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Integrated Science Process Skills of Science, Technology and Engineering Students: Challenges and Opportunities for Improvement

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Abstract

The Philippines has one of the lowest average scientific proficiency scores among the PISA-participating countries and economies. The present study investigates the integrated science process skills of grade 9 Science, Technology, and Engineering (STE) program students in Angeles City, Philippines. 79 grade 9 STE program students were invited to be part of the study. They were mostly female and came from non-special science elementary schools. This study utilised a 30-item integrated science process skills test by Kazeni (2005). The reliability of the instrument is 0.81. This study used statistical analysis, specifically descriptive statistics (frequency, mean, standard deviation, one-way ANOVA, and point-biserial correlation). Based on the results, there is no significant relationship between their score from the 30-point integrated science process skills test and their gender and previous elementary school, whether the students came from special science elementary school or non-special science elementary school. This investigation recommends integrating science process skills throughout the curriculum by embedding inquiry-based learning opportunities. Courses could be designed to progress from basic science process skills such as observing, measuring, communicating, classifying, and predicting to more complex tasks such as defining operationally, formulating hypotheses, interpreting data, experimenting, and formulating models. Aligning the curriculum with frameworks that emphasise critical thinking and problem-solving, which are core components of integrated science process skills, is suggested. A series of instructional strategies that foster active student engagement with these skills, such as case- and project-based learning strategies, are proposed. The use of formative assessments is recommended to track the science process skills over time. Integration of technology tools that design and simulate experiments to offer additional avenues for skill development is encouraged.

Keywords: Integrated Science Process Skills, Operationally Defining, Strategic Intervention Material, Science, Technology, and Engineering Program Students, Philippines

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INTRODUCTION

The capacity to think critically and use scientific inquiry techniques is more important than ever in today's quickly changing scientific environment. The foundation of this scientific literacy is comprised of integrated science process skills (ISPS), which include core competencies such as variable manipulation, data analysis, and hypothesis creation. Research indicates that many students find it difficult to acquire these abilities in a logical, practical way despite their crucial necessity. This study examines how students interact with and develop these crucial skills within the scientific curriculum, as well as the present status of ISPS development. In order to better prepare students for the challenges of tomorrow's scientific and technological breakthroughs, this project attempts to provide practical insights that can transform science teaching.

The phrase "scientific process skills" is frequently used today. These abilities, made popular by the curriculum initiative Science - A Process Approach (SAPA), are described as a collection of broadly transferable competencies suitable for various science disciplines and indicative of the behaviour of scientists. Process skills were divided into two categories by SAPA: basic and integrated. The basic (easier) process abilities provide a basis for understanding the integrated (more complex) skills. The basic SPS entails observing, classifying, communicating, measuring, using numbers, predicting, making inferences, and using spacetime relationships. On the other hand, the integrated SPS includes identifying and controlling variables, making hypotheses, interpreting data, defining operationally, and experimenting (NARST, 2018).

Every three years, 15-year-old pupils' science literacy is evaluated as part of the Program for International Student Assessment (PISA), a global assessment. PISA intentionally focuses on the practical skills that students have learned as they get closer to finishing their compulsory education (Kastberg et al., 2021). According to PISA results 2018, the Philippines has one of the lowest average scientific proficiency scores among the participating nations and economies. 15-year-olds perform on average 357 points in the science subject and a rank of 76/77. Boys' scientific performance is among the worst among PISA-participating nations and economies, with a 355 PISA Score and a rank of 76/77. With a 359 PISA Score and a 76/77 ranking, girls' science performance is among the worst among PISA participant nations and economies (Education GPS, 2022). The PH education system is five to six years behind, according to the PISA results (Ines, 2023).

Moreover, according to the Trends in International Mathematics and Science Study 2019, the Philippines performed "much lower" on math and science tests for grade 4 than any other country that took part. The Philippines' scientific score of 249 is "much lower" than any other participating nation. The nation received the worst grade out of the 58 competing nations. The pre-assessment performance showed that the students were "moving toward mastery" in their basic science process skills and at a "low mastery" level in their integrated science process skills. In contrast, their post-assessment performance showed that they were "near mastery" in their integrated science process skills and "mastery" in their basic science process skills. When it comes to basic and integrated science process abilities, there is a notable difference in the student's performance before and after the evaluation. Accordingly, the respondents thought that case and project-based learning was a very successful approach. Teachers may think about using lesson exemplars with case and project-based learning methodologies as a way to evaluate and enhance their students' science skills based on the conclusions presented (*Case and Project-Based Learning Lessons in Enhancing Science Process Skills - IIARI*, 2024).

According to the findings of another study, the use of practical work led to a consistent increase in students' acquisition of science process skills in each cycle, and all students were able to show some degree of the necessary science process skills at the post-test level as compared to the pre-test level. Additionally, a paired sample t-test analysis with a 95% confidence level revealed a substantial improvement in the student's academic performance before and after the practical work (Apeadido et al., 2024).

The impact of research inquiry-based teaching tactics on students' academic accomplishments (AA), attitudes, and scientific process abilities was examined in a quasi-experimental study by Tekin, Mustu, and colleagues (2021). (SPS). Fifty pupils in Grade 7 at a Bartin secondary school connected to the Ministry of Education (MoE) made up the study sample. This study aimed to compare the effectiveness of research inquiry-based teaching styles using experimental and control groups. Following the research-inquiry-based teaching methodology and the objectives outlined in the MoE curriculum, a three-week trial run of a teaching program for the topic of "Reflection and Light Absorption in Mirrors" was done with the experimental group. The normal Classroom Science Course Curriculum was used in the control group. The experimental and control groups underwent pre-and post-tests using the SPS Test, AA Test, and Attitude Scale. Utilising quantitative analysis techniques, the test findings were examined. Thus, it was discovered that adopting research inquiry-based techniques in science courses favoured students' AA, attitudes, and SPS.

Before putting the procedures into practice, students need to have a solid grasp of the science process skills (SPS) to conduct effective science inquiry and engage in hands-on science learning. SPS serves as the foundation for scientific investigation and critical thinking. The study looked into how well kids were learning SPS and how that related to their scientific and academic performance. The Science Process Skills Test was given to 100 randomly chosen Grade 7 students at a private secondary school in Northern Luzon, Philippines. It is a 24-item test to measure students' basic and integrated SPS. Both descriptive and correlational research techniques were used to analyse the data. According to the study, the students have a poor level of integrated science process skills and an average level of fundamental science process skills. It was found that basic SPS and student performance in science were significantly correlated. On the other hand, it was discovered that pupils' integrated SPS was not significantly related. Additionally, there was a very strong, positive association between students' achievement in science and their overall science process skills. Therefore, it was advised that to improve and elevate students' accomplishments in science, the science process skills of students are enhanced through appropriate designs of inquiry-based experiments and activities (Derilo, 2019).

The Special Program in Science, Technology, and Engineering (STE) offers a four-year curriculum focusing on science based on the K–12 secondary education programs. The K–12 Curriculum's Learning Competencies must be followed in the main disciplines. The research subject shall be used in place of the Technology and Livelihood Education subject. However, a lesson on computer education for research will be included. The subject selections and time allotment must be adhered to strictly. Science and math courses have been improved.

Patterns in students' scientific literacy and process skills are regularly seen in the results of numerous international science assessments, highlighting the need for focused interventions. These all-encompassing, worldwide metrics, however, frequently fall short of capturing the unique educational requirements and environments of regional communities. In the Division of Angeles City, where comprehensive, region-specific examinations that examine science process abilities within the framework of the local Science, Technology, and Engineering (STE) Program are lacking, this deficit in localised data is especially noticeable. Because of this, current teaching methods might not adequately address the particular difficulties and requirements of pupils in this area.

By doing a localised assessment of science process skills with a particular focus on the STE Program in implementing schools in Angeles City, this study seeks to close this crucial gap. The study will offer more practical insights that are directly applicable to the educational landscape of the area by establishing the assessment in local circumstances. The findings of this study will provide specific, contextually relevant data that can be used as a basis for focused enhancements to the STE Program, in contrast to worldwide assessments that provide broad generalisations. This study aims to improve the effectiveness of science education at the regional level by ensuring that local educational initiatives are more in line with students' actual requirements.

The research objectives align with this gap by: 1) To describe the integrated science process skills of students in the STE program. Since there are currently few region-specific assessments available in the local context, it directly addresses the need for localised data on how students in this program are performing in terms of ISPS, 2) To analyse the connection between STE program students' integrated science process abilities, gender, and prior primary school experience — This objective aims to investigate how individual factors like gender and past educational background impact ISPS development. Comprehending these connections can provide subtle perspectives that are not covered by international evaluations, enabling more customised solutions; 3) To Analyze the connection between STE program students' integrated science process abilities, gender, and prior primary school experience — This objective aims to investigate how individual factors like gender and past educational background impact ISPS development. Comprehending these connections can provide subtle perspectives that are not covered by international evaluations, enabling more customised solutions; 4) To develop strategic intervention materials based on the lowest skill identified: This objective is to provide useful materials that can be used immediately in the classroom, guaranteeing that the results of the study result in improvements that can be implemented in the local STE Program. It addresses the deficiency of regionally relevant teaching resources and approaches, and 5) To inform curriculum development and teaching strategies in the Science, Technology, and Engineering Program – By providing specific, contextually grounded data, this objective will contribute to the refinement of teaching strategies and curriculum content. The aim is to bridge the gap between broad, generalised international assessments and the unique needs of local students, ensuring that the STE Program is more effective in developing essential science process skills.

Overall, the objectives of this study are carefully designed to address the gap in localised assessments of ISPS and to provide specific recommendations that can directly improve the STE Program's effectiveness.

METHODS

Given the study's emphasis on characterising and evaluating the integrated science process skills (ISPS) of Grade 9 students in the Science, Technology, and Engineering (STE) Program, the descriptive research design is the most suitable methodology for this inquiry for a number of important reasons. The goals of this study are perfectly aligned with this methodology, which is specifically designed to collect comprehensive, methodical information about the characteristics of a certain group. The main objective is to characterise the ISPS level of students in the STE Program. The descriptive technique is the most efficient method because the study documents present skills rather than modifying variables or establishing causal links.

The goal of descriptive research is to provide answers to basic questions like "what," "when," and "how." This study aids in determining the degree of integrated science process abilities possessed by Grade 9 STE students. Moreover, what elements affect these abilities (e.g., gender, previous schooling)? The descriptive technique offers a thorough and accurate knowledge of the student's present level of science process skills by collecting data that address these topics.

The descriptive design's capacity to gather information in an organic, real-world setting is one of its advantages. The study evaluates students' science process abilities in the classroom, guaranteeing that the findings are based on real-world, genuine learning settings. This is important because one of the main goals of this research is to make the findings more usable and relevant to the local context. This method of data collection guarantees that the study's conclusions are relevant to the particular requirements and difficulties that the students in the Angeles City Division encounter (Research Connections Organization, 2022).

The sampling procedure for this study involved the selection of Grade 9 students enrolled in the Science, Technology, and Engineering (STE) Program in the Division of Angeles City. At the Grade 9 level, students in the Philippines are typically aged 14-15 years. According to the latest enrollment report, there are 79 students currently enrolled in the Grade 9 STE Program within the targeted schools.

A census sample strategy was used because the overall population of Grade 9 STE students is manageable and very small. This indicates that all 79 STE Program students were invited to take part in the study rather than choosing a sample from the general community. In order to ensure that the results are representative of the target population, the study included all Grade 9 students in order to collect thorough data that appropriately reflects the group's integrated science process skills (ISPS).

Because it removes sample bias and gives a comprehensive picture of how all students in the Grade 9 STE Program use science process skills, this method was selected to maximise the reliability and validity of the results. The study's conclusions are made richer by the manageable population size, which also enables a more thorough examination of the abilities and traits of each participant.

This study utilised a 30-item integrated science process skills test developed by Kazeni (2005) with a reliability coefficient of 0.81. The test assesses skills such as identifying and controlling variables, stating hypotheses, defining operationally, graphing and interpreting data, and experimenting. To ensure content validity, six peer reviewers, including biology instructors, physicists, chemists, and University of Limpopo lecturers, evaluated the test's alignment with its intended goals. After reviewing the test items, the raters provided 456 responses, with 68% agreeing on the appropriate alignment of items with the objectives. Although this content validity agreement was initially low, revisions were made based on feedback from the pilot study's item analysis.

Further validation focused on the accuracy and objectivity of the scoring key. Ninety-five per cent of the raters agreed with the test developer's scoring key. Items that did not receive consistent agreement were adjusted or removed. An English professor also reviewed the language for grammatical and clarity issues, and students in Grades 9, 10, and 11 identified problematic phrases. Based on all feedback, the test was revised, eliminating problematic items and retaining 58 items for the second draft used in the pilot study.

Following the pilot study, a second round of validation with the same six raters resulted in 186 responses, with 98% agreement on item alignment with the goals and full consensus on the accuracy and objectivity of the test items. These revisions ensured the test's content validity before it was used in the main study.

To obtain the contact information of the author of the instrument, the researcher emailed the school where she is currently affiliated, which gave the author a direct email. The researcher emailed the author directly and was permitted to use the 30-item valid and reliable instrument.

This study utilised statistical analysis, specifically, descriptive statistics (frequency, mean, standard deviation, one-way ANOVA, and point-biserial correlation), which involves tabulating, depicting, and describing collected data. One-way ANOVA compares the means to determine whether there is statistical evidence that the associated population means of two or more independent groups are significantly different. The point-biserial correlation measures the relationship between a continuous variable and a dichotomous variable (i.e. male/female). A statistician was consulted to correctly apply statistical theories and methods to analyse and interpret quantitative data.

An information sheet was presented to the interested parties before administering the structured questionnaire. With this, the participants will be fully informed about the rationale and purpose of the study, the time required to answer the structured questionnaire, the study procedure, and the name and contact information of the researcher in case there is a question or concern about the research. Participants were reminded of voluntary participation and had the right to withdraw without harmful consequences. Participants did not receive a financial reward for participating in the study. Collected data, which include but are not limited to personal information, consent, and analysed data, shall be processed in compliance with the provisions of the Data Privacy Act of the Philippines. These were kept in secured storage and will be disposed of after the study has been published. Data was retained on a password-protected computer, and printed documents must be kept in a secured cabinet for a year before being deleted and shredded. The collected data will be solely used for this research. Participants will be asked for their consent before the researcher can keep and use their information for further study, although they are free to decline. To protect participants from the risk of harm and being recognised based on their distinctive characteristics, their identity will not be revealed in the published research paper. Individual findings will not be sent to the organisation, administration, or staff with whom they are now associated. Therefore, they will not have any bearing on their connection with them. The researcher will let the participants know whether the study will be presented at a colloquium or forum for researchers or whether it will be published in a journal. Each participant can obtain a summary of the results before it is generally accessible to the public. The research study's conduct involves no funding or conflicts of interest. The researcher seeks the approval of an Institutional Review Board to ensure that the process will give importance to the ethical concerns that need to be addressed.

RESULTS & DISCUSSION

Results

This section presents the level of integrated science process skills and the relationship between integrated science process skills, gender, and previous elementary school of science, technology, and engineering program students. The findings will become the basis of the material to be developed.

Table 1. Summary of Mean and Standard Deviation in terms of the Integrated Science Process Skills of Grade 9 Science, Technology, and Engineering Program Students

Integrated Science Process Skill	Mean	Std. Deviation	Verbal Interpretation
Defining Operationally	0.37	0.22	Low
Identifying and Controlling Variables	0.74	0.23	High
Experimenting	0.59	.027	Average
Interpreting Data	0.51	0.23	Average
Formulating Hypothesis	0.43	0.23	Average
General Average	0.53	0.24	Average

The mean and standard deviation were computed due to the differing number of items per skill or category. Using these measures of central tendencies reflects that the skill with the highest computed mean is identifying and controlling variables skill where

$\bar{x}$=.0.74 and SD=0.23 are interpreted as "High." However, the skill interpreted as "Low" is on defining operationally, which has a computed mean of $\bar{x}$=0.37, SD=0.22. Experimenting, interpreting data, and formulating hypotheses are interpreted as "Average." The table also reflects that the general mean score of the respondents is at $\bar{x}$=0.53 and SD=0.24 with a verbal interpretation of Average.

Further investigation of the individual items of the low-rated skill on defining operationally was conducted. The mean score for each item was observed, and it was found that item 18 obtained the lowest mean at $\bar{x}$=0.16, SD=0.37, interpreted as Very Low. This implies that this item has the least number of correct responses by the participants. It is worth noting that there were items rated as Low, such as item 7 ($\bar{x}$=0.21, SD=0.41) and 22 ($\bar{x}$=0.26, SD=0.4).

Table 2. Multiple Comparisons Test using One-Way ANOVA in terms of the Integrated Science Process Skills of Grade 9 Science, Technology, and Engineering Program Students

(I) Skill	(J) Skill	Mean Difference (I-J)	Sig.
Defining operationally	Identifying and controlling variables	-0.37^{*}	0.00
	Experimenting	-0.22^{*}	0.00
	Interpreting data	-0.14^{*}	0.015
	Formulating hypothesis	-0.06	0.64
Identifying and controlling variables	Experimenting	0.15^{*}	0.01
	Interpreting data	0.23^{*}	0.00
	Formulating hypothesis	0.31^{*}	0.00
Experimenting	Interpreting data	0.08	0.34
	Formulating hypothesis	0.16^{*}	0.004
Interpreting data	Formulating hypothesis	0.08	0.34

Note. A significant difference, p<0.01. The negative mean difference implies that the other variables obtained a significantly higher mean score than the mean score for the other skill.

After treating the data per skill using one-way ANOVA, it can be seen from the table that there is a statistically significant difference in the scores of participants between defining operationally and identifying and controlling variables (MD=-0.37, p < 0.01), defining operationally and experimenting (MD=-0.22, p < 0.01), representing operationally and interpreting of data (MD=-0.14, p < 0.01).

It can also be observed that there was a significant difference in the scores when items were grouped according to identifying and controlling variables and experimenting (MD=0.15, p < 0.01), denoting that the latter has a lower mean score than the former. A significant difference was also observed between skills in identifying and controlling variables in comparison to interpreting data (MD=0.23, p < 0.01), as well as identifying and controlling variable skills versus formulating hypothesis (MD=0.31, p < 0.01).

When the scores of participants under the experimenting skills were compared to scores on other skills, there was a significant difference between the means score for experimenting and the scores on the skill of formulating hypothesis (MD=0.16, p < 0.0). The last pairing is the comparison of skills in interpreting data and the skills in formulating hypotheses but rendered insignificant differences on the computed means.

Table 3. Significant Relationship in Integrated Science Process Skills of Grade 9 Science, Technology, and Engineering Program Students in terms of Gender and Previous Elementary School

Gender	Pearson Correlation	-.036
	Sig. (2-tailed)	.790
Previous Elementary School	Pearson Correlation	0.004
	Sig. (2-tailed)	0.978

Note. There was no significant correlation for both variables and no computed *p*<0.05.

A point-biserial correlation was used to determine whether there was a significant relationship between the demographics of the respondents and the scores they obtained from the test. This test was conducted because there were only two responses for each variable. It can be observed that there is no significant relationship between the gender of the respondents and their score (p=0.79). Also, there is no statistically significant correlation between the previous elementary school attended by the participant and the garnered score (p=0.978). No computed p-value is less than α=0.05, implying no significant correlation for both variables.

Discussion

Based on the data, many of the Grade 9 STE Program students in the Division of Angeles City are female. In terms of their previous elementary school, many of them came from non-special science elementary schools.

The integrated science process skill that obtained the interpretation "high" is identifying and controlling variables.

The integrated science process skill that gained the lowest mean is the skill of defining operationally. A thorough explanation of the technical phrases and measures used during data gathering is known as an operational definition of terms. The purpose of this is to standardise the data. Every time data is being gathered, it is essential to specify the data collection process precisely. Undefined data has the potential to be inconsistent and may not produce the same findings in a replicated study. We frequently presume that the people gathering the data know what to do and how to accomplish it. People may, however, interpret the same thing differently, which will have an impact on the data gathering. A thorough operational definition of terms is the sole method to guarantee data consistency (*How to Write Operational Definition of Terms?*, 2019).

Since the skill of operationally defining obtained the lowest mean, the strategic intervention material, which is the output of the study, focused on this skill. In terms of the skill sequence, the following progression was followed: 1.0 differentiate an operational definition from a conceptual one; 2.) select characteristics of phenomena suited to use in a working definition; 3.) state minimal observable characteristics required for an operational definition, and 4.) evaluate and modify specific operational purposes. Since the participants came from the grade 9 level, terms from the first quarter period of the grade 9 curriculum guide were utilised. The actual topics included were: 1. Circulatory System; 2. Respiratory System; 3. Inheritance; 4. Genetic Variation; 5. Species Extinction; 6. Photosynthesis; and 7. Cellular Respiration. The strategic intervention material includes a guide card, activity card, enrichment card, assessment card, and reference card. The Strategic Intervention Material was created to help students who are struggling with a particular skill.

After determining the relationship between the respondent's demographics, particularly gender and previous elementary school, and their score from the 30-point integrated science process skills test, it was found that there is no significant relationship between gender and the score from the integrated science process skills test. Similarly, there is no significant relationship between the previous elementary school and the integrated science process skills test score. In contrast with the results of this study, Yuliskurniawati's (2019) analysis showed that the abilities of male and female students in the science process differed. Compared to male pupils, female students demonstrated superior science process skills. This result is consistent with a recent study that successfully showed that the science process skills of female students were significantly superior to those of male students. The scientific exam results of the female pupils dramatically improved. According to a study on the relationship between students' attitudes toward science and their performance in science, female students demonstrated more positive attitudes toward science and, as a result, scored higher than male students. According to research, female students are more conscientious and thorough than male pupils. Female students are more likely to verify the outcomes of their work frequently. Even though male and female students will often utilise comparable approaches to problem-solving, they also have a more substantial capacity for argument. Before deciding, female students like to get a second perspective.

In contrast, other research findings revealed that male students had stronger science process abilities than female students. They are also more competitive than male students, who prioritise dependence on learning. Gender has no bearing on mathematics, communication, science, or aggressiveness, according to the report. Science process skills across men and women did not differ significantly. In reality, male students are stronger in math and science, while female students will score better in more feminine fields, like music and painting. Additionally, the fundamental, informal, experimental, and science process skills of male and female students vary. In comparison to female students, male students are more proficient in fundamental, informal, and experimental process abilities.

CONCLUSION

The study's conclusions highlight the development of integrated science process abilities of both students in the Grade 9 STE program and their opportunities for growth. Although the majority of these pupils are female and attend elementary schools that do not concentrate on science, they show a high level of competence in identifying and controlling variables. This skill needs to be maintained and developed. However, abilities like conducting experiments, analysing data, and developing hypotheses continue to be mediocre, indicating the obvious need for focused interventions to improve these proficiencies. The lack of competence in operationally defining variables is very concerning and calls for prompt attention as well as specialised teaching methods.

It is interesting to note that neither gender nor previous educational background significantly correlated with students' integrated science process skills. This research casts doubt on presumptions regarding the influence of these variables and emphasises the necessity of more targeted, skill-specific teaching strategies. The findings ultimately imply that, even though certain fundamental abilities are being taught, a thorough revision of the curriculum and instructional strategies is required to close the gaps in students' science process skills and better equip them for the demands of scientific research in the future. The extremely small sample size of this study, which only included Grade 9 STE students from one division in Angeles City, is one of its limitations. This small sample might not accurately reflect all pupils in the Philippines or other educational settings. Findings that are more broadly applicable and representative of a greater variety of student experiences would be possible with a larger, more varied sample drawn from several geographical areas. Furthermore, rather than monitoring students' development over an extended period, the study's cross-sectional methodology merely offers a glimpse of their integrated science process skills at a single moment in time. A deeper understanding of how students' abilities change and advance throughout their education, particularly in response to instructional interventions, might be possible with longitudinal studies.

The study's exclusive focus on gender and prior educational experience as potential influencing factors, which did not reveal any meaningful associations with students' skills, is another drawback. Other important factors, such as instructional strategies, socioeconomic standing, or resource accessibility, were not thoroughly examined, nevertheless. To better understand the wide range of influences on the development of science process abilities, future studies should take these elements into account. Furthermore, even while the 30-item integrated science process skills exam was dependable, it might not have adequately represented every facet of scientific investigation. Students' proficiency in different science process skills could be better understood by using more thorough or extra evaluations.

Future research should use a larger, more varied sample and a longitudinal design that monitors the evolution of science process abilities over time in order to overcome these constraints. This would make it possible to examine how skills develop and how different teaching methods affect students' learning in more detail. Furthermore, future studies should examine how various teaching methods, student motivation, and outside resources affect skill development, broadening the scope of variables taken into account. More focused suggestions for enhancing scientific education would result from this wider reach. Additionally, more targeted, interactive activities that promote skill mastery should be employed to improve the curriculum in areas where students showed average or low competency, especially in experimenting and operationally defining variables. Finally, professional development programs for teachers could improve their capacity to teach these critical science process abilities successfully.

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