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Self-Efficacy and Attitudes Toward Science as Predictors of Science Process Skills among Grade 11 Senior High School Students

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Abstract — Low science process skills remain a pressing global educational concern. This study determined the levels, relationships, and predictive influence of self-efficacy and attitudes toward science on the science process skills of Grade 11 senior high school students, employing a descriptive-predictive design with correlation and multiple linear regression analysis. A total of 250 Grade 11 students were selected through stratified random sampling. The findings revealed that both self-efficacy and attitudes toward science were significantly related to, and predictive of, science process skills, collectively explaining 34.6% of the variance in science process skills. The results affirm the Social Cognitive Theory, though with limitations in the dimension of environmental influences. Future quantitative studies may incorporate additional variables to explain the remaining variance in science process skills. Educational institutions are encouraged to integrate educational interventions that strengthen students' confidence and positive attitudes toward science.

Keywords: Self-Efficacy and attitudes towards science, Predictors of science process skills, grade 11 senior high school students

I. INTRODUCTION

Low science process skills remain a persistent global issue in education, as students across various countries continue to demonstrate limited ability to apply fundamental scientific procedures (Dolapcioglu & Subası, 2022). Tomas (2023) found that learners consistently underperformed in tasks requiring science process skills. Similarly, Beichumila et al. (2022) reported that students in multiple regions exhibited inadequate development of science process skills. Studies have also documented this issue at the international level, identifying deficiencies in countries such as Malaysia, Tanzania, and Indonesia. Research by Beichumila et al. (2022) and Kurniahtunnisa et al. (2024) showed that students in these nations consistently exhibited low science process skills. A study by Shofawati et al. (2023) revealed that senior high school students in the Philippines demonstrated limited proficiency in science process skills. This finding is consistent with larger evaluations like the PISA 2018 results, which showed that Filipino students scored much lower than the OECD average in science literacy, indicating ongoing difficulties in developing scientific skills across grade levels (Bernardo et al., 2023). Low science process skills among senior high school students can limit their ability to engage in scientific inquiry, critically evaluate information, and solve real-world problems, skills essential for academic success and future STEM careers (Tomas, 2023). Despite the importance of these competencies, limited research has examined how internal factors, such as self-efficacy and attitudes toward science, influenced students' development of science process skills, particularly in the Philippine context. This study addressed that gap by examining how students' self-efficacy and attitudes toward science predicted their proficiency in science process skills.

The study examined how grade 11 students' self-efficacy and attitudes toward science predicted their science process skills, emphasizing their role in fostering meaningful engagement in scientific inquiry. It highlighted that students who believed in their abilities and maintained positive attitudes toward science were more likely to develop and effectively apply science process skills (Tan et al., 2020). The findings supported Sustainable Development Goal 4 on quality education and suggested that strengthening self-efficacy and cultivating positive attitudes enhanced students' scientific competence and engagement in real-world and environmental problem-solving (Han et al., 2021).

This study determined the significance of self-efficacy and attitudes toward science as predictors of students' science process. Specifically, it was aimed to determine the levels of self-efficacy in terms of self-engagement, self-oriented decision-making, other-oriented problem-solving, and interpersonal Climate; attitudes toward science in terms of liking learning science, valuing science, and confidence in science; and science process skills in terms of observation, experimentation, measurement skills, communication skills, and inference skills, the significance of the correlation between self-efficacy, attitudes toward science, and science process skills, and the significance of self-efficacy and attitudes toward science to predict science process skills.

This study was anchored in Bandura's Social Cognitive Theory (1986), which emphasized the reciprocal interaction between personal characteristics, behavioral patterns, and environmental influences in shaping learning outcomes. In this study, self-efficacy, characterized by indicators such as self-engagement, self-oriented decision-making, other-oriented problem-solving, and interpersonal Climate (Darmayanti et al., 2021), served as the personal factor. Likewise, attitudes toward science, encompassing dimensions such as liking learning science, valuing science, and being confident in science (Al-Mutawah & Fateel, 2018), served as the behavioral factor. This study focuses on Grade 11 senior high school students and examines how these personal and behavioral factors predicted their science process skills. Both factors were hypothesized to influence students' science process skills, which include observation, experimentation, measurement skills, communication skills, and inference skills (Akani, 2015). Although Bandura's Social Cognitive Theory included environmental influences, the study delimited its scope to personal and behavioral factors to examine their predictive power on students' development of science process skills.

II. METHODOLOGY

This study employed a quantitative non-experimental descriptive-predictive research design to examine whether self-efficacy and attitudes toward science significantly predict science process skills among Grade 11 senior high school students. Quantitative non-experimental designs were appropriate when independent variables could not be manipulated and when the goal was to observe how variables related as they occurred naturally (Han & Ellis, 2022). A

descriptive-predictive design was employed to examine the strength and direction of relationships between self-efficacy, attitudes toward science, and science process skills and to determine whether these variables significantly predict science process skills without implying causation (Takona, 2023).

This study was conducted in one of the public senior high schools within Cluster 5, Davao City. The specific school was chosen for its large, diverse student population. This diversity is important for the study because it helps make sure that the research results on self-efficacy, attitudes toward science, and science process skills apply to a wider range of students, not just a similar group.

This study included 250 Grade 11 senior high school students from a selected public senior high school in Davao City. To ensure fair representation across the student population, stratified random sampling was employed as the primary sampling technique. The entire Grade 11 population was categorized into specific strata by strand, and a proportional number of students was randomly selected from each stratum to ensure adequate and equitable representation in the final sample. The inclusion criteria required that respondents were officially enrolled in the research locale during the school year 2025-2026 and were Grade 11 students under the senior high school program. The appropriate sample size was determined using the Raosoft calculator.

Three adapted questionnaires were used in this study, namely, the Self-Efficacy Scale by Darmayanti et al. In 2021, the Attitudes Toward Science questionnaire, by Al-Mutawah & Fateel (2018), and the Science Process Skills questionnaire by Akani (2015) were used. All these questionnaires were modified and adjusted to fit the specific goals of this study. All of them have a scale (Likert-type) with specific indicators describing the current conditions of respondents. Moreover, they underwent reliability testing. All the items included had a Cronbach's alpha of 0.940, indicating reliability.

In gathering the data for the first predictive variable, which is self-efficacy, the researcher adapted the research instrument Questionnaire developed by Darmayanti et al., (2021). It was an adapted research instrument, as several items in the questionnaire were modified to fit the local setting and address the research questions. This instrument contained 25 items covering the sub-dimensions of self-engagement, self-oriented decision-making, others-oriented problem-solving,

and interpersonal climate. To evaluate the self-efficacy of Grade 11 students, the respondents used the following Likert scale to rate the questionnaire: 4 for strongly agree, 3 for agree, 2 for disagree, and 1 for strongly disagree. The Likert scale below was used to analyze the results:

Range of Means	Description	Interpretation
3.26 – 4.00	Very High	This means that a student's self-efficacy is excellent.
2.50 – 3.25	High	This means that student's self-efficacy is very good.
1.75 – 2.49	Low	This means that student's self-efficacy is poor
1.00 – 1.74	Very Low	This means that student's self-efficacy is very poor

In gathering the data for the second predictive variable, the researcher adapted the research instrument Questionnaire developed by Al-Mutawah & Fateel (2018) to assess indicators of attitudes toward science. The questionnaire contained 20 items. To evaluate the attitudes toward science of Grade 11 students, the respondents will use the following Likert scale: 4 for strongly agree, 3 for agree, 2 for disagree, and 1 for strongly disagree. The Likert scale below was used to analyze the results for attitudes toward science:

Range of Means	Description	Interpretation
3.26 – 4.00	Very High	This means that a student's attitudes toward science is excellent.
2.50 – 3.25	High	This means that student's attitudes toward science is very good.
1.75 – 2.49	Low	This means that student's attitudes toward science is poor
1.00 – 1.74	Very Low	This means that student's attitudes toward science is very poor

In gathering data for the criterion variable, which is the science process skill, the researcher adapted the Science Process Skills Questionnaire originally developed by Akani (2015). It was modified to fit a local context to address the research questions. The modified instrument consisted of 28 items covering the following indicators: observation, experimentation, measurement skills, communication skills, and inference skills. To evaluate Grade 11 students' science process skills, respondents will rate the questionnaire using the following Likert scale: 4 as strongly agree, 3 as agree, 2 as disagree, and 1 as strongly disagree. The Likert scale will be used to analyze the results as follows:

Range of Means	Description	Interpretation
3.26 – 4.00	Very High	This means that a student's science process skills are excellent.
2.50 – 3.25	High	This means that student's science process skills are very good.
1.75 – 2.49	Low	This means that student's science process skills are poor
1.00 – 1.74	Very Low	This means that student's science process skills are very poor

The researcher utilized the getting of mean to assess the levels of self-efficacy, attitudes toward science, and science process skills, Pearson Product-Moments Correlation Coefficient to determine the significance of the correlation between self-efficacy, attitudes toward science, and science process skills, and Multiple Linear Regression Analysis to determine the significance of self-efficacy and attitudes toward science to predict science process skills.

The study followed strict ethical standards in conducting research involving grade 11 students. Prior to data collection, informed consent from parents and assent from the students were obtained to ensure voluntary participation and protect the confidentiality of their responses. The research instruments underwent expert validation and reliability testing to ensure the accuracy and credibility of the results. Permission to conduct the study was formally secured from the Department of Education at the division, cluster, and school level. Moreover, the research proposal was reviewed and approved by the Society of Moral Integrity and Legal Ethics (SMILE) to ensure that the study complied with ethical, legal, and moral research standards.

III. RESULTS AND DISCUSSION

Table 1 is the descriptive table. It contains the variables involved in the study, namely, self-efficacy, attitudes toward science, and science process skills, and their corresponding indicators. Moreover, it contains the standard deviation (SD), the mean, and the corresponding descriptive level.

TABLE 1
DESCRIPTIVE TABLE

Variables	Standard Deviation	Mean	Descriptive Level
Self-Efficacy (IV_1)	**0.249**	**3.14**	**High**
Self-Engagement	0.288	3.11	High
Self-Oriented Decision-Making	0.317	3.13	High
Others-Oriented Problem Solving	0.325	3.05	High
Interpersonal Climate	0.413	3.29	Very High

Students' Attitudes Toward Science (IV_2)	**0.425**	**2.97**	**High**
Liking learning science	0.554	3.09	High
Valuing science	0.485	2.98	High
Confident in science	0.459	2.84	High
Science Process Skills (DV)	**0.357**	**3.00**	**High**
Observation Skill	0.388	3.00	High
Experimentation	0.442	2.97	High
Measurement skills	0.461	2.99	High
Communication Skill	0.439	2.99	High
Inference Skills	0.450	3.04	High

Based on the Table, the Self-Efficacy Scale (IV_1) had an overall mean of 3.14, indicating that students' self-efficacy is very good (High). All indicators received a high rating, including Self-Engagement, Self-Oriented Decision-Making, and Others-Oriented Problem Solving. Interpersonal Climate had the highest mean, which was Very High, which means that the learning environment was good and encouraging.

Students' Attitudes Toward Science (IV_2) registered an overall mean of 2.97, also interpreted as High, indicating very good attitudes toward science. The indicators Liking Learning Science, Valuing Science, and Confidence in Science were all rated High. Finally, Science Process Skills (DV) yielded an overall mean of 3.00, interpreted as High, indicating that the student's science process skills were also very good, enabling them to effectively engage in all aspects of scientific inquiry.

These findings are supported by Zysberg and Schwabsky (2020), who found that academic self-efficacy is positively related to student achievement, emphasizing the importance of self-beliefs in learning outcomes. In addition, Mao et al. (2021) and Manguil and De Leon (2025) found that positive attitudes toward science are significantly associated with improved science achievement and stronger science process skills. These studies reinforce the present findings, which show high levels of self-efficacy, positive attitudes toward science, and strong science process skills among students.

Table 2 is the correlation table. It contains the predictive variables, namely, self-efficacy, attitudes toward science, and the criterion variable, which is the science process skills. It also contains the r-value, the p-value, the decision for the hypothesis, and the corresponding interpretation.

TABLE 2
CORRELATION TABLE

Variables	Science Process Skills (DV)			
	r	p-value	Decision on Ho	Interpretation
Self-Efficacy (IV_1)	0.428	$p < 0.001$	Reject Ho	Significant
Students' Attitudes Toward Science (IV_2)	0.541	$p < 0.001$	Reject Ho	Significant

Level of Significance: 0.05
Decision Rule: Reject H_0 if $p < 0.05$

The correlation analysis in Table 2 indicates statistically significant, positive relationships between the independent variables and Science Process Skills, highlighting that both self-efficacy and attitudes toward science are associated with students' scientific competencies. The results indicate a moderate positive correlation between self-efficacy and science process skills ($r = 0.428$, $p < 0.001$), suggesting that higher levels of students' self-efficacy are associated with better performance in science process skills. Similarly, the positive correlation between attitudes toward science and science process skills ($r = 0.541$, $p < 0.001$) shows that students with more favorable attitudes toward science tend to demonstrate higher levels of science process skills. These findings indicate that both self-efficacy and attitudes toward science are significantly associated with students' science process skills among Grade 11 senior high school students.

The rejection of the null hypotheses confirms that both self-efficacy and attitudes toward science have statistically significant relationships with science process skills. Overall, these findings highlight the importance of fostering both positive self-beliefs and favorable attitudes to support the development of students' competencies in scientific inquiry.

These findings are congruent with those of Manguil and De Leon (2025), who reported a significant relationship between students' attitudes toward science and their science process skills,

highlighting the role of learner dispositions in shaping performance. Similarly, the results align with Mellona and Angeles (2025), who found that positive attitudes toward science are significantly associated with better performance in basic science process skills among senior high school students.

Table 3 is the regression table. It contains the predictors, namely self-efficacy and attitudes toward science. It also contains the criterion variable, which is the science process skills. Finally, it contains the coefficients β, t-value, p-value, the decision on the hypotheses, and the corresponding interpretation.

TABLE 3
REGRESSION TABLE

	Science Process Skills (DV)						
	Unstandardized Coefficients		Standardized Coefficients				
	B	**Std. Error**	**Beta**	**t**	**p value**	**Decision on Ho**	**Interpretation**
Constant	0.772	0.236	-	3.275	0.001	-	-
Self-Efficacy (IV_1)	0.360	0.081	0.251	4.463	p <0.001	Reject Ho	Significant
Students' Attitudes Toward Science (IV_2)	0.370	0.047	0.441	7.838	p<0.001	Reject Ho	Significant

$R = 0.588$; $R^2 = 0.346$; Adjusted $R^2 = 0.340$; F-value = 65.26; p-value = $p < 0.001$
Level of Significance: 0.05
Decision Rule: Reject H_0 if $p < 0.05$

The regression analysis in Table 3 shows that self-efficacy and students' attitudes toward science significantly predict science process skills, collectively explaining 34.6% of the variance in the dependent variable ($R^2 = 0.346$; Adjusted $R^2 = 0.340$). The overall model is statistically significant ($F = 65.26$, $p < 0.001$), indicating that the independent variables contribute significantly to predicting students' science process skills. Specifically, self-efficacy has a positive and

significant effect (B = 0.360, β = 0.251, p < 0.001), suggesting that higher levels of self-efficacy are associated with higher levels of science process skills among the students.

Notably, students' attitudes toward science emerge as a stronger predictor of science process skills (B = 0.370, β = 0.441, p < 0.001), reinforcing earlier correlational findings that affective and motivational factors play a central role in science learning. The rejection of the null hypotheses for both predictors confirms their independent and combined contributions to the model, with attitudes toward science exerting a greater relative influence than self-efficacy. Overall, the results suggest that while cognitive behavioral beliefs, such as self-efficacy, support the development of science process skills, fostering positive attitudes toward science may be particularly critical for strengthening students' engagement and competence in scientific inquiry.

These findings are supported by Manguil and De Leon (2025), who found that attitudes toward science significantly predict students' science process skills using multiple linear regression analysis. Their study further demonstrated that affective factors, such as self-concept, play a crucial role in enhancing scientific skills. Similarly, Araes et al. (2024) reported that attitudes toward science significantly contribute to students' cognitive performance, reinforcing the importance of attitudinal variables in predicting science-related competencies. Collectively, these studies support the present finding that students' attitudes toward science serve as a strong and significant predictor of science process skills.

Summary of Findings

The results reveal that students exhibit a high level of self-efficacy in science learning, with Interpersonal Climate showing the highest mean (Very High), suggesting that supportive classroom relationships significantly strengthen students' confidence. This finding corroborates Ince (2023), who emphasized that self-efficacy is shaped not only by individual beliefs but also by the learning environment, and Digo and Disca (2025), who identified self-efficacy as a key determinant of science proficiency. Similarly, students demonstrated high attitudes toward science, particularly in Liking Learning Science; this pattern aligns with Mao et al.'s (2021) meta-analysis, which underscored the influence of attitudes and confidence on academic achievement. Furthermore, Science Process Skills were rated high overall, with the highest mean in Inference

and adequate performance across Observation, Experimentation, Measurement, and Communication, supporting Digo and Disca (2025) and Mao et al. (2021) in asserting the interconnected roles of self-efficacy, attitudes, and process skills in promoting effective science learning.

The results indicating that self-efficacy demonstrates a moderately low significant correlation, while attitudes toward science exhibit a moderately high significant correlation with science process skills, are consistent with previous studies emphasizing the role of affective factors in science learning. Self-efficacy, which refers to students' belief in their ability to perform specific academic tasks, has been shown to be positively related to science-related performance, though the strength of this Relationship may vary across learning contexts. Research has reported that self-efficacy shows a positive, though sometimes moderate, relationship with science learning outcomes, indicating that students who believe in their ability to perform scientific tasks are more likely to engage in inquiry- and problem-solving-based activities that develop science skills. For instance, studies examining science self-efficacy found moderate correlations between self-efficacy and science achievement, suggesting that students with higher confidence in their scientific abilities tend to perform better in science-related tasks and learning outcomes (Hu et al., (2022). Furthermore, attitudes toward science have been found to play an even stronger role in shaping students' engagement with scientific activities. A meta-analysis examining the relationship between attitudes toward science and science achievement reported a positive and statistically significant correlation, indicating that students with more favorable attitudes toward science tend to demonstrate higher levels of engagement and better learning outcomes (Mao et al., 2021). This finding aligns with the present result showing a stronger association between attitudes toward science and science process skills compared to self-efficacy.

However, although several studies have reported relationships among self-efficacy, attitudes toward science, and science-related outcomes, some research has produced contrasting findings. For instance, Sui et al. (2023) found that self-efficacy did not directly predict students' learning outcomes, with its relationship operating through other variables such as perceived technology use and self-regulation. These findings suggest that affective factors such as self-efficacy and attitudes toward science may show varying degrees of association with students' scientific performance across different contexts. Similarly, other studies have shown that attitudes

toward science may not always be significantly related to academic outcomes or performance indicators in science learning contexts. Additionally, research on students using self-learning modules found no significant correlation between attitudes toward science and academic performance in science, indicating that positive feelings toward the subject do not automatically lead to improved learning outcomes (Mutya et al., 2023).

Latest findings indicates that both self-efficacy and attitudes toward science significantly predict science process skills (SPS), with attitudes emerging as the stronger predictor. Positive attitudes toward science enhance students' engagement, motivation, and willingness to participate in scientific activities—core components of SPS such as observing, experimenting, and interpreting data. For example, Manguil and De Leon (2025) found that secondary students with favorable perceptions of science demonstrated deeper participation in inquiry-based activities, leading to stronger SPS. Similarly, a meta-analysis reported a moderate positive association between attitudes toward science and learning outcomes, suggesting that students who value and enjoy science tend to perform better and engage more effectively in scientific practices (Mao et al., 2021).

Self-efficacy also contributes to science learning, as students who believe in their capabilities are more likely to persist in problem-solving and inquiry-based tasks (Hu et al., 2022). However, attitudes may exert a stronger influence because they directly shape students' interest, enjoyment, and perceived value of science, which in turn affects their active participation in experiments and other scientific processes.

Despite these findings, some studies report contrasting results. Research in STEM education has noted instances where high self-efficacy does not translate into higher performance or stronger scientific skills, suggesting that confidence alone may not consistently predict outcomes (Whitcomb et al., 2020). Furthermore, cognitive factors, instructional strategies, and hands-on learning experiences such as guided inquiry or laboratory-based interventions—can enhance SPS independently of students' initial attitudes or self-efficacy, highlighting the critical role of instructional design in skill development (Panuluh, 2022).

IV. CONCLUSION

The findings of this study indicate that both self-efficacy and attitudes toward science are significant predictors of Grade 11 students' science process skills, collectively accounting for 34.6% of the observed variance. Attitudes toward science emerged as the stronger predictor, emphasizing the critical role of students' affective dispositions in shaping their engagement with scientific inquiry. Consistent with Bandura's (1996) Social Cognitive Theory—which posits that learning outcomes arise from the dynamic interaction of personal beliefs, behavioral patterns, and environmental influences—this study delimits environmental influences, highlighting confidence and positive attitudes as key drivers of science learning outcomes.

V. RECOMMENDATIONS

Based on the conclusion, it is recommended that future research may incorporate additional variables to account for the remaining variance in science process skills. qualitative studies may also be conducted to uncover additional factors and themes that help further clarify predictors of science process skills. furthermore, the Department of Education is encouraged to implement educational interventions that strengthen students' confidence and positive attitudes toward science, in alignment with providing high-quality and meaningful opportunities under SDG 4.

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