hypothesis, which states that there was no significant difference in the science process skills when classified according to age, was not rejected. Although the older group appears to have a slightly higher mean, the difference is not statistically significant, suggesting that science process skills are relatively consistent across age groups. This study strongly argues that the development of science process skills may be related to prior learning experiences rather than age. This assertion aligns with that of Rahman et al. (2023), who argue that students' preparation and exposure are more significant for the development of academic skills than demographic characteristics.

Similarly, regarding process science skills, no significant differences were found by sex. The declared t-value was 0.348, and the p-value was 0.728. Indicated was a p-value greater than the 0.05 level of significance, which meant that no significant differences were found regarding the process of science skills, based on sex. Thus, the null hypothesis was actually confirmed. This probably means that both groups of respondents have nearly the same level of science skills, and gender probably doesn't contribute much to the development of these skills. This study was likely related to recent research (Fitriani et al., 2022) demonstrating that when male and female students are given the same learning opportunities, they are likely to achieve the same results in performing scientific and logical activities and tasks.

When comparing results classified by school location, the t-value was 1.084, and the p-value was 0.280. The study found no significant differences among respondents. The p-value was greater than 0.05,

indicating no significant difference in the degree of scientific process skills across school locations. The null hypothesis states that there were no significant differences in scientific process skills by school location, which was not rejected. This means that the scientific process skills of respondents in both school locations were at the same level, and school location and its resources were not barriers to the respondents. The uniform skill range may be due to the standardization of instruction and curriculum in the institutions. This also supports the study by Susilowati et al. (2020), which highlights the importance of standardizing instructional practices to address performance disparities. This indicates that skills in the domain of Science are within the range of students' profiles and the environment in which learning takes place, and that competitors are the curriculum, the instruction, and the level of students' engagement, rather than the demographic and education system variables. Improving classroom practices, enhancing laboratory activities, and integrating inquiry-based science learning are science process skills strategies that strengthen learners' skills across the spectrum (Creswell & Creswell, 2024; Karamustafaoglu, 2021; OECD, 2023).

Table 5. *Differences in the Science Process Skills of First-Year College Students When Classified According to Age, Sex, and School Location*

Variable	N	Mean	Mean Difference	t-value	df	p-value	Remarks
Age							
17-19 years old	154	2.67	.263	1.559	155	0.121	Not Significant
20-22 years old	3	2.93					
Sex							
Male	35	2.69	.020	0.348	155	0.728	Not Significant
Female	122	2.67					
School Location							
Main	127	2.66	.064	1.084	155	0.280	Not Significant
External	30	2.73					

*p-value \geq 0.05

Table 6 summarizes the differences in Science Process Skills among the first-year college students when classified according to SHS tracks and was interpreted using Analysis of Variance (ANOVA).

There was a significant difference in respondents' science process skills across shs academic tracks. The F-value was 2.615, and the p-value was .037. Since the p-value is less than .05, the respondents showed a significant difference in their skills. As a result, the null hypothesis is accepted, which states that the respondents showed no significant difference in their skills. This strongly indicates that the Science Process Skills of respondents differ depending on the Academic Tracks they took in SHS.

This illustrates that students' scientific ability, notably skills of observing, experimenting, and analyzing data, are influenced by the Academic Track they choose in SHS. For respondents in STEM tracks, their strong orientation to scientific questioning results from classroom activities, problem-based, research-oriented learning, and laboratory work. This is not the case for students in the more general, or shallow, tracks who have had limited or no opportunities to develop advanced competencies upon entering college.

This is consistent with the research by Rahman et al. (2023), who noted that Science Process Skills are the result of a more structured, developed education.

Additionally, the differences seen across the various academic tracks emphasize the role of curricular consistency and the preparation of students at different levels in assessing their readiness to perform advanced secondary tasks in Science. Susilowati et al. (2020) argue that students who are persistently engaged in active, hands-on educational experiences tend to be better at reasoning and conducting scientific experiments. This accounts for students from educational tracks with a stronger focus on research, data analysis, and critical thinking, achieving a better performance in science process skills.

In addition, the significant result also implies that differences in instructional approaches across tracks contribute to unequal development of competencies. Tracks such as ABM and HUMSS may develop analytical and communication skills, but may not provide the same depth of laboratory or experimental exposure as STEM. As noted by Fitriani et al. (2022), integrating research-based activities and experiential learning is crucial for strengthening students' higher-order thinking skills, including hypothesis formulation and data analysis. Finally, the findings imply that the academic track is a significant factor influencing science process skills, underscoring the need for bridging programs and targeted instructional interventions for students coming from non-STEM backgrounds. Providing additional laboratory exposure, research training, and inquiry-based activities can help ensure that all students, regardless of academic track, develop the necessary competencies for success in college science courses (Putri et al., 2021).

Table 6. *Differences in the Science Process Skills of First-Year College Students When Classified According to SHS Academic Track*

Source of Variation	Sum of Squares	df	Mean Square	F	p-value	Remarks
SHS Academic Track						
Between Groups	.852	4	.213	2.615	0.037	Significant
Within Groups	12.381	152	.081			
Total	13.233	156				

*p-value \geq 0.05

To further analyze which five groups in the SHS academic track differ in their science process skills among first-year college students, Post hoc test (LSD) was used.

Table 6a presents the Post hoc LSD results identifying specific differences in the science process skills of first-year college students when classified according to the SHS academic track. The findings reveal that significant differences are concentrated mainly between GAS and all other tracks, while most other comparisons show no significant variation.

Among GAS respondents, there are significant differences across all other tracks: STEM ($p=.007$), ABM ($p=.044$), HUMMS ($p=.035$), and Non-Academic ($p = .014$). This indicates that GAS respondents have significantly lower science process skills compared to these groups. The consistent pattern suggests that the general nature of the GAS curriculum may provide less intensive exposure to scientific inquiry, experimentation, and analytical thinking. As a result, respondents from GAS may be less equipped with the skills required for scientific tasks. This aligns with studies emphasizing that focused academic preparation enhances the development of science-related competencies (Rahman et al., 2023).

In contrast, the STEM track shows no significant differences compared with ABM ($p=.448$), HUMMS ($p=.498$), or the Non-Academic tracks ($p=.465$); however, it does show a significant difference in the GAS track ($p=.007$). This indicates that STEM respondents perform similarly to respondents across most tracks, except in GAS, where their mean scores are generally higher. The lack of significant difference with other strands suggests that while STEM provides strong scientific training, other tracks may still

develop comparable levels of science process skills through general academic exposure. Research supports that diverse learning experiences can still foster scientific thinking even outside strictly science-focused programs (Fitriani et al., 2022).

For the ABM track, a significant difference was observed only compared with GAS ($p=.044$), whereas comparisons with STEM ($p=.448$), HUMMS ($p=.305$), and Non-Academic tracks ($p=.818$) showed no significant difference. This suggests that ABM respondents demonstrate science process skills comparable to most groups, despite their focus on business and management. This may be due to the development of analytical and problem-solving skills within the ABM curriculum, which can also support scientific reasoning.

Similarly, the HUMMS track showed a significant difference only with GAS ($p = .035$), with no significant differences with STEM ($p = .498$), ABM ($p = .305$), or Non-Academic tracks ($p = .264$). This indicates that HUMMS respondents, although oriented toward the humanities and social sciences, can still develop science process skills at a level comparable to those in other tracks. This supports the idea that critical thinking and inquiry skills are not exclusive to science-based disciplines.

Lastly, the Non-Academic track also shows a significant difference only with GAS ($p = .014$), while STEM ($p = .465$), ABM ($p = .818$), and HUMMS ($p = .264$) show no significant difference. This suggests that even students from non-academic backgrounds can develop science process skills comparable to those of students from academic tracks, provided they are exposed to appropriate learning experiences.

The results revealed a significant difference in the science process skills of respondents, classified by SHS academic track, with the variation primarily in the GAS strand. Thus, the null hypothesis, which stated that there was no significant difference in science process skills across academic tracks, was rejected. Specifically, the GAS track consistently shows significant differences compared with STEM, ABM, HUMMS, and Non-Academic strands, indicating that students in GAS tend to demonstrate lower science process skills. In contrast, no significant differences were found among STEM, ABM, HUMMS, and Non-Academic groups, suggesting that these strands possess comparable levels of competence. Overall, the findings highlight that disparities in science process skills are concentrated in the GAS strand, while the other academic tracks exhibit relatively uniform performance.

This pattern highlights that specialized or even moderately structured academic tracks contribute more effectively to the development of science process skills than general tracks like GAS. It also suggests the need for targeted instructional support for GAS students, particularly in experimentation, data analysis, and scientific reasoning. Strengthening these areas can help bridge the gap and promote more balanced skill development across all academic tracks (Putri et al., 2021; Susilowati et al., 2020).

Table 6a. *Post hoc test (LSD) in the Science Process Skills of First-Year College Students When Classified According to SHS Academic Track*

Dependent Variable	Academic Track	Mean Difference	Significance	Remarks
Science Process Skills	GAS vs STEM	.182	.007	Significant
	GAS vs ABM	.283	.044	Significant
	GAS vs HUMMS	.146	.035	Significant
	GAS vs Non-Academic	.248	.014	Significant
	STEM vs GAS	.182	.007	Significant
	STEM vs ABM	.101	.448	Not Significant
	STEM vs HUMMS	.036	.498	Not Significant

STEM vs Non-Academic	.066	.465	Not Significant
ABM vs GAS	.283	.044	Significant
ABM vs STEM	.101	.448	Not Significant
ABM vs HUMMS	.137	.305	Not Significant
ABM vs Non-Academic	.035	.818	Not Significant
HUMMS vs GAS	.146	.035	Significant
HUMMS vs STEM	.036	.498	Not Significant
HUMMS vs ABM	.137	.305	Not Significant
HUMMS vs Non-Academic	.102	.264	Not Significant
Non-Academic vs GAS	.248	.014	Significant
Non-Academic vs STEM	.066	.465	Not Significant
Non-Academic vs ABM	.035	.818	Not Significant
Non-Academic vs HUMMS	.102	.264	Not Significant

*p \geq 0.05, significant

The significant difference in the science process skills of first-year college students when classified according to university was interpreted using analysis of variance (ANOVA).

Table 6b shows significant differences in science process skills among first-year college students, classified by university. Results revealed a significant difference in the science process skills of respondents across universities; the F-value was 2.331, with a p-value of 0.045. The p-value was less than 0.05, indicating a significant difference in science process skills across universities. Therefore, the null hypothesis, which stated that there was no significant difference in science process skills across universities, was rejected, suggesting that respondents' science process skills are not uniform across institutions.

This large variation suggests that students' scientific skills in observation, experimentation, data analysis, and scientific communication are influenced by their university's scientific excellence. Reasons for performance differences can include differences in school practices, curriculum and sequence, the number of laboratory facilities, and the extent of participation in research. Universities that employ laboratory instruction, in which students learn through experimentation and inquiry, and instruction that helps students engage in purposeful, guided inquiry are more likely to produce students with stronger science process skills. This also supports the assertion by Fitriani et al. (2022) that students' scientific skills development is greatly influenced by research-based learning in scientific research-oriented learning environments.

The results also indicate that the various student outcomes are related to the university's support, including mentorship, equipment, and scientific research collaborations. According to Susilowati et al. (2020), the ability to solve problems and think critically is a result of ongoing participation in inquiry and research. This helps explain why some universities are better than others at developing students' process skills.

The results also indicate that while there may be some adherence to a unifying curriculum framework, variations may exist in how deeply that framework is implemented, how meaningful students' learning experiences are, and in skill development. According to Rahman et al. (2023), prolonged SARS and STEM and inquiry-led teaching and learning target skills that relate to higher-order thinking, specifically skills related to the formulation of hypotheses and the interpretation of data. The results also indicate that institutional characteristics affect the development of science process skills among first-year

students. Therefore, universities must invest in developing their science programs by enhancing the available supplies and infrastructure in their laboratories and by incorporating research-based instruction and faculty engagement. The institution of clear alignment in instructional practices may reduce the range and enhance the equality of students' scientific learning levels (Putri et al., 2021).

Table 6b. *Differences in the Science Process Skills of First-Year College Students When Classified According to University*

Source of Variation	Sum of Squares	df	Mean Square	F	p-value	Remarks
University						
Between Groups	.948	5	.190	2.331	.045	Significant
Within Groups	12.285	151	.081			
Total	13.233	156				

*p-value \geq 0.05

To analyze how the six university groups differ in the science process skills of the first-year students, the LSD Post hoc test was applied.

From Table 6c, Post hoc LSD indicates that University F differed from the others, indicating consistent differences across universities. In this, University F students differ significantly in science process skills compared to University B ($p=.008$), University C ($p=.007$), University D ($p=.020$), University E ($p=.011$), but not University A ($p=.067$). This indicates that University F respondents lack critical Science skills compared to respondents from universities B, C, D, and E, who likely have more academic, laboratory, and hands-on Science activities. University A showed no significant differences from any of the other universities, including University F ($p=.067$). Although the mean difference was the largest, the difference from the other universities was not significant. University A can be characterized as performing at a middle ground between University F and the other high-performing universities B, C, D, and E.

The findings indicated marked differentiation in science process skills across university classifications, with a focus group at University F. The null hypothesis, from the lack thereof in science process skills from university classifications, was rejected. This validates that University F substantially diverges from this constellation and could be indicative of poor instructional delivery, a lack of learning instructional resources, and/or a lack of academic assistance that reinforces the cultivation of the University's F students' science process skills. Notably, Universities A, B, C, D, and E do not show significant variance, suggesting that the five universities exhibit a unified development of science process skills. Universally, universities have the same instructional resources, the same curriculum across all learning disciplines, and the same academic support for instructional strategies. Harmonization, systemized and standardized frameworks, and best instructional practices unify the variances in academic progress among the universities with the same levels of science process skills.

This pattern shows that University F's low performance in the science process skills is mainly responsible for the significant overall ANOVA result, rather than the statistically significant performance across the other participating institutes. That is, the differences in the science process skills may be concentrated at one university, requiring specific academic interventions. In teaching, this may mean that the universities help students develop the science process skills. Research training, an engaged mentor, and the opportunity to learn by doing all help students develop science process skills. On the other hand, if students are denied the opportunity to learn by doing, believe it or not, they learn less science process skills. University F exemplifies this. Newer research shows that students develop better science process skills

when they learn by doing, are mentored by a professor or instructor, and have science process skills available to assist them. (Rahman et al., 2023; Fitriani et al., 2022).

Table 6c. *Post hoc test (LSD) in the Science Process Skills of First-Year College Students When Classified According to University*

Dependent Variable	University	Mean Difference	Significance	Remarks
Science Process Skills	A vs B	.152	.166	Not Significant
	A vs C	.068	.368	Not Significant
	A vs D	.035	.642	Not Significant
	A vs E	.048	.507	Not Significant
	A vs F	.145	.607	Not Significant
	B vs A	.152	.166	Not Significant
	B vs C	.084	.437	Not Significant
	B vs D	.118	.278	Not Significant
	B vs E	.104	.333	Not Significant
	B vs F	.297	.008	Significant
	C vs A	.068	.368	Not Significant
	C vs B	.084	.437	Not Significant
	C vs D	.033	.651	Not Significant
	C vs E	.019	.787	Not Significant
	C vs F	.213	.007	Significant
	D vs A	.035	.642	Not Significant
	D vs B	.118	.278	Not Significant
	D vs C	.033	.651	Not Significant
	D vs E	.014	.846	Not Significant
	D vs F	.180	.020	Not Significant
	E vs A	.048	.507	Not Significant
	E vs B	.104	.333	Not Significant
	E vs C	.019	.787	Not Significant
	E vs D	.014	.846	Not Significant
	E vs F	.193	.011	Significant
	F vs A	.145	.067	Not Significant
	F vs B	.297	.008	Significant
	F vs C	.213	.007	Significant
	F vs D	.180	.020	Significant
	F vs E	.193	.011	Significant

* $p \geq 0.05$, significant

Significant Differences in the Research Competence of First-Year College Students when Classified According to Age, Sex, Senior High School Academic Track, School Location, and University

Table 7 shows the differences in research competence among first-year college students, classified by age, sex, and school location, and was interpreted using a t-test for independent samples.

Results revealed no significant difference in research competence among respondents by age; the t-value was 0.105, and the p-value was 0.988. The p-value was greater than 0.05, indicating no significant

difference in research competence across age groups. Therefore, the null hypothesis, which stated that there was no significant difference in research competence across age groups, was not rejected. This implies that age does not significantly influence students' research competence. This suggests that, despite slight age differences among first-year students, their ability to perform research-related tasks remains relatively consistent. This finding supports recent studies that emphasize that research competence at the early college level is more influenced by academic exposure and learning experiences rather than age differences (Rahman et al., 2023).

Similarly, there was no significant difference in research competence among respondents by sex; the t-value was 0.592, and the p-value was 0.555. The p-value was greater than the 0.05 level of significance, indicating that there was no significant difference in research competence when classified by sex. Therefore, the null hypothesis, which stated that there was no significant difference in science process skills across sex groups, was not rejected. This implies that both male and female students possess comparable levels of research competence. The result aligns with contemporary research suggesting that when provided with equal access to learning resources and academic opportunities, both sexes demonstrate similar levels of academic and research-related skills (Fitriani et al., 2022). This further implies that gender is not a determining factor in the development of research competence among first-year students.

Likewise, there was no significant difference in research competence among respondents classified by school location; the t-value was 1.826, and the p-value was 0.070. The p-value was greater than 0.05, indicating no significant difference in research competence across school locations. Thus, the null hypothesis, which assumed no major differences in science process skills across school locations, was rejected. Slight differences in research competence could be a result of gaining access to different resources and academic support; nevertheless, none are believed to be the key factor. Several studies have shown that most research-related learning outcome differences across locations are due to the consistent delivery of a standardized curriculum and school policies (Putri et al., 2021; Susilowati et al., 2020). Finally, it can be stated that, for the purpose of building research competence among many groups of students, more emphasis should be placed on teaching and academic support than on demographic variables such as the original country (Creswell & Creswell, 2024; Fraenkel, Wallen, & Hyun, 2022; OECD, 2023).

Table 7. *Differences in the Research Competence of First-Year College Students When Classified According to Age, Sex, and School Location*

Variable	N	Mean	Mean Difference	t-value	df	p-value	Remarks
Age							
17-19 years old	154	3.29	.003	.015	155	.988	Not Significant
20-22 years old	3	3.28					
Sex							
Male	35	3.26	.039	.592	155	.555	Not Significant
Female	122	3.30					
School Location							
Main	127	3.31	.127	1.826	155	.070	Not Significant
External	30	3.18					

*p-value \geq 0.05

Table 7a shows the analysis of variance (ANOVA) differences in research competence among the First-Year College Students by the SHS academic track.

The results show that the level of research competence does not differ significantly across respondents by SHS academic track (F-value = 1.013, p-value = 0.403). Since the p-value is greater than the 0.05 level of significance, there is no significant difference in research competence across their SHS academic tracks. Thus, the stated null hypothesis that there is no significant difference among the respondents with respect to their SHS academic track is not rejected. This indicates that the SHS academic track does not have a significant effect on the level of first-year college students' research competence.

The results suggest that the research competence levels of first-year college students across all SHS academic tracks (STEM, ABM, HUMSS, GAS, and no academic track) are roughly the same. The results indicate no significant difference in respondents' research competence across the various tracks. It can also mean that the respondents' basic research competence has been developed at roughly the same level across tracks, or that college instruction has already begun to eliminate the differences. Lastly, the results show that respondents' prior academic track experiences may not be the main reason for their observed differences in research competence, but rather a combination of their learning environment, teaching approaches, and college research exposure.

Additionally, this confirms the idea that universities may offer the same base of research skills in the first year of study, thereby limiting the impact of differences in preparation in senior high school. This aligns with recent studies suggesting that structured instruction, guided research activities, and academic support systems at the college level bridge the knowledge and skill gaps of students with diverse academic backgrounds (Rahman et al., 2023; Fitriani et al., 2022). Standardized curricula and instructional methods may also contribute to achieving comparable learning outcomes (Putri et al., 2021). Therefore, the results show that academic track is not a factor in the research competence of study participants at the beginner level. That instruction and the college environment determine their research skills. It further suggests that the interventions and programs to address competence in research skills target instructional methods rather than the learner's academic track.

Table 7a. *Differences in the Research Competence of First-Year College Students When Classified According to SHS Academic Track*

Source of Variation	Sum of Squares	df	Mean Square	F	p-value	Remarks
SHS Academic Track						
Between Groups	.485	4	.121	1.013	0.403	Not Significant
Within Groups	18.188	152	.120			
Total	13.233	156				

*p-value \geq 0.05

Table 7b illustrates differences in research competence among first-year students, grouped by university, using analysis of variance (ANOVA).

Research competence is demonstrated by universities when they are classified. A 3.432 F-value was observed when a 0.006 p-value was given. Within this range, a significant difference in research competence was detected by university. Thus, the null hypothesis, which stated that there was no significant difference in research competence by university, was rejected. Based on these results, the influence of research competence level is university-specific.

This significant variation also demonstrates that students' research skill development results from a combination of initiatives at the given university and is reflected in students' research competence. Elements of university and research competence are classified. It includes faculty, the university's overall

curriculum, and research training, which is coupled with directed research that develops students' analytical and investigative competence.

Moreover, research suggests that the assistance universities provide in developing students' research skills is not uniform. Some offer better mentoring systems, provide research workshops, and permit students to work on research projects. In contrast, not having such opportunities allows research skills to stagnate. This is corroborated by findings from contemporary educational research, which show that students' research and academic outcomes are significantly associated with the academic support systems and settings of institutions (Putri et al., 2021). Finally, research confirms that students' research skills differ across universities and research centers, regardless of academic program or the teaching and learning environment. This suggests that universities that fall short of research training standards incorporate research-based activities into academic programs and provide research support to students to strengthen their research skills.

Table 7b. *Differences in the Research Competence of First-Year College Students When Classified According to University*

Source of Variation	Sum of Squares	df	Mean Square	F	p-value	Remarks
University						
Between Groups	1.905	5	.381	3.432	0.006	Significant
Within Groups	16.768	151	.111			
Total	18.673	156				

*p-value \geq 0.05

To assess differences in research competence among first-year college students from six different universities, a Post hoc test (LSD) was conducted.

The Post hoc LSD found in Table 7c compares the different levels of research competence of college students across various universities. The results show both significant and non-significant differences, indicating research competence; however, the degree varies by university and is not the same across all universities. This means that some universities are significantly more research-oriented than others.

The results show several significant differences with University A. It shows a significant difference when compared to University B ($p = .023$), University C ($p = .001$), University E ($p = .038$), and University F ($p = .001$), and was not significantly different from University D ($p = .060$). This means that University A was either significantly higher or significantly lower than the other competing universities. Differences in research competence may stem from variations in the curriculum, research exposure, and faculty guidance. Research support and training at higher education institutions are considered to have a significant influence on students' research competence (Rahman et al., 2023; Fitriani et al., 2022).

For University B, a significant difference is noted when compared to University A ($p = .023$). Other comparisons (Universities C, D, E, and F) do not yield significant differences, suggesting that research competence is comparable across most universities. Notably, this reflects consistent research and teaching methodologies and suggests standardized curricula may lead to similar results (Putri et al., 2021).

Apparently, University C shows a significant difference when compared to University A ($p = .001$). For all other comparisons (Universities B, D, E, and F), there is no significant difference. Without a significant difference with all other Universities except University A, it can be construed that University C is comparable to most Universities. Specifically, University D shows no significant difference from the

other Universities, indicating that, along with University D, research guests overall are statistically comparable to, or somewhere along the same continuum as, all listed institutions.

A substantial difference is noted only with University A ($p = .038$), whereas all other Universities (B, C, D, and F) show no significant difference. Thus, University E, in this study, is more aligned with most universities than University A. Meanwhile, University F is significant compared to University A ($p = .001$) but not compared to Universities B, C, D, and E. As a result, research competence with University A is a clear distinction. For all other institutions, it is comparable.

University A is the main source of variation, because it is the only school that shows significant differences when compared with more than one school. On the other hand, Universities B, C, D, E, and F are quite similar to each other. This implies that the ANOVA's significant result is due to University A's performance relative to the other universities.

Based on the findings, it is clear that University A is on a different level compared to the other universities. The difference observed between University A and the other universities underscores the importance of institutional systems and research education and support systems in developing students' research skills. Universities B, C, D, E, and F use one or more of these systems, including integrating research, mentoring, and inquiry-based learning. Where research education and support systems are lacking, gaps in research competence can be decreased. Therefore, University A could be a research education system or a positive example in other educational systems regarding the degree of research competence and innovation in university education in the country. This only confirms that the educational systems in the Research education in a country and the different learning environments strongly determine the development of research skills of students (Putri et al., 2021; Susilowati et al., 2020) and the theological practitioner.

Table 7c. Post hoc test (LSD) in the Research Competence of First- Year College Students When Classified According to University

Dependent Variable	University	Mean Difference	Significance	Remarks
Research Competence	A vs B	.293	.023	Significant
	A vs C	.299	.001	Significant
	A vs D	.164	.060	Not Significant
	A vs E	.178	0.38	Significant
	A vs F	.320	.001	Significant
	B vs A	.293	.023	Significant
	B vs C	.006	.965	Not Significant
	B vs D	.129	.309	Not Significant
	B vs E	.116	.357	Not Significant
	B vs F	.027	.836	Not Significant
	C vs A	.299	.001	Significant
	C vs B	.006	.965	Not Significant
	C vs D	.134	.117	Not Significant
	C vs E	.121	.149	Not Significant
	C vs F	.021	.813	Not Significant
	D vs A	.164	.060	Not Significant
	D vs B	.129	.309	Not Significant
	D vs C	.134	.117	Not Significant
	D vs E	.013	.872	Not Significant
	D vs F	.156	.084	Not Significant
E vs A	.178	.038	Significant	

E vs B	.116	.357	Not Significant
E vs C	.121	.149	Not Significant
E vs D	.013	.872	Not Significant
E vs F	.142	.107	Not Significant
F vs A	.320	.001	Significant
F vs B	.027	.836	Not Significant
F vs C	.021	.813	Not Significant
F vs D	.156	.084	Not Significant
F vs E	.142	.107	Not Significant

* $p \geq 0.05$, significant

Significant Differences in the Performance of First-Year College Students when Classified According to Age, Sex, SHS Academic Track, School Location, and University

Table 8 presents the differences in the performance of first-year college students, classified by age, sex, and school location, and is interpreted using a t-test for independent samples.

Results revealed no significant difference in respondents' performance across age groups; the t-value was 0.840, and the p-value was 0.402. The p-value was greater than 0.05, indicating no significant difference in performance across age groups. Therefore, the null hypothesis, that there was no significant difference in performance across age groups, was not rejected. This suggests that age does not play a crucial role in determining academic performance among first-year students. The similarity in performance may be attributed to the fact that most students, regardless of age, are at similar stages of cognitive and academic development upon entering college. This finding is consistent with recent studies, which emphasize that academic success in higher education is more influenced by prior preparation and learning strategies than by age differences (Rahman et al., 2023; Putri et al., 2021).

Regarding sex, there was no significant difference in respondents' performance; the t-value was 1.677, and the p-value was .095. The p-value was greater than 0.05, indicating no significant difference in performance when classified by sex. Therefore, the null hypothesis, which stated that there was no significant difference in performance when classified by sex, was not rejected. This implies that both male and female students demonstrate comparable levels of academic performance. The result supports existing literature suggesting that when provided with equal learning opportunities and academic support, both sexes can achieve similar outcomes in higher education (Fitriani et al., 2022; Susilowati et al., 2020). While minor variations may exist, these are not strong enough to create meaningful performance gaps.

In contrast, there was a significant difference in respondents' performance across school locations; the t-value was 4.107, and the p-value was 0.000. Since the p-value was less than 0.05, a significant difference in performance was found. As a consequence, the null hypothesis, which claimed that the classification of performance makes no considerable difference, was accepted. This means the claimed hypothesis, that there was a noticeable difference in school location performance, was accepted. Better student performance on the main campus, compared to other campuses (referred to as external campuses), is due to factors such as greater availability of instructional and learning support. An accumulation hinders and constrains students' performance. The distribution and layout of the other main campuses and external campuses have considerable basic instructional resources and facilities, such as learning support. This aligns with the literature on the distribution of resources and the layout of other and external campuses. Lastly, students' performance by school location was considerable, and students from the main and external campuses were not strongly influenced by school location.

Table 8. *Differences in the Performance of First-Year College Students When Classified According to Age, Sex, and School Location*

Variable	N	Mean	Mean Difference	t-value	df	p-value	Remarks
Age							
17-19 years old	154	89.14	1.85	.840	155	.402	Not Significant
20-22 years old	3	87.29					
Sex							
Male	35	88.16	1.21	1.677	155	.095	Not Significant
Female	122	89.37					
School Location							
Main	127	89.89	4.107	5.917	155	.000	Significant
External	30	85.78					

*p-value \geq 0.05

Table 8a presents the differences in the performance of first-year college students, classified according to SHS academic track, as interpreted using analysis of variance (ANOVA).

Results revealed a significant difference in respondents' performance across SHS academic tracks; the F-value was 5.371, with a p-value of 0.000. The p-value was less than 0.05, indicating a significant difference in performance across SHS academic tracks. Therefore, the null hypothesis, which stated that there was no significant difference in research competence across SHS academic tracks, was rejected, suggesting that a student's SHS academic track has a meaningful influence on their college performance.

Moreover, the significant variation implies that students coming from different academic tracks enter college with varying levels of preparation, which affects their academic outcomes. Tracks like STEM and ABM are designed to cultivate skills like analytical thinking, problem-solving, and academic discipline. These skills are crucial for succeeding in higher education. Accordingly, students from these tracks are likely to outperform students from other, non-academic tracks. This aligns with recent research suggesting that academic specialization and degree alignment are key determinants of student success (Rahman et al., 2023; Fitriani et al., 2022).

The discrepancies among academic tracks inevitably reflect differences in exposure to and engagement with discipline-specific content and learning methodologies. Students in tracks with more intensive academic preparation are likely to transition to collegiate-level coursework with less difficulty. Conversely, students in more general tracks are likely to experience wider learning gaps and thus need more remedial assistance to address them. Studies have emphasized that curriculum alignment and prior knowledge are crucial for facilitating students' transition to higher education (Putri et al., 2021; Susilowati et al., 2020). Finally, the findings highlight that the academic track is a significant determinant of freshmen performance, emphasizing the importance of aligning senior high school preparation with college academic demands. These results suggest the need for targeted academic interventions, such as bridging programs or supplemental instruction, particularly for students coming from non-specialized tracks, to ensure equitable learning outcomes and improve overall academic performance (OECD, 2023; UNESCO, 2021; Bernardo, 2020).

Table 8a. *Differences in the Performance of First-Year College Students When Classified According to SHS Academic Track*

Source of Variation	Sum of Squares	df	Mean Square	F	p-value	Remarks
SHS Academic Track						
Between Groups	275.09	4	68.772	5.371	0.000	Significant
Within Groups	1946.37	152	12.805			
Total	2221.46	156				

*p-value \geq 0.05

To further analyze which five groups in the SHS academic track differ in the performance of first-year college students, a Post hoc test (LSD) was used.

As shown in Table 8b, the Post hoc LSD results reveal that significant differences in the performance are mainly concentrated in comparisons involving the STEM track. In contrast, most other track comparisons are not statistically different. This pattern indicates that the observed variation in performance is not widespread but is largely driven by a single group.

Similarly, among the significant differences, STEM consistently excelled. The comparison between STEM and GAS ($p = .002$) shows that STEM respondents perform significantly better than GAS respondents. This suggests that the general nature of the GAS curriculum may not provide the same level of academic rigor and analytical training as STEM. Similarly, STEM vs HUMMS ($p = .000$) indicates a highly significant difference, highlighting that although HUMMS develops critical thinking and communication skills, it may not sufficiently prepare students for quantitatively demanding college tasks. In addition, STEM vs. Non-Academic ($p = .003$) shows a significant difference, suggesting that respondents from non-academic tracks may lack the structured academic preparation that STEM students receive. These findings align with studies that emphasize that students exposed to rigorous, specialized curricula tend to perform better in higher education (Rahman et al., 2023; Fitriani et al., 2022).

On the other hand, several non-significant differences were observed across tracks. Notably, STEM and ABM ($p = .783$) do not significantly differ, suggesting that ABM respondents perform at a level comparable to STEM students. This may be due to the analytical and problem-solving components embedded in the ABM curriculum, particularly in business and financial contexts. Likewise, GAS shows no significant difference from ABM, HUMMS, and Non-Academic tracks, indicating that these groups perform similarly despite specialization differences. Furthermore, HUMMS and Non-Academic tracks also do not significantly differ from ABM and GAS, reinforcing the idea that these tracks share relatively comparable levels of academic performance.

Moreover, the results show that STEM is the only track that consistently shows significant differences, with higher academic performance than several other tracks. In contrast, ABM, GAS, HUMMS, and Non-Academic tracks are statistically similar to one another, suggesting that their differences in curriculum do not translate into significant variations in college performance.

Furthermore, this pattern highlights that academic specialization and rigor, particularly in STEM, play a key role in enhancing student performance, while other tracks tend to produce relatively uniform outcomes. These findings emphasize the importance of strengthening academic preparation across all tracks, especially through curriculum alignment and skill development, to ensure that students are equally prepared for the demands of higher education (Putri et al., 2021; Susilowati et al., 2020).

Table 8b. *Post hoc test (LSD) in the Performance of First-Year College Students When Classified According to SHS Academic Track*

Dependent Variable	Academic Track	Mean Difference	Significance	Remarks
Performance	GAS vs STEM	2.672	.002	Significant
	GAS vs ABM	2.214	.207	Not Significant
	GAS vs HUMMS	.167	.846	Not Significant
	GAS vs Non-Academic	.739	.555	Not Significant
	STEM vs GAS	2.672	.002	Significant
	STEM vs ABM	.458	.783	Not Significant
	STEM vs HUMMS	2.505	.000	Significant
	STEM vs Non-Academic	3.411	.003	Significant
	ABM vs GAS	2.213	.207	Not Significant
	ABM vs STEM	.458	.783	Not Significant
	ABM vs HUMMS	2.047	.223	Not Significant
	ABM vs Non-Academic	2.953	.123	Not Significant
	HUMMS vs GAS	.167	.846	Not Significant
	HUMMS vs STEM	2.504	.000	Significant
	HUMMS vs ABM	2.047	.223	Not Significant
	HUMMS vs Non-Academic	.906	.430	Not Significant
	Non-Academic vs GAS	.739	.555	Not Significant
	Non-Academic vs STEM	3.41	.003	Significant
	Non-Academic vs ABM	2.95	.123	Not Significant
	Non-Academic vs HUMMS	.906	.430	Not Significant

* $p \geq 0.05$, significant

Table 8c presents the differences in the performance of first-year college students, classified by university, and was analyzed using analysis of variance (ANOVA).

Results revealed a significant difference in respondents' performance across universities; the F-value was 17.942, with a p-value of 0.000. The p-value was less than 0.05, indicating a significant difference in performance across universities. Therefore, the null hypothesis, which stated that there was no significant difference in research competence across universities, was rejected, confirming that students' performance varies meaningfully across universities.

Furthermore, the considerable gap in outcomes indicates that various institutions influence students' academic performance. Variations in teaching, lecturer quality, and the presence of academic resources and academic assistance could account for the academic disparity among students at different institutions. Accessible teaching and effective learning environments, supported by research, have positive and lasting impacts on learning outcomes (Darling-Hammond et al., 2020; Schneider & Preckel, 2021). Likewise, institutions that have Classrooms that emphasize learning, surround students with academic feedback, and employ active learning strategies tend to have students who perform better.

The variation in outcomes could also be attributed to passive learning within institutions, particularly in their failure to employ active learning and academic rigor. Active learning, supported by critical and analytical thinking, could lead to better academic outcomes. Current studies also support the idea that students' learning and academic outcomes are directly influenced by institutions with comprehensive teaching systems, active learning, and well-structured academic organizational structures (Freeman et al., 2021; OECD, 2022).

Also include access to facilities and learning infrastructure such as laboratories, libraries, and digital learning resources. Students are more likely to develop a better understanding of their courses and perform better when they can access learning resources. Furthermore, institutional culture factors such as motivation, peer factors, and academic expectations may account for these differences (Marginson, 2021). Lastly, the findings suggest that academic performance across universities varies, and the observed differences highlight the role of institutions in enhancing student success. This is evidence that universities with lower performance outcomes are compelled to improve their teaching quality, access to academic support, and learning environment to close the performance gap.

Table 8c. *Differences in the Performance of First-Year College Students When Classified According to University*

Source of Variation	Sum of Squares	df	Mean Square	F	p-value
University					
Between Groups	827.919	5	165.584	17.942	0.000
Within Groups	1393.540	151	9.229		
Total	2221.459	156			

*p-value \geq 0.05

To further analyze which six groups of universities differ in the performance of first-year college students, a Post hoc test (LSD) was used.

As shown in Table 8d, the Post hoc LSD test revealed that first-year college students' performance significantly varies across universities. University A showed significant differences with University B ($p = .013$), University C ($p = .000$), and University D ($p = .000$), but no significant difference with University E ($p = .178$) and University F ($p = .219$). University B also differed significantly from University A ($p = .013$), University C ($p = .000$), University E ($p = .001$), and University F ($p = .001$), but not from University D (MD = 0.237, $p = .837$). Notably, University C showed significant differences with all universities, including University A ($p = .000$), University B ($p = .000$), University D ($p = .000$), University E ($p = .001$), and University F ($p = .002$), highlighting a distinct range of performance. University D significantly differed from University E ($p = .000$), University C ($p = .000$), University F ($p = .000$), and University A ($p = .000$), and University B ($p = .837$). University E focused on University B (MD = 3.968, $p = .001$), University C (MD = 2.565, $p = .001$), and University D (MD = 4.205, $p = .000$), and University A (MD = 1.049, $p = .178$) and University F (MD = 0.016, $p = .984$). Finally, University F showcased significant difference compared to University B (MD = 3.951, $p = .001$), University C (MD = 2.581, $p = .002$), and University D (MD = 4.188, $p = .000$). Moreover, University A (MD = 1.033, $p = .219$) and University E (MD = 0.016, $p = .984$) showed no difference.

The conclusive survey grouped A with E and F, and B with D, whereas University C stood as an incomparable entity. Many pairwise comparisons rejected the null hypothesis, suggesting no notable difference among first-year students within a particular University. It was therefore concluded that the particular University attended by a student strongly impacts their performance, attributed to factors such as established teaching methods, academic support, and overall educational environments (De Guzman, 2024; Torres & Villanueva, 2023).

Table 8d. *Post hoc test (LSD) in the Performance of First-Year College Students When Classified According to University*

Dependent Variable	University	Mean Difference	Significance	Remarks
Performance	A vs B	2.918	.013	Significant
	A vs C	3.614	.000	Significant
	A vs D	3.156	.000	Significant
	A vs E	1.049	.178	Not Significant
	A vs F	1.033	.219	Not Significant
	B vs A	2.918	.013	Significant
	B vs C	6.532	.000	Significant
	B vs D	.237	.837	Not Significant
	B vs E	3.968	.001	Significant
	B vs F	3.951	.001	Significant
	C vs A	3.161	.000	Significant
	C vs B	6.532	.000	Significant
	C vs D	6.770	.000	Significant
	C vs E	2.565	.001	Significant
	C vs F	2.581	.002	Significant
	D vs A	3.156	.000	Significant
	D vs B	.237	.837	Not Significant
	D vs C	6.770	.000	Significant
	D vs E	4.205	.000	Significant
	D vs F	4.188	.000	Significant
	E vs A	1.049	.178	Not Significant
	E vs B	3.968	.001	Significant
	E vs C	2.565	.001	Significant
	E vs D	4.205	.000	Significant
	E vs F	.016	.984	Not Significant
	F vs A	1.033	.219	Not Significant
	F vs B	3.951	.001	Significant
	F vs C	2.581	.002	Significant
	F vs D	4.188	.000	Significant
	F vs E	.016	.984	Not Significant

* $p \geq 0.05$, significant

Relationship between Science Process Skills, Research Competence, and Performance of First-Year College Students

To determine the relationships among science process skills, research competence, and the performance of first-year college students, the researcher employed the Pearson Product-Moment Correlation Coefficient (r).

As shown in Table 9, the results revealed a low correlation and a significant relationship ($r = 0.382$, $p = 0.000$). Thus, the null hypothesis, which states that there is no significant relationship between the science process skills and research competence, was rejected. This result indicates that respondents who demonstrate higher levels of science process skills also exhibit stronger research competence. This relationship suggests that foundational scientific skills such as observing, classifying, inferring, and experimenting are closely linked to the ability to conduct research effectively. This finding aligns with recent studies emphasizing that science process skills serve as a core foundation for developing research capability, as they enhance analytical thinking and methodological understanding (Dela Cruz & Ramos,

2021; Villanueva, 2022). In higher education contexts, students with strong science process skills are more likely to perform better on research-related tasks, thanks to improved data interpretation and problem-solving (Garcia & Mendoza, 2023).

On the other hand, the relationship between the science process skills and the performance of first-year college students, as assessed using the Pearson Product-Moment Correlation Coefficient, is negligible and non-significant ($r = 0.119$, $p = 0.138$). Thus, the null hypothesis, which stated no significant relationship between the science process skills and performance, was not rejected. This implies that science process skills do not have a meaningful direct relationship with students' overall academic performance. This suggests that academic performance may be influenced more by factors such as study habits, motivation, instructional quality, and the learning environment than by science process skills alone. Similar findings were reported in recent educational research, where cognitive skills alone did not significantly predict overall academic performance when other variables were considered (Reyes & Santos, 2020; Lim & Navarro, 2022).

Similarly, the relationship between research competence and the performance of first-year college students, as measured by the Pearson Product-Moment Correlation Coefficient, is negligible and non-significant ($r = 0.137$, $p = 0.087$). Thus, the null hypothesis, which states that there is no significant relationship between research competence and performance, was not rejected. This result means that higher research competence does not necessarily translate into higher overall academic performance among first-year students. This result may imply that research competence is still developing at the freshman level and may not yet strongly influence general academic outcomes. According to recent studies, research competence becomes increasingly influential in later academic years, as students engage in more complex academic writing and research outputs (Torres & Villanueva, 2023; Santos, 2022).

Table 9. *Relationship between Science Process, Research Competence, and Performance of First-Year College Students*

Variables	r-value	p-value	Interpretation
Science Process Skills vs Research Competence	0.382**	0.000	Significant
Science Process Skills vs Performance	0.119	0.138	Not Significant
Research Competence vs Performance	0.137	0.087	Not Significant

** Correlation is significant at the 0.01 level (2-tailed).

CONCLUSIONS

Based on the foregoing findings, the following conclusions were drawn:

1. First-year college students tend to be well-equipped with science process skills regardless of age, sex, academic track, school location, and university, which shows a uniformity in the development of these basic scientific skills among varying constituents of students
2. Research competence is high, with most students demonstrating strong research skills. However, differences across academic tracks, school locations, and universities suggest that competence is influenced by prior preparation and institutional support.
3. The academic performance of first-year students is generally very good, demonstrating their ability to meet the academic demands of college. However, differences between schools and universities suggest that institutional factors may affect performance variations.
4. The science process skills show that age, sex, and school location do not have a significant effect. In contrast, academic track and university do, reflecting the impact of both prior academic training and the institution's context.

5. Research competence shows that age, sex, school location, and academic track do not have a significant effect, while the number of universities does, reflecting the role of institutional practices and research training settings.

6. Research competence shows that age and sex do not have a significant effect, while several universities do, reflecting the role of institutional practices and research training settings.

7. There is a strong link between science process skills and research competence, suggesting these skills share a close relationship. However, both science process skills and research competence do not have a strong link to academic performance, which suggests that a multitude of other variables influence students' academic achievements.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are hereby proposed:

1. Since science process skills are generally high but vary widely by academic track and university, institutions should focus on enhancing inquiry-based and laboratory-centered instruction, particularly for non-STEM and non-academic-track students. Bridging activities and exposure to remedial science laboratories may help standardize competencies across different groups.

2. Despite high levels of research competence, variations across institutions of higher education signal the need to strengthen institutional research training programs. To achieve uniformity in capacity building across campuses, universities need to organize structured workshops on research design, statistical analysis, qualitative data coding, and research software.

3. Given the impact of academic track on science process skills and academic performance, there is a need for better alignment between senior high school and college curricula. Bringing together programs focused on Science and research to fill the gaps in preparation for the scientific and academic tracks should be implemented.

4. Variations in students' academic performance by school location and type signal the need to improve access to laboratories, learning materials, and academic assistance, especially on external campuses. The focus should also be on the equity of instructional standards within campuses.

5. To enhance students' science process skills and research capabilities, instructors should adopt student-centered, research-oriented approaches.

6. Mentoring systems, peer tutoring, and academic coaching should be introduced to help students improve both their research competence and academic performance, particularly in non-STEM disciplines and on external campuses.

7. Given the relationship but lack of direct correlation between science process skills, research competence, and academic performance, academic and research programs should incorporate factors such as motivation, study habits, and learning environment, as these are critical for student development.

8. To gain further insight into student success in higher education, additional studies can explore learning motivation, teaching quality, learning strategies, and socio-economic background as factors that impact academic performance.

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