



Unveiling the Relationship Between Self-Concept and the Acquisition of Science Process Skills in Basic Science and Technology among Junior Secondary School Students in Nasarawa State

Simon, Pannan D & L. N. Nworgu

Department of Science Education, University of Nigeria, Nsukka.

Corresponding author: pannansimon01@gmail.com

Abstract

This study investigates the intricate relationship between students' academic self-concept and the acquisition of science process skills in Basic Science and Technology among Junior Secondary School students in Nasarawa State. Conducted in the Lafia Education Zone, the research aims to contribute valuable insights into educational strategies fostering positive self-concept and cultivating science process skills. The study population comprised 4642 JSS two students from 138 public secondary schools, with a sample size of 368 students selected from five schools. Two instruments, the Science Self-Concept Inventory (SSCI) and Science Process Skill Observation Scale (SPSOS), were employed for data collection. Results indicate a very strong positive relationship (correlation coefficient = 0.92) between students' academic self-concept and the acquisition of science process skills, with 85% of the variation in skills accounted for by self-concept. Regression analysis supports the significance of this relationship (F-ratio = 34.11). Additionally, a medium positive relationship (correlation coefficient = 0.63) exists among academic self-concept, academic achievement, and the acquisition of science process skills. Regression analysis further confirms the significance of this relationship (F-ratio = 118.26). These findings underscore the importance of promoting positive academic self-concept to enhance students' acquisition of science process skills. This study concludes by confirming a strong link between students' academic self-concept and science process skills, with self-concept explaining 85% of skill variation, but also highlights the influence of other factors yet to be explored. The study recommends regular counselling to build positive self-concept, emphasizing its role in fostering skills acquisition in Basic Science and Technology education.

Keywords: Self-concept, science process skills, academic achievement, Basic Science, Junior Secondary School.

Introduction:

Basic Science and Technology (BST) education in Nigeria refers to the foundational learning process that introduces students to fundamental concepts in science and technology at the basic education level. The educational system in Nigeria typically includes a nine-year basic education cycle, which comprises six years of primary education and three years of junior secondary education. BST education is a crucial component of the junior secondary education curriculum (Daramola, et al, 2023). It plays a crucial role in equipping young minds with the fundamental knowledge and skills needed to navigate an increasingly tech-driven world. It encompasses various scientific and technological concepts introduced at the primary and junior secondary school levels. Enyi, and Ikenazor (2023) states that the BST curriculum is developed by

the Nigerian Educational Research and Development Council (NERDC) and emphasizes integrated learning across subjects like Biology, Chemistry, Physics, Agriculture, and Information Technology. According to FGN (2014), Basic science and technology education seeks to develop scientific mind, innovative and responsible individuals who can think critically and make discovery of things that will make living the environment and society easier. Therefore, the main aims and objectives of teaching and learning Basic science education in Nigeria are to:

- Acquire basic knowledge and skills in science and technology;
- Be safety and security conscious;
- Apply scientific and technological knowledge and skills to meet contemporary societal needs;
- Avoid drug abuse and related vices;



- Become prepared for further studies in science and technology;
- Develop an interest in science and technology; and
- Take advantage of the numerous career opportunities provided by science and technology.

The inability of Basic Science and Technology to foster a positive self-concept may impede acquisition of science process skills, as a lack of confidence or perceived competence in these subjects could hinder a student's motivation and success in related academic endeavours. There are various factors contributing to the challenge of Basic Science and Technology in nurturing a positive self-concept, which, in turn, can impede academic achievement and acquisition of science process skills. One significant factor is the teaching methods employed in these subjects; if they are not engaging or fail to cater to diverse learning styles, students may struggle to comprehend the content, leading to a lack of confidence (Duc Dat, Van Bien, & Kraus, 2023). Additionally, the availability of resources and infrastructure plays a crucial role. Inadequate materials, outdated resources, or a lack of access to technology can compromise the quality of education in Basic Science and Technology, impacting students' perceptions of their abilities.

The competence and enthusiasm of teachers also factor into this equation. If educators lack the necessary expertise or passion for Basic Science and Technology subjects, students may find it challenging to connect with the material, affecting their self-concept. Moreover, the relevance of the curriculum is crucial. If the content does not align with real-world applications, students may struggle to see the practical significance of Basic Science and Technology, impacting their motivation and self-concept.

Negative peer influences and an unsupportive learning environment can also contribute to students feeling insecure about their abilities in Basic Science and Technology. Societal stereotypes and biases related to gender, race, or socioeconomic status may further influence students' beliefs about their competence in these subjects, potentially hindering their self-concept and academic acquisition of science process skills.

The term self-concept is commonly defined as one's knowledge and perception of oneself, shaped by self-awareness and the evaluation of personal qualities and characteristics within one's experiences (Chu, & Lowery 2023). Given each individual's unique identity, people hold varying beliefs about themselves and adopt

different approaches to self-understanding. Individuals explore their qualities and capabilities to assess their performance. These self-perceptions, once formed, play a significant role in individual growth and maturity (Kania, & Juandi, 2023).

Academic self-concept refers to an individual's perception and evaluation of their own abilities, competencies, and worth in an academic context. It involves how a person sees themselves as a learner and their role within educational settings. This concept encompasses a person's beliefs about their academic skills, intellectual capabilities, and potential for success in various academic tasks. Academic self-concept refers to students' self-evaluation of their educational abilities and potential (Yang, et al 2023). It can also be defined as an individual's feelings about themselves as learners and their role in academic settings. Perinelli, et al (2022) conceptualized academic self-concept as students' awareness and perception of their academic capacities. Rohmalimna, Yeau, and Sie (2022) revealed in their research that certain influencing variables, such as students' academic routines, teaching method innovations, are prioritized to modify students' self-concept. The level of academic self-concept can determine one's performance in the educational field and typically varies across different grades. A slight increase in academic self-concept is observed with improvements in academic achievements. Academic self-concept encompasses various aspects that are interconnected with pupils' academic success. Several factors contribute to the formation of academic self-concept, including experiences in learning, achievements, feedback from teachers and peers, and personal reflections on one's academic performance. Positive experiences, successes, and supportive feedback tend to enhance academic self-concept, fostering confidence and a positive attitude toward learning. On the other hand, negative experiences, failures, or lack of support can contribute to a lower academic self-concept, leading to self-doubt and diminished motivation (Torppa, et al 2023).

The connection between academic self-concept and the acquisition of science process skills in Basic Science and Technology is pivotal for students' engagement in scientific learning. A positive self-concept empowers students with the confidence to actively participate in science-related activities, fostering curiosity and perseverance in developing science process skills such as observation, measurement, and critical thinking. Conversely, a negative self-concept may hinder the acquisition of



these skills, as students doubting their abilities might shy away from hands-on experiments and scientific inquiry. Educational strategies that cultivate a positive self-concept, through supportive learning environments and hands-on activities, play a vital role in enhancing students' mastery of science process skills and promoting a deeper understanding of scientific principles (Audu & Angura, 2023).

Basic science process skills are essential abilities needed for understanding and exploring science. They include observing and recording details, measuring using standard units, communicating ideas clearly, organizing information into categories, drawing logical conclusions from evidence (inference), predicting future outcomes based on patterns, and explaining the meaning of observations or data (interpretation). These skills help people systematically explore and understand the natural world, forming the basis for effective scientific thinking and problem-solving (Kefi, 2023).

Science process skills (SPS) constitute indispensable cognitive and physical abilities for scientific inquiry, deemed crucial for students and scientists alike. Despite their significance, there appears to be a gap between classroom learning and real-life application. Science process skills, involving the systematic breakdown of thought processes and the resolution of questions, are deemed applicable not only in scientific contexts but also in situations requiring critical thinking. This study concentrates on basic process skills, such as observation, classification, measurement, communication, inference, and prediction, underscoring their pivotal role in scientific inquiry (Moopeloa, Bhagwandeem & Rambuda, 2022). The Federal Ministry of Education advocates for prioritizing the acquisition of these skills in basic science and technology instructions, emphasizing their contribution to the development of both physical and cognitive abilities for future adaptation and growth.

Despite the growing focus on science education in Nigeria, there remains a consistent challenge of secondary school students experiencing limitations in acquiring science process skills within the Basic Science and Technology domain. While several factors could contribute to this issue, the existing research exploring the relationship between these factors and the acquisition of science process skills in Basic Science and Technology is notably scarce. The primary question framing this study is, what is the relationship between academic self-concept and the acquisition of science process skills? This study aims to address the gaps in

understanding how students' perceptions of their academic abilities relate to their acquisition of basic science process skills, providing valuable insights for improving science education in the Nigerian context.

The main purpose of this study is to examine students' academic self-concept and acquisition of science process skills in Basic Science and technology in Nasarawa State.

Research Questions

The study was guided by the following research questions

1. What is the relationship between students' academic self-concept and the student acquisition of science process skills in Basic Science and Technology?
2. What is the relationship between academic self-concept, students' academic achievement and acquisition of science process skills in Basic Science and Technology?

Hypotheses

The following null hypotheses were formulated for the study and tested at a 0.05 level of significance.

HO₁: There is no significant relationship between students' academic self-concept and students' acquisition of science process skills in Basic Science and Technology.

HO₂: There is no significant relationship between academic self-concept, students' achievement and acquisition of science process skills in Basic Science and Technology

Methods

A correlational survey design was employed to investigate the relationship between students' self-concept, and science process skills acquisition, in Basic Science and Technology. A correlational design is a research design that involves collecting data through self-report surveys or questionnaires to examine the relationship between two or more variables. Chibueze (2021) explains that this type of design is useful for studying variables that are difficult or impossible to manipulate and can provide a broad perspective on the relationship between variables. This design was considered suitable for the study because the researcher did not manipulate independent variables.

The study involved 4,642 Junior Secondary School (JSS 2) students across 138 schools in Lafia Education Zone examined their experiences. The study focused on five schools within the Lafia Education

Zone, representing a diverse sample from across the zone's five local government areas. The study involved a sample of 368 JSS two students drawn from five public secondary schools within the Lafia Education Zone. A multi-stage sampling method selected the students from 5 schools in the Zone. 5% margin of error and purposive criteria (labs, participation, student numbers) guided school selection. Students were then chosen through a combination of random and proportional sampling techniques to ensure equal chance of participation. Student distribution varied across the five local government areas, with Lafia having the most schools and students. JSS 2 students were chosen for easier access and reduced academic pressure, potentially leading to more reliable responses. Two instruments were utilized for data collection:

The Science Self-Concept Inventory (SSCI), is a validated tool designed to measure students' Self-concept and achievements in Basic Science and Technology. Adapted from existing SSCI scales, the 20 items used in this study were subjected to exploratory factor analysis to identify underlying dimensions of self-concept related to Basic Science and Technology. Items with strong factor loadings and statistically significant correlations were retained for assessing students' self-perception of achievement and science process skills alongside measures of their actual acquisition of science process skills. The instrument showed good internal consistency of 0.77 Cronbach's alpha, meaning its items reliably assess individuals' self-concept in Basic Science. This is because

Cronbach's alpha is suitable for non-dichotomous items like those in the SSCI.

Science Process Skill Observation Scale (SPSOS): An observation-based assessment measuring students' ability to identify basic science process skills during laboratory experiments. To assess the consistency of ratings across different teachers, the Science Process Skills Observation Scale (SPSOS) underwent an inter-rater reliability test using Kendall's Coefficient of Concordance. Three teachers independently evaluated students in each sample school, assigning scores to various items on the scale. The resulting reliability coefficient of 0.77 indicated a strong level of agreement among the teachers' ratings, demonstrating the SPSOS's ability to produce consistent results when used by multiple observers.

Data Analysis:

Descriptive statistics, Pearson Product-Moment Correlation Coefficient, and Regression analysis were employed for data analysis: Pearson Product-Moment Correlation Coefficient was applied to assess the relationships between variables and answer research questions. Regression ANOVA was utilized to test research hypotheses.

Ethical Considerations:

Ethical approval was obtained from the department of science education, University of Nigeria, Nsukka, ensuring the protection of participants' rights and confidentiality.

Results:

Table 1: Pearson's Product-Moment Correlation Analysis of students' academic self-concept and acquisition of science process skills in Basic Science and Technology.

Variables	\bar{x}	SD	N	R	R ²
science process skills	56.38	7.12			
self-confidence	55.44	7.88	368	0.92	0.85

$\alpha = 0.05$, R² = coefficient of determination

To answer this research question, the scores from the responses of the respondents on students' academic self-concept were correlated with the responses on acquisition of science process skills in Basic Science and Technology. The result in Table 1 shows that the correlation coefficient obtained was 0.92. This means that, there exist a very high direct positive relationship between students' academic self-concept and acquisition of science process skills in Basic Science and Technology. Table 1 also shows that, the coefficient

of determination (R²) associated with the correlation coefficient of 0.92 was 0.85. This coefficient of determination (R²) indicates that, 85% of student acquisition of science process skills in Basic Science and Technology was accounted for by students' academic self-concept. This is an indication that 15% of the variation in student acquisition of science process skills in Basic Science and Technology is attributed to other factors not studied.

Table 2: Regression Analysis of students’ academic self-concept and students’ acquisition of science process skills in Basic Science and Technology

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1586.54	1	1586.54	34.11	.00
	Residual	17022.20	366	46.51		
	Total	18608.74	367			

$\alpha = 0.05$

In order to test hypothesis 1 (H_{01}), regression analysis was used. The result in Table 2 shows that an F-ratio of 34.11 with an associated exact probability value of 0.00 was obtained. This probability value of 0.00 was compared with 0.05 set as level of significant for testing the hypothesis and it was found to be significant because 0.00 is less than 0.05. The null hypothesis which stated that; there is no significant relationship between students’ academic self-concept

and acquisition of science process skills in Basic Science and Technology was therefore rejected and inference drawn was that, students’ academic self-concept significantly determines students’ acquisition of science process skills in Basic Science and Technology. In other words, there is a significant relationship between students’ academic self-concept and acquisition of science process skills in Basic Science and Technology.

Table 3: Regression Analysis of students’ academic self-concept, students’ academic achievement and acquisition of science process skills in Basic Science and Technology

Model	R	R-Squared	Adj. Squared	R-	S. E
1	.63 ^a	.39	.39		.63 ^a

$\alpha = 0.05$, $R^2 =$ coefficient of determination

Table above shows the regression analysis of students’ academic self-concept, academic achievement and acquisition of science process skills in Basic Science and Technology. The result in Table 3 shows that the correlation between students’ academic self-concept, academic achievement and the acquisition of science process skills in Basic Science and Technology was 0.63. This means that, there exist a medium direct positive relationship among students’ academic self-concept, academic achievement, and the acquisition of science process skills in Basic Science and Technology.

Table 3 also shows that, the coefficient of determination (R^2) associated with the correlation coefficient of 0.63 was 0.39. This coefficient of determination (R^2) indicates that, 39% of students’ academic self-concept, academic achievement accounted for students’ acquisition of science process skills in Basic Science and Technology. This is an indication that just 61% of the variation in students’ academic self-concept and academic achievement are attributed to other factors not studied.

Table 4: Regression Analysis of Variance (ANOVA) of the students’ academic self-concept and students’ achievement and acquisition of science process skills in Basic Science and Technology.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5895.91	2	2947.95	118.26	.000 ^b
	Residual	9098.40	365	24.93		
	Total	14994.30	367			

$\alpha = 0.05$

In order to test hypothesis 10 (H_{010}), regression analysis was used. The result in Table 4 shows that an F-ratio of 118.26 with associated exact probability value of 0.00 was obtained. This probability value of

0.00 was compared with 0.05 set as level of significant for testing the hypothesis and it was found to be significant because 0.00 is less than 0.05. The null hypothesis which stated that; there is no significant



relationship among academic self-concept, students' academic achievement and acquisition of science process skills in Basic Science and Technology was therefore rejected and inference drawn was that, academic self-concept and students' achievement significantly determine students' acquisition of science process skills in Basic Science and Technology. In other words, there is a significant relationship among students' academic self-concept, academic achievement and students' acquisition of science process skills in Basic Science and Technology.

Discussion of the Findings

Students' academic self-concept strongly predicts their acquisition of science process skills in Basic Science and Technology. This study found a very high and positive correlation ($r = 0.92$) between these two variables, indicating that as students feel more confident in their academic abilities, their mastery of science process skills also improves. Notably, 85% of the variation in students' science process skills can be explained by their academic self-concept, highlighting its key role in science learning. These findings align with past research demonstrating a consistent link between academic self-concept and achievement. Similar results were reported by Ogbogu, et al (2021) and Zhang et al. (2021), who found that students with higher self-concepts tend to perform better in academics, including advanced courses and science classrooms. This strong association suggests that fostering positive academic self-concepts could be a valuable strategy for improving students' science process skills and overall science learning outcomes.

A moderate link exists between students' academic self-concept, achievement, and their acquisition of science process skills. As Table 3 shows, these variables share a statistically significant positive relationship (correlation coefficient of 0.63). In simpler terms, as students feel more confident in their academic abilities and perform better in their studies, their ability to perform science processes also improves. However, it's worth noting that only 39% of the variation in science process skills can be explained by the combined influence of self-concept and achievement. This means nearly 61% of the observed differences in skill mastery remain attributable to other factors outside this study's scope. While self-concept and achievement play a meaningful role, there's more to the story when it comes to science process skills development. This finding aligns with another research. Nwolisa (2020) observed increased self-concept in students using science process

scales, and Sandeep & Rashmi (2017) reported a strong positive correlation between self-concept and skill acquisition. These studies lend further support to the idea that self-concept and achievement contribute to, but don't solely determine, science process skills. This moderate association suggests a complex interplay of factors influencing science process skills. While fostering positive self-concept and promoting academic achievement are valuable strategies, further research is needed to explore the remaining 61% of the equation and identify other significant influences on students' science learning pathways.

Conclusion

The findings in this study are in line with the work of other researchers. The correlation coefficient of 0.92 indicates a very strong positive relationship between students' academic self-concept and their acquisition of science process skills in Basic Science and Technology. This means that as students' academic self-concept increases, their acquisition of science process skills also increases. The coefficient of determination (R^2) of 0.85 further supports this notion, indicating that 85% of the variation in students' acquisition of science process skills can be explained by their academic self-concept. This suggests that students' academic self-concept is a very influential factor in determining their ability to acquire science process skills. These findings suggest that while student academic self-concept and achievement contribute significantly to the acquisition of science process skills, there are other factors beyond those studied that also play a substantial role in influencing these outcomes.

Recommendation

In view of these findings, the following recommendation was made that since there exist a positive relationship between student's academic self-concept and acquisition of science process skills in Basic Science and Technology, it is therefore recommended that students should be properly and regularly counseled by a good guidance counselors and classroom teachers with regards to building positive self-concept in order to enhance students' achievement and acquisition of science process skills.

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