ISSN 2962-5548
https://doi.org/10.56773/ejer.v4i1.74
Eureka: Journal of Educational Research, 4(1), 1-7

School locations and gender variables on students' science process skills as a predictor of academic achievement in senior secondary school

Maxwell Chukwunazo Obikezie[1]*, Ekoyo Destiny Onyebuch[1], Esther Ebele Akachukwu[1], Henrietta Obioma Nnalue[2]
[1]Department of Science Education, Nnamdi Azikiwe University—Awka, Nigeria
[2]Department of Science Education, Chukwuemeja Odumegwu Ojukwu University, Nigeria
*cm.obikezie@unizik.edu.ng

Received: April 9, 2025
Revised: May 18, 2025
Accepted: June 20, 2025

Abstract

This study examined school locations and gender variables on students' science process skills as a predictor of academic achievement in senior secondary school. Guided by two research objectives and two hypotheses tested at the 0.05 level of significance, the study employed a correlational survey design. The population of the study comprised 2720 senior secondary two (SS2) students offering biology, chemistry, data processing, physics and mathematics in all the public secondary schools in Onitsha Education Zone. A Sample size of 408 SS 2 students offering biology, chemistry, data processing, physics and mathematics in the Education Zone was drawn using multistage procedure. Students Science Process Skills Scale (SSPSS) and the achievement scores which was obtained from biology, chemistry, data processing, physics and mathematics teachers' grade book for 2023/2024 academic session from the sampled schools were used as instruments for data collection. The instruments were validated by three experts. The reliability of SSPSS was established using Cronbach alpha method. The reliability coefficient of SSPSS was found to be 0.73. Data from SSPSS and academic scores were collected; analysis involved correlation coefficients (R, R^2) and regression ANOVA to answer research questions and test hypotheses. The study revealed low predictive value of students' science process skills on academic achievement in science for both urban and rural schools, regardless of gender. Science process skills are not significant predictors of students' achievement in both school locations and gender based. From the findings recommendations and conclusions were made.

Keywords

Gender, school location, students' science process skills.

INTRODUCTION

Disparities in educational resources, opportunities, and gender roles is said to be one of thing that influence students' development of science process skills, which are crucial for academic success in science subjects. In the Onitsha education zone of Anambra State, Nigeria, these disparities has said to have led to unequal academic achievements among students based on school location—urban or rural—and gender [1], [2]. Such inequities may have hindered students' scientific understanding and performance, ultimately affecting their future academic and career prospects not minding school location.

School locations significantly impact students' science process skills, serving as a

predictor of academic achievement in senior secondary schools. According to Marc Jackman and Morrain-Webb [3] and Kocsis and Molnár [4] urban schools often provide better resources, including laboratories, access to technology, and extracurricular science programs, which enhance students' practical skills and understanding of scientific concepts. In contrast, rural schools may face challenges such as limited facilities and fewer instructional materials, potentially hindering the development of essential skills like observation, experimentation, and analytical thinking [1], [3].

Research indicates that students with well-developed science process skills tend to perform better academically, as these skills foster critical thinking and problem-solving abilities [5]. Furthermore, the learning environment in science process skills, including teacher expertise and peer interactions, varies by location, further influencing skill acquisition. Chinda and Achigbe [6] opined that science process skills is a significant predictor to academic performance of students in cross river state colleges. While Chinda and Achigbe [6] revealed moderate relationship in academic performance of students in Economics on the ground of school location in Isokan local government area of Osun State, Nigeria. Kocsis and Molnár [4] observed a low positive relationship between academic achievement of high school students and their personal skills in science oriented subjects in most Scopus journals in united kingdom not minding the school locations. Okoye and Onwuachu [7] observed that cognitive styles and school location had a significant influence on students' interest mean achievement in biology.

However, Awodun and Oyeniyi [8] observed no statistical significant difference in the academic achievement mean scores of male and female students in the urban school areas and also no statistical significant difference in the academic achievement mean scores of male and female students in the rural school areas in basic science subject in Ekiti State, Nigeria. Samuelsson and Samuelsson [9] found that boys feel that they use group work more than the girls do but based on the observation, with respect to students' relations to mathematics. They found that boys perceive mathematics to be more important than girls do in Sweden. The authors revealed that could be as a result of high science process skills and problem solving tasks that is dominant in boys than their girls' counterparts. Furthermore, research indicates that male students often outperform females in hands-on science activities and problem-solving tasks, while females tend to excel in collaborative and verbal aspects of science learning especially when considering science process skills [5]. This could be the reason while researchers like Amit [10] and Gabdrakhmanova et al. [11] maintained respectively in their findings that gender factor has a negligible impact on the progress of students at the institute of physics and the differences is in favour of boy students in university, with respect to science process skills as well as academic achievement scores in art subjects among art students in secondary schools. But Suman and Xavier [12] revealed that there is a positive correlation between science process skills and the achievement in science subjects among male and female students in Northern Asia while Glory and Ihenko [13] reported that gender has no significant influence on achievement of integrated science students in Obio Akpor local government area of Rivers State. However, Asio and Mondejar [14] that observed significant differences in the communication skills and academic achievements of students when grouped according to gender during pandemic.

From the literature reviewed above, the issue of gender is still inconclusive. Most of the studies reviewed were done independently on senior secondary school science subjects. While some were done in universities', art subjects and in junior secondary. Also, since school location is one of the major moderating variable under study, the whole of the literature reviewed shows that the present study is rare in Onitsha education zone of Anambra state, Nigeria and the issue of collective consideration of most senior secondary school science subject is also rare in the literature and in most recent studies. On this note, the researchers investigated on school locations and gender variables on students' science process skills as a predictor of academic achievement in senior secondary school in Onitsha Education Zone of Anambra State, Nigeria.

Purpose of study

The purpose of the study was to investigate: (1) Students' science process skills as a predictor of academic achievement in senior secondary school science subjects among urban and rural based schools; (2) Students' science process skills as a predictor of academic achievement of

male and female senior secondary school students.

Research question

The following Research Questions (RQ) guided the study: (RQ1) To what extent do students science process skills predicts academic achievement in science subjects in urban and rural based senior secondary schools?; (RQ2) To what extent do students science process skills predicts academic achievement of male and female senior secondary school science students?

Hypotheses

The following hypotheses were tested at 0.05 1evel of significance: (H01) Students' science process skills are not significant predictors of the academic achievement of urban and rural based senior secondary school students in science subjects; (H02) Students' science process skills are not significant predictors of the academic achievement of male and female senior secondary school students in science subjects.

RESEARCH METHOD

This study adopted the predictive correlation design. The area of the study was Onitsha Education Zone of Anambra State. The population of the study comprised of 2720 Senior Secondary two (SS2) science students in public secondary schools in Anambra state were used. The sample size for the study consisted of 408 SS2 senior secondary school science students in Onitsha Education Zone of Anambra state.

According to Nworgu in Abumchukwu [15], a sample size of about 15% to 50% of the population depending on the population size is adequate for a survey research. Thus, 15% of total population (2720) is 408 was used for the study due to the targeted population (co-education schools). Multistage sampling procedure involving different techniques were used in the study.

First using purposive sampling technique, the local government were drawn according to locations (urban and rural). Onitsha North and Onitsha South local governments' area were drawn as urban location while Ogbaru local government area was drawn as rural location. Secondly using stratified random sampling, co-educational government own schools were drawn reason was to ensure equal representation of male and female students because gender is a variable under consideration in this study as one of the moderating variables.

Finally, using proportionate sampling technique, four co-educational schools each were drawn from each of the local government that comprised Onitsha Education Zone making it a total of twelve schools. Reasons were to ensure equal number of school representation in these local government that made up the education zone and also to ensure that sample reflected population proportions.

Instrument

The instruments for data collection are Students Science Process Skills Scale (SSPSS) and average termly biology, chemistry, data processing, physics and mathematics scores from teachers' grade book for 2023/2024 academic session from the sampled schools.

SSPSS was adapted by the researchers from Science Process Skills. This instrument was developed and used by Zeidan and Jayosi [16] in study titled Science Process Skills and Attitudes toward Science among Palestinian Secondary School Studentsby. It has a reliability coefficient of 0.73 and consists of nine (9) science process skill namely; observation, measuring, classifying, predicting, communicating, controlling variables, hypothesizing, experimentation and data interpreting.The instrument omitted assessment of skills like inference, generalization, experimentation design, and reasoning, which are crucial for comprehensive science process skills and deeper understanding of how school location and gender influence academic achievement. Omitting inference, generalization, experimentation design, and reasoning is justified to streamline the instrument, focusing on core skills directly linked to observable actions like observation and measurement, which are more practical for assessing students within the specific context of school location and gender influence. The adapted instrument is relevant to the field conditions because it directly assess key scientific abilities influenced by school location and gender. This is what prompted the nine (9) clusters of the original instrument to be compressed to five (5) clusters which makes the instrument ideal to implement in the present study.

More so, the five (5) clusters has the most common representation of science process skill as it is used in secondary schools in Nigeria. Four

point scale response format was used which ranging from very low extent (1 point), low extent (2 point), high extent (3 point) and very high extent (4 point). The reliability co-efficient of the questionnaires was established by administering each of the questionnaires once on 50 SS2 senior secondary science students randomly selected from a Community Secondary School at Nawfia in Awka Education Zone, Anambra State. The school is outside the area of the study. Cronbach's alpha technique was used to determine the internal consistency of items in the instruments. Thereafter, set of scores for each respondent were coded for computer analysis using SPSS. The result of the analysis shows that SSPSS yielded a Cronbach alpha coefficient of 0.73. The achievement scores were obtained from biology, chemistry, data processing, physics and mathematics teachers'grade book for 2023/2024 academic session from the sampled schools. The average scores from the teachers' grade book were used as the achievement test. The results specified the students' achievement and was confirmed and validated by experts from the zone and the head of biology, chemistry, data processing, physics and mathematics subjects in the sampled schools.

RESULT AND DISCUSSION

This section deals with the analysis and presentation of data collected from respondents to answer the research questions and hypotheses.

Student science process skills and academic achievement: The role of school location

Table 1 presents the regression results examining the extent to which students' science process skills predict their academic achievement in science subjects, with the analysis separated by school location (urban and rural). The findings provide insight into whether the predictive strength varies between the two contexts.

Table 1. Regression of science process skills on academic achievement by school base

School Location	N	*R*	R^2	Adjusted R^2	Std. Error	*F*	*p*-value	Decision
Urban	257	0.036	0.021	0.009	41.650	0.498	0.684	Low
Rural	151	0.021	0.000					correlation

The result in Table 1 reveals predictive value of science process skills and senior secondary school students' academic achievement in science subjects as moderated by school based. It reveals that correlation coefficient *R* between science process skills and urban school based senior secondary school students' academic achievement in science subjects is 0.36 indicating a low positive predictive value with associated coefficient of determination R^2 in urban school based as 0.21. The coefficient of determination (0.021) also known as the predictive value means that 2.1% of urban senior secondary school based students' response on their science process skills accounted for the variation in academic achievement of urban senior secondary school based students in science subjects. This is an indication that 97.9% of variation in urban school based students' academic achievement in senior secondary science subjects is attributed to other factors other than their science process skills.This shows that improvement in science process skills would lead to increase in both urban and rural school based academic achievement in senior secondary school science subjects. Also in Table 1 shows correlation coefficient *R* between science process skills and rural school based senior secondary students' academic achievement in science subject is 0.021 indicating a low positive predictive value with associated coefficient of determination R^2 in rural school based students as 0.00. The coefficient of determination (0.00) also known as the predictive value means that 0% of rural school based students' response on science process skills accounted for the variation in academic achievement in senior secondary school science subject. This is an indication that 100% of variation in rural based school senior secondary students' academic achievement in science subjects are attributed to other factors other than science process skills.This shows that improvement in science process skills would lead to only urban based senior secondary school students' academic achievement in science subjects.

Table 1 also reveals no significant difference $F_{(1,404)}$=0.498, *p*-value=0.684>0.05=α indicating that science process skill is not a significant predictor of the academic achievement of urban and rural senior secondary school students in science subjects. The inference drawn was that

science process skill is not a significant predictor of the academic achievement of urban and rural senior secondary school students in science subjects.

The findings of the study in Tables 1 shows a low positive predictive value exist between students' science process skills and the academic achievement in science subjects among urban and rural based senior secondary school students. However, science process skill is not a significant predictor of the academic achievement of urban and rural senior secondary school students in science subjects in Table 3. A low positive predictive value that exists between students' science process skills and academic achievement in science subjects among urban and rural senior secondary school students could be due to factors like inadequate exposure to practical applications, different motivational levels, and varied quality of instructional methods that may hinder effective learning. Or socio-economic factors like resource availability, impacting students' engagement and skill application in real-world contexts. The finding is not in line with Babawale [17] who revealed moderate relationship in academic performance of students in Economics on the ground of school location in Isokan local government area of Osun State Nigeria. The findings are not also in consonance with Chinda and Achigbe [6] who reported that science process skills is a significant predictor to academic performance of students in cross river state colleges.

However, the finding is in line with Awodun and Oyeniyi [8] who observed no statistical significant difference in the academic achievement mean scores of male and female students in the urban school areas and also no statistical significant difference in the academic achievement mean scores of male and female students in the rural school areas in basic science subject in Ekiti State, Nigeria. But in contrast with Okoye and Onwuachu [7] who observed that cognitive styles and school location had a significant influence on students' interest mean achievement in biology. The reason for science process skill not a significant predictor of the academic achievement of urban and rural senior secondary school students in science subjects as observed from the study could be as a result of inadequate resources, ineffective teaching and limited hands on experiences impede science process skills' effect on most senior secondary school science subjects' academic achievement. By virtue of this finding, this research has joined the school of thought that observed that science process skill is not a significant predictor of the academic achievement of urban and rural senior secondary school students in science subjects.

Student science process skills and academic achievement: The role of gender

Table 2 displays the regression results assessing the extent to which students' science process skills predict academic achievement in science subjects, categorized by gender (male and female). This analysis explores whether the predictive relationship differs between male and female senior secondary school science students.

Table 2. Regression analysis of science process skills and academic achievement by gender

Gender	N	*R*	R^2	Adjusted R^2	Std. Error	*F*	*p*-value	Decision
Male	133	0.103	0.011	0.001	42.558	0.936	0.423	Low correlation
Female	275	0.0.23	0.001					

The result in Table 2 reveals predictive value of science process skills and senior secondary school students' academic achievement in science subjects as moderated by gender. It reveals that correlation coefficient R between science process skills and male students' academic achievement in senior secondary school science subjects is 0.103 indicating a low positive predictive value with associated coefficient of determination R^2 in male as 0.011. The coefficient of determination (0.011) also known as the predictive value means that 1.1%of male students' response on their science process skills accounted for the variation in academic achievement of male students in senior secondary school science subjects. This is an indication that 98.9% of variation in male students' academic achievement in senior secondary school science subjects are attributed to other factors other than their science process skills.This shows that improvement in science process skills would lead to small increase in both male and female students' academic achievement in senior secondary school science subjects. Also in Table 2 shows correlation coefficient R between science process skills and female students'

academic achievement in senior secondary school science subjects is 0.023 indicating a low positive predictive value with associated coefficient of determination R^2 in female students as 0.01. The coefficient of determination (0.01) also known as the predictive value means that 1.0%of female students' response on science process skills accounted for the variation in academic achievement in senior secondary school science subjects. This is an indication that 99% of variation in female students' academic achievement in senior secondary school science subjects are attributed to other factors other than science process skills.This shows that improvement in science process skills would lead to small increase in both male and female students' academic achievement in senior secondary school science subjects.

Table 2 also shows no significant difference $F_{(1,404)}$=0.936, *p*-value=0.423>0.05=α indicating that science process skill is not a significant predictor of the academic achievement of male and female senior secondary school students in science subjects. The inference drawn was that science process skill is not a significant predictor of the academic achievement of male and female senior secondary school students in science subjects.

The findings of the study in Table 2 show a low positive predictive value that exist between students' science process skills and academic achievement of male and female senior secondary school students in science subjects. Thus, science process skill is not a significant predictor of the academic achievement of male and female senior secondary school students in science subjects in Table 4. The findings is in line with Suman and Xavier [12] revealed that there is a positive correlation between science process skills and the achievement in science subjects among male and female students in Northern Asia. But however, the findings is in contrast with researchers who observed that gender factor has a negligible impact on the progress of students at the institute of physics and those who observed that there were gender differences, in the favor of boy students in university, with respect to science process skills as well as academic achievement scores in art subjects among art students in secondary schools [10], [11]. The low positive correlation between students' science process skills and academic achievement in senior secondary school science subjects as observed from the study may have being resulted from ineffective pedagogy, where students struggle to apply these science process skills in assessments or real-world scenarios, coupled with underlying issues like lack of exposure to experimental learning, and differing engagement levels among students.

More so, this study observed that science process skill is not a significant predictor of the academic achievement of male and female senior secondary school students in science subjects. The finding is inconsonance with Glory and Ihenko [13] reported that gender has no significant influence on achievement of integrated science students in Obio Akpor local government area of Rivers State but not inconsonance with Asio and Mondejar [14] that observed significant differences in the communication skills and academic achievements of students when grouped according to gender during pandemic. The reason that made science process skills not to significantly predict the academic achievement of senior secondary students in science subjects could be due to a reliance on traditional, rote learning methods. May be students often struggle to apply these science skills in assessments, resulting in a disconnection between their practice and the required test achievement which affected the students response to the instrument. Additionally, external factors, such as teaching effectiveness and classroom engagement, can overshadow the impact of process skills. By virtue of this finding, this research has joined the school of thought that observed that science process skill is not a significant predictor of the academic achievement of male and female senior secondary school students in science subjects.

CONCLUSION

It is concluded that, a low positive predictive value exist between students' science process skills and the academic achievement in science subjects among urban and rural based senior secondary school students. However, science process skills are not significant predictors of the academic achievement of urban and rural senior secondary school students in science subjects. From the finding also observed a low positive predictive value exist between students' science process skills and academic achievement of male and female senior secondary school students in science subjects. Hence, science process skills are not significant predictors of the academic

achievement of male and female senior secondary school students in science subjects. Based on the findings it was recommended that senior secondary school science teachers should endavour to indicate other factors that can influence students' achievement more significantly than students' science process skills irrespective of students' gender and school base.

REFERENCES

[1] M. C. Obikezie, I. S. Nwuba, and F. N. Ibe, "Influence of school location and gender on generative learning model on secondary school students' academic achievement in chemistry," *Eureka J. Educ. Res.*, vol. 2, no. 1, pp. 51–59, Aug. 2023.

[2] R. O. Mensah, K. D. Amponsah, P. Adiza Babah, and H. S. Jibril, "Factors affecting students' academic performance and teachers' efficiency in Ghana; a case study of Wa senior high school," *Cogent Arts Humanit.*, vol. 11, no. 1, Dec. 2024.

[3] W. Marc Jackman, J. Morrain-Webb, and C. Fuller, "Exploring gender differences in achievement through student voice: Critical insights and analyses," *Cogent Educ.*, vol. 6, no. 1, pp. 12–19, Jan. 2019.

[4] Á. Kocsis and G. Molnár, "Factors influencing academic performance and dropout rates in higher education," *Oxford Rev. Educ.*, vol. 51, no. 3, pp. 414–432, May 2025.

[5] A. A. Abumchukwu *et al.*, "Social learning environment and problem solving techniques on students' performance in senior secondary school science: Do gender moderate the correlation?," *Asian J. Univ. Educ.*, vol. 21, no. 1, pp. 119–134, 2025.

[6] W. Chinda and J. O. Achigbe, "Science Process Skills and Academic Performance of Students in Cross River State Colleges," *Fac. Nat. Appl. Sci. J. Math. Sci. Educ.*, vol. 6, no. 1, pp. 126–132, 2024.

[7] P. C. Okoye and W. C. Onwuachu, "Influence of cognitive styles and school location on academic achievement of students' interest in biology," *IAA J. Sci. Res.*, vol. 4, no. 1, pp. 1–8, 2018.

[8] A. O. Awodun and A. D. Oyeniyi, "Influence of school location on students' academic achievement in junior secondary school basic science in Ekiti State, Nigeria," *J. Emerg. Technol. Innov. Res.*, vol. 5, no. 6, pp. 125–129, 2018.

[9] M. Samuelsson and J. Samuelsson, "Gender differences in boys' and girls' perception of teaching and learning mathematics," *Open Rev. Educ. Res.*, vol. 3, no. 1, pp. 18–34, Jan. 2016.

[10] A. Ahuja, "Study of science process skills and academic achievement among secondary school students," *Int. J. Adv. Netw. Appl.*, pp. 343–346, 2019.

[11] R. Gabdrakhmanova, G. Garnaeva, L. Nefediev, and I. Garipov, "The Influence of the Gender Factor on the Quality of Education in the University," in *ARPHA Proceedings*, 2019, vol. 1, pp. 1741–1755.

[12] S. Suman and S. Xavier, "Relationship Between Science Process Skills and Achievement in Science of Secondary School Students," *Int. J. Creat. Res. Thoughts*, vol. 8, no. 10, pp. 3719–3726, 2020.

[13] G.-E. Glory and I. Sopuruchi, "Influence of Gender on Interest and Academic Achievement of Students in Integrated Science in Obio Akpor Local Government Area of Rivers State," *Eur. Sci. Journal, ESJ*, vol. 13, no. 10, pp. 211–219, Apr. 2017.

[14] J. M. R. Asio and H. C. U. Mondejar, "Students' Level of Science Process Skills Acquisition and Academic Achievement During the Pandemic," *C. J. Sci.*, vol. 26, no. 2, pp. 63–73, 2022.

[15] A. A. Abumchukwu, "Social learning environment and problem-solving skills as correlates of secondary school students' attitude and performance in chemistry," Nnamdi Azikiwe University, 2023.

[16] A. H. Zeidan and M. R. Jayosi, "Science Process Skills and Attitudes toward Science among Palestinian Secondary School Students," *World J. Educ.*, vol. 5, no. 1, Dec. 2014.

[17] K. O. Babawale, "School location as a correlate of students' academic performance among senior secondary schools in Isokan local government area of Osun State," *Int. J. Acad. Multidiscip. Res.*, vol. 3, no. 11, pp. 5–8, 2019.