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SCIENCE PROCESS SKILLS OF INDUSTRIAL TECHNOLOGY STUDENTS IN THE HIGHER EDUCATION: A CLASSROOM-BASED ASSESSMENT

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ABSTRACT

Industrial technology students not only preparing for the opportunity to be grabbed by the outside world through development of their technical skills but also must integrate science literacy and processing skills. As they progress through years of learning in tertiary education, the skills they obtain from area of specialization and science process skills will be improve and integrate over time. The study aims to determine the level of science process skills of industrial technology students in terms of year level and major or area of specialization and both of its significant differences. the site of the conducted research was made on one of the classrooms of College of Engineering and Technology in Zamboanga Peninsula Polytechnic State University and the respondent are the researcher's students. The method of gathering data and instrument used was TIPS II and statistically treated using Descriptive Statistics and Inferential statistics specifically One way ANOVA. The statistical result shows that there was a significant difference between the year level of students and their science process skill specifically both second year and fourth year students of industrial technology course. Meanwhile the Major or Area of Specialization of the students in relation with their science process skill yields no significant difference. this concludes that the factor contributing to the improvement of science process skills of the student when they progress through year level.

INTRODUCTION

The preparation of modern graduates for a modern, technological and evidence-based manpower is the challenge facing by the Higher Education which it requires the expectation of having technical proficiency paired with scientific literacy. The involvement of teaching science process skill is important not to enhance their knowledge and literacy but to make the students more responsible and productive, as well as to make them have a sense of usefulness and to contribution to the society. For industrial technology courses, it determines how well a student's ability to troubleshoot on a given problem situationally by using the simplest form of scientific method. It also applies to the technical skills, digital tools, and specialized equipment. The science process skills, which include both basic competencies such as observation and classification as well as integrated competencies such as experimenting and formulating conclusions serve as the intellectual framework for evidence-based and critical decision-making in their choice of industrial technology fields.

The existence of gap between the mastery of their own discipline in the classroom-based skills and the specialized hands-on training will be significant as they progress through the year level. The model of Instruction used by the instructors and professors for teaching science-based subjects is traditional and sometimes it can emphasize procedural execution over the application of analysis and investigation in the process of learning of students. As a result, instructors and professors often notice that while college industrial technology students are competent at using digital environments or equipment, they may find it challenging to manage their own research, separate variables, or derive reliable causal conclusions from unprocessed data in a lab or classroom.

This study assesses the classroom-based science process skills of college industrial technology students to close this gap. By evaluating both basic and integrated competencies within organized academic environments, this research aims to identify specific strengths and developmental flaws of student's approach on inquiry-based tasks. The results will give curriculum designers who are involved in the designing the subjects for industrial technology program and industrial technology instructors as well as the engineers who teaches in the related program a useful guidance on the application of the scientific reasoning into technical training, ultimately producing graduates who are not only technically competent but also a proficient critical problem solver.

STATEMENT OF THE PROBLEM

This study aims to assess and evaluate the scientific process skills of the college industrial technology students through given standardized assessment tool. Specifically, it seeks to determine their proficiency levels and propose an instructional enhancement to strengthen their applied scientific literacy.

Specifically, this study seeks to answer the following questions:

What is the demographic profile of the technology students in terms of:

1.1 Year level?

1.2 Major / Area of Specialization (Specifically Industrial Technology student)?

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Level of Basic Science Process Skills:
What is the level of proficiency of college technology students in basic scientific skills during classroom tasks, specifically in:

2.1 Observation and measurement?
2.2 Classification and data organization?
2.3 Scientific communication and reporting?

Significant Difference / Relationship

- Is there a significant difference in the level of scientific process skills among technology students when grouped according to their year level and their major specialization?

SCOPE AND DELIMITATION

The aim of this study is to evaluate college industrial technology students' classroom-based science process skills during the 2026–2027 academic year. The main focus is on using validated standardized assessment tools for assessing both integrated science process skills (identifying and controlling variables, formulating hypotheses, defining operationally, designing investigations, and interpreting data) and basic science process skills (observing, measuring, inferring, classifying, predicting, and communicating).

The respondents of the study are delimited to officially enrolled undergraduate bachelor of science in industrial technology students across specific industrial technology programs within the researcher's direct instructions in the institution. This research does not cover students who are enrolled in the specific bachelor's program but not under the researcher's direct instruction.

Geographically, the study focused within the Zamboanga Peninsula Polytechnic State University exclusively for the Bachelor of Science in Industrial Technology of College of Engineering and Technology only. The findings may not be broadly generalized to industrial technology students in other colleges, universities, or regional settings with different academic programs. Finally, while the research evaluates cognitive inquiry skills demonstrated within classroom and laboratory environments, it does not measure broader technical manual dexterity, industry-specific operational proficiencies, or long-term workplace performance.

SIGNIFICANCE OF THE STUDY

The results of this study will offer insights into the degree of classroom-based science process skills among the students of industrial technology students of Zamboanga Peninsula Polytechnic State University. Understanding students' mastery of science process skills becomes significant and relevant as industrial technology programs requires a demand of technical problem-solving, experimental analysis, and critical thinking instead of technical skills only.
More specifically, the following stakeholders will benefit from the results of the study:

- **Technology Students.** With a focus on fundamental and incorporated science process skills (such as observing, inferring, experimenting, and interpreting data), this study will assist students in determining their strengths and weaknesses. They can implement proactive steps to enhance their analytical and practical skills, which are essential for both academic success and future technical careers by identifying these skill gaps.
- **Science and Technology Faculty.** The results will give teachers useful information about their students' present proficiency levels. This will enable teachers to assess their students, adjust and modify their methods of instruction, lab exercises, and evaluation in order to better develop critical science process skills in addition to technical coursework.
- **Program Chairs and Curriculum Developers.** The results of this assessment will be used as a starting point for evaluating and improving the technical and scientific curricula in ZPPSU's Bachelor of Science in Industrial Technology programs. In order to ensure that science subjects successfully support technological applications, it will assist administrators in matching instructional objectives with the demands of practical skills.
- **Future Researchers.** Particularly in the domain of Industrial Technology courses of polytechnic Universities and other relevant high education sectors, this study will add to the set of literature on science process skills. It can be used as a baseline study or reference by future researchers working on related projects in different fields or academic institutions.

METHODOLOGY

This section outlines the methodology for a quantitative approach to assess the science process skills of college technology students at the College of Engineering and Technology (CET) of Zamboanga Peninsula Polytechnic State University (ZPPSU). The study seeks to determine and describe the existing level of students' science process skills as demonstrated during classroom and laboratory activities.

3.1 Research Design

This study uses a descriptive research design using a quantitative approach to assess the science process skills inside the classrooms of different college industrial technology students at the College of Engineering and Technology (CET) of Zamboanga Peninsula Polytechnic State University (ZPPSU). The study seeks to determine and describe the existing level of students' science process skills as demonstrated during classroom and laboratory activities thus, the use of a descriptive design is appropriate for this study.

The study focuses on basic and integrated science process skills, particularly on observation, classification and data organization, and scientific communication and reporting. The study will also gather information regarding the respondents' demographic profile including the year level there in and their major or area of specialization.

Wherein, an inferential analysis was used to determine whether significant differences exist in students' science process skills when grouped according to selected profile variables. This study may also examine the relationship between students' science process skill proficiency and their academic performance in their respective courses.

3.2 Research Locale

The study was conducted at the College of Engineering and Technology of Zamboanga Peninsula

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Polytechnic State University (ZPPSU). The college provides classroom and laboratory-related learning environments in which technology students engage in practical, technical, and science-related activities.

The selected classroom and laboratory settings are appropriate for the study because they provide contexts in which students can demonstrate observation, measurement, classification, data organization, and scientific communication and reporting. The study is specifically delimited to the Bachelor of Science in Industrial Technology under the College of Engineering and Technology, consistent with the scope stated in Chapter I.

3.3 Participants of the Study

The chosen participants of the study are officially enrolled Bachelor of Science in Industrial Technology students of the College of Engineering and Technology at ZPPSU during the 2026–2027 academic year. Students from the eligible year levels represented in the program may be included in the study to allow the researchers to describe and, where applicable, compare their science process skill proficiency.

The participants' year level and major or area of specialization, was obtained through a profile questionnaire. Only students who meet the established inclusion criteria and provide informed consent will participate in the study.

3.4 Sampling Procedure

Among the entire population of the officially enrolled of Bachelors of Science in Industrial Technology, the researchers' chosen sample are from the students who are enrolled in the relevant program and in the handle of the research's instructions. If the eligible population is manageable, total enumeration was employed so that all qualified students are invited to participate. If the population is too large for total enumeration, an appropriate probability sampling procedure, such as stratified random sampling by year level, was used to ensure adequate representation of the eligible groups.

The final sample size and sampling procedure was based on the actual enrollment population, the inclusion criteria, and the requirements of the selected statistical analyses. The researchers will document the final number of eligible students, invited participants, and valid responses.

3.5 Research Instrument

The instrument responsible for data gathering was Test for integrated Process Skills II revised in1985 by Burns, Okey and Wise as it is already standardized before. This tool was used to evaluate students' science process skills assessment tool designed or adapted to measure the basic science process skills specified in the statement of the problem. The assessment tool will cover the following areas concerning the science process skills of the students of industrial technology. This tool was created for secondary and tertiary education. The scope of the instrument is the determine the following parameters:

- Observation and measurement ability of the students;
- Classification and data organization; and
- Scientific communication and reporting.

The assessment may consist of standardized structured questions that is related to the laboratory-based tasks that the students experienced when demonstrating the identified skills rather than merely recall scientific concepts. A researcher developed profile questionnaire that was administered to the students to obtain their information on year level and major or area of specialization.

3.6 Data Gathering Procedure

The researchers will follow a systematic procedure in gathering the data needed for the study:

1. Secure approval and permission from the appropriate authorities of ZPPSU and the College of Engineering and Technology before conducting the study.
2. Explain the purpose, procedures, expected activities, and participants' rights. Participation was voluntary and informed consent was obtained before data collection.
3. Administer the profile questionnaire to obtain the respondents' year level and major or area of specialization.
4. Administer the science process skills assessment in the designated classroom or laboratory-related setting using standardized instructions and procedures.
5. Collect and check the completed instruments for completeness. The responses were coded and organized in a data file for statistical analysis.
6. Analyze and interpret the data using the statistical treatments specified in this chapter and in accordance with the research questions.

3.7 Scoring Procedure

The science process skills assessment was scored using the established scoring guide for the instrument. Each basic science process skill area was scored separately to determine students' performance in observation ability, classification and data organization, and scientific communication and reporting.

The total and domain scores was summarized using the appropriate descriptive statistics. If a rating scale is used, the researchers will establish corresponding descriptive interpretations (for example, Very High, High, Moderate, Low, or Very Low) based on the final validated scoring system. For performance-based tasks, the prepared rubric will provide explicit criteria for each competency so that students' strengths and areas for improvement can be identified.

3. 8 Statistical Treatment of Data

The data gathered was analyzed using both descriptive and inferential statistical techniques that correspond directly to the research questions.

1. Frequency and Percentage

Frequency counts and percentages was used to describe the demographic profile of the respondents in terms of year level, major or area of specialization, and prior exposure to laboratory or practical science courses.

The percentage was calculated using:

$$P = (f / N) \times 100$$

where:

P = percentage

f = frequency of responses

N = total number of respondents

2. Mean and Standard Deviation

The mean and standard deviation was used to determine and describe the level of the respondents' basic science process skills, both overall and for each identified

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competency. The mean will indicate the average performance of the respondents, while the standard deviation will indicate the degree of variation in their scores.

3. Test of Significant Difference

To answer the research question concerning differences in science process skill proficiency when students are grouped according to year level or major/area of specialization, an appropriate inferential test was used based on the number of groups and the assumptions of the data. An independent-samples t-test may be used when comparing two independent groups, while one-way analysis of variance (ANOVA) may be used when comparing three or more independent groups. The level of significance was set at 0.05.

3. 9 Ethical Considerations

The researchers observed appropriate ethical standards throughout the conduct of the study. Participation was voluntary, and respondents was informed about the purpose of the study, the procedures involved, and their rights before data collection. Informed consent was obtained from the participants in accordance with applicable institutional requirements.

The confidentiality and anonymity of the respondents was maintained. Personal identifying information was not be disclosed in the presentation or publication of the findings. The data was stored and handled only for legitimate academic and research purposes and was reported in aggregate form. Participants were informed that they may decline participation or withdraw from the study in accordance with applicable institutional research policies.

RESULTS AND DISCUSSION

This purpose of this conducted research is to determine the relationship between the science process skill of the college industrial technology students to their science process skills. Specifically, to determine the significant relationship of their science process skills with the students based on their year level and Major or area of specialization.

Table 1. Frequency and percentage of industrial technology student of different year level.

Year Level	Frequency	Percentage
First Year	40	29.6 %
Second Year	38	28.1 %
Third Year	30	22.2 %
Fourth Year	27	20.0 %
Total	135	100.0 %

Table 1 shows the frequency and percentage of different year levels of college industrial technology students in increasing order of frequency. The first-year students have a largest count of frequency with a number of 40 (29.6%), then then the second-year students with a count of 38 (28.1%) followed by third year students with a count of 30 (22.2%) and the fourth-year students with a count of 27 (20.0%), total of 135 counts. This presents a minor gradient but suffice the comparison of scores across the year level remains robust and reliable for applying inferential statistical test (one way ANOVA).

Table 2. Frequency and percentage of industrial technology student of different major/ area of specialization.

Majors/ Area of Specialization	Frequency	Percentage
Electrical	21	15.6 %
Electronics	78	57.8 %
Food Technology	8	5.9 %
Mechatronics	9	6.7 %
Power Plant Engineering	19	14.1 %
Total	135	100 %

Table 2 shows the frequency and percentage of different majors or area of specialization of college industrial technology students in increasing order of frequency, the students who took Electronics major have a largest count of frequency with a number of 78 (57.8%), then then the Electrical students with a count of 21 (15.6%) followed by Power Plant Engineering students with a count of 19 (14.4%) then the Mechatronics students with a count of 9 (6.7%) and last, the Food technology students with a count of 8 (5.9%), total of 135 counts. With the largest count of the student who responded which are the electronics which also consist of half of respondents, will reflect the study to them mostly. If the electronic students' scores are high or low, the skewness will be significant to the overall institutional average. This implies the different science process, laboratory skill, foundation of math and science across majors may account for variations in student scores.

Table 3. Mean and Standard deviation of students' score based on year level.

Year Level	Mean	Standard Deviation
First Year	15.3750	7.76147
Second Year	11.4211	6.36983
Third Year	13.7667	7.46340
Fourth Year	18.7778	7.75258
Total	14.5852	7.69220

The mean and standard deviation of students' scores on different year level was shown in table 3. Fourth year students reveal having an average score of 18.7778 (SD = 7.75258), first year students have an average score of 15.4750 (SD = 7.76147), followed by third year students having an average score of 13.7667 (SD=7.46340) and second year students having an average score of 11.4211 (SD=6.36983). Fourth year students demonstrate cumulative learning since the average score produced was the highest. Also, the average scores of the first-year students, compared to the second year and third year students is relatively higher. This means that entry level students with high initial scores often reflect it previous learnings in introductory level science education.

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Table 4. Mean and Standard deviation of students' score based on Major/Area of Specializations.

Majors/ Area of Specialization	Mean	Standard deviation
Electrical	13.6667	6.71069
Electronics	14.1538	7.49732
Food Technology	12.8750	7.37636
Mechatronics	16.3333	9.87421
Power Plant Engineering	17.2632	8.56246
Total	14.5852	7.69220

As shown in table 4, the means and standard deviation of each students scores based on their majors or area of specializations are displayed. Among the majors, Power plant engineering students scored the highest which has an average score of 17.2632 (SD = 8.56246), followed by Mechatronics students which has an average score of 16.3333 (SD = 9.87421), then Electronics students which has an average score of 14.1538 (SD = 7.49732), lastly the Electrical followed by the Food technology students which has a score of 13.6667 (SD = 6.71069) and 12.8750 (SD = 7.37636) respectively. This means that the nature of the majors reflects the scores they obtained. For instances, Power Plant Engineering and Mechatronics Industrial Technology Majors focuses on Energy system, electro-mechanical integration, thermodynamics and physics-heavy troubleshooting. While Electronics and Electrical majors focus on electromagnetism applications and food technology focuses on biological and chemical applications related to food processing and preservation techniques. Numerically, With the dominant response count of Electronic Major, they anchor the overall institutional baseline score based on performance.

Table 5. One-way ANOVA for Year level.

Year Level	Sum of Squares	df	Mean square	F	P value
Between groups	900.099	3	300.033	5.592	0.001
Within groups	7028.671	131	53.654		
total	7928.770	134			

Significance level = 0.05

In table 5, One-way ANOVA was used to determine the significance difference of the scores taken from the assessment of science process skills among the year level. With the degree of freedom of 3 and the F value of 5.592, the p values give off 0.001 at significant level of 0.05 which tells that the result is significant in table 5. The significant of the student's scores based on the year level implies that the academic progression of the students is effectively contributing to the science process skills as they advance through year levels. Exposure to a hands-on technical work on their major subjects and laboratory and scientific practice in the class also helps their mastery on the science process skills.

Table 6. Post Hoc Analysis of year level using Tukey's HSD Post Hoc.

Year level (I)	Year level (J)	Mean Difference (I-J)	Std error	Adjusted p value	95% confidence level	
					Lower bound	Upper bound
First year	Second year	3.95395	1.65931	.085	-.3641	8.2720
	Third year	1.60833	1.76913	.800	-2.9955	6.2122
	Fourth year	-3.40278	1.82443	.248	-8.1505	1.3450
Second year	First year	-3.95395	1.65931	.085	-8.2720	.3641
	Third year	-2.34561	1.78897	.558	-7.0011	2.3098
	Fourth year	-7.35673	1.84367	.001	-12.1545	-2.5589
Third year	First year	-1.60833	1.76913	.800	-6.2122	2.9955
	Second year	2.34561	1.78897	.558	-2.3098	7.0011
	Fourth year	-5.01111	1.94310	.053	-10.0677	.0455
Fourth year	First year	3.40278	1.82443	.248	-1.3450	8.1505
	Second year	7.35673	1.84367	.001	2.5589	12.1545
	Third year	5.01111	1.94310	.053	-.0455	10.0677

Significance level = 0.05

Since in table 5, the result of its p-value was revealing a significant status statistically. Table 6 shows the result from the significant difference of student's year level in table 5 which qualifies to conduct a Post Hoc test. The Post Hoc test used was Tukey's HSD to determine the significant difference between each year levels. As shown in table 6, each year level is comparing a single year level (I) to the other three-year levels (J) which reveals individual adjusted p-value of each year level (J). among the significant differences of each year level relations, fourth year students and second year students shows the most significant which implies that there is really a significance in terms of the academic progression of the students which is effectively contributing to the science process skills as they advance through year levels.

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Table 7. One-way ANOVA for Major/area of specialization.

Major/ Area of specialization	Sum of Squares	df	Mean square	F	P value
Between groups	219.391	4	54.848	0.925	0.452
Within groups	7709.380	130	59.303		
total	7928.770	134			

Significance level = 0.05

However, in this table, with the degrees of freedom of 4, F value is at 0.925 with the P-value of 0.452 at significant level of 0.05, it means that there is no significant difference between the Majors or area of specialization student taking in and their scores from assessing their own science process skill. This implies that the student's science process skills relative to the majors or area of specialization that they are taking in are consistent.

CONCLUSION

This study aims to determine the scientific process skills of the students under the researcher's guidance inside the classroom based on their year levels and major or area of specialization. Specifically, is there a significant difference in the level of scientific process skills among technology students when grouped according to their year level and their major specialization.

Based on the data gathered and analyzed, the follow conclusion was formed:

- Frequency data of students' year levels reveals that the distribution of the frequency suffice the comparison however, the frequency data based on major or area of specialization, with the electronics, which consist the half of respondents in this study, reflects the study to them mostly. the electronic students' scores are high or low, making the statistical skewness significant to the overall institutional average.
- The mean and standard deviation of scores based on the year level, reveals that the average scores of fourth year students have a higher number and it implies that previous learnings from their previous subject is applied until the end of the course. The mean and standard deviation of scores based on the major or area of specialization does reflect the given questions specifically.
- Using One-way ANOVA method, the difference between the year level and the scores are significant. Furthermore, using Tukey's HSD Post hoc test reveals that a fourth year and second year students was significant. On the other hand, processed using One-way ANOVA between Major or area of specialization with the science process skill of the students yields no significant difference.

Overall, the findings demonstrate that based on students' year level, specifically fourth year and second year students has a significant developed science process skills and these findings help students and teaching staff maintain and improve the science-based subjects on other year level specifically on first year and third year levels. Meanwhile with the limitation of the study is within the classroom, the following study must widen the scope not only in the researcher's students but on other classrooms to increase the number of participants and the majors or area of specialization for better statistical result.