A Comparison of the Effects of School Locations on Student's Academic Achievement in Chemistry in Cross River State, Nigeria

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Abstract

This study sets out to assess how school location (urban and rural) influence students' academic achievement in Chemistry in Cross River State, Nigeria. The research design adopted for the study is the quasi experimental non-randomized factorial design, using a pretest-posttest control group for this study. The population consisted of all senior secondary one (SS1) chemistry students in the eighty-five (85) public secondary schools in Calabar Education Zone, while the sample for the study comprised of 220 senior secondary one (SS1) chemistry students drawn from six secondary schools through simple random sampling technique (118 from urban and102 from rural location). Chemistry achievement test (CAT) with 50 items multiple choice questions was the instrument for data collection, administered to the 220 students across their different schools. The reliability of the instrument was obtained as 0.88 using Kuder Richardson formula (KR-20). Independent t-test analysis was used for data analysis, the result showed that the calculated t-cal value was 8.20, while the critical table value was 1.960, therefore there is a significant difference in the mean scores achievement in Chemistry between rural and urban secondary schools 1 students. The difference is in favor of urban schools. It was concluded that students in the urban areas performed academically better than their rural counterparts. It was then recommended among others that schools in the rural areas should be provided with the necessary learning facilities such as well-equipped laboratories with qualified and committed teachers for effective teaching and learning of chemistry in the area.
Keywords: school location, students academic achievements, chemistry, teaching strategies, learning facilities and chemistry achievement test

Introduction

Science education is an essential instrument for national development. The impacts of science and technology on the society cannot be overemphasized. Modern invention and discoveries have cumulatively helped to improve man's progress in health, happiness and productivity. Omika (2016) asserted that the relevance of science to national goals, aspirations and economy development dictates to a large extent, the huge commitment and support which nations make and give to science and technological development.

Giving adequate attention to science education especially at the secondary school level, may help Nigeria as a developing country, to raise a science-oriented generation of youths that would be better prepared and equipped with scientific knowledge and skills. This will help ensure effective dissemination and inculcation of scientific concepts, culture and thinking, as well as boost the pace of advancement in technology and economic development. This is based on the fact that the growth and development of any nation is a measure of its level of science education, through which citizens are made to acquire technical competencies for industrialization, (Onyinye, Egbo & Agujiobi, 2023).

Ali and Ullah, (2020) observed that science education is the process whereby learners are prepared or equipped with knowledge and skills to help ensure effective dissemination and inculcation of scientific concepts, culture, critical thinking process, innovation and activities through generally accepted pedagogical strategies and tactics, based on the application of learning (teaching) and educational theories (Alkhaldi, Pranata & Athauda, 2016). It is that particular field of study that exposes learners to the contents as well as methodology (processes) of acquiring scientific knowledge for practical application (Asare, Annan & NgmanWara, 2022).

The development of every nation is pivoted around a strong science educational system of that nation (Putra & Wiza 2019). In a fast-growing world, a country is considered developed when it has advanced in science and technology (Duran et al 2021). Science plays a critical role in shaping society, advancing education, and improving the lives of individuals. It serves as a cornerstone of progress and innovation, offering solutions to pressing global challenges while fostering intellectual and societal growth (Kerzie & Zorko 2023). The contributions of science in any nation are profound and multifaceted. Science drives societal development by providing the tools and knowledge needed to address issues such as health, technology, and environmental sustainability (Taim, 2023). Through scientific research, societies have been able to combat diseases, improve living standards, and develop technologies that enhance their quality of life. For instance, medical advancements such as vaccines and antibiotics have significantly reduced mortality rates and eradicated diseases like

smallpox (World Health Organization, 2021). Furthermore, science enables nations to address climate change through renewable energy solutions and policies informed by empirical data (IPCC, 2022). These contributions underscore science's pivotal role in ensuring societal well-being and sustainability.

Science offers a deeper understanding of the world and empowers individuals to make informed decisions about health, safety, and personal well-being (Astaiini & Kurniawan 2019). It is against this background that science education has been accorded a prime position worldwide. Within the context of science education, chemistry has been identified as a very important science subject and its importance in scientific and technological development of any nation has been widely reported (Alkhaldi, Pranata & Athauda, 2016; Ali & Ullah, 2020 Onyinye, Egbo & Agujiobi, 2023).

Chemistry as a subject of study combines with other natural science subjects like Physics, and Biology as well as Mathematics to qualify students for admission into tertiary institutions to read courses like Medicine and Surgery, Pharmacy, Engineering, Science, Agriculture etc. Chemistry is central to the study of science based courses (Aliyu, 2017). This is because it is a core natural science which its knowledge forms the basis of every scientific activity. Knowledge of Chemistry is very relevant and applicable to all areas of life, and without it, life on the planet is miserable and primitive (Anamezie, 2018). Furthermore, the production of essential human needs such as soap of all kinds, creams, drinks, petroleum and its bi-products, clothing, drugs and household utensils and chemicals for preservation of food items, as well as textiles, are all product of the knowledge and application of Chemistry (Faulconer & Gruss, 2018; Kapici, Akcay & de Jong., 2019).

Kapici, Akcay and de Jong, (2020) found in their study that Chemistry provides an understanding and explanation of the physical and chemical properties of atoms and molecules and practical methods for creating new molecular structures and materials with useful applications. This implies that adequate knowledge of Chemistry is very significant to standard living and a

progressive society. From the foregoing, it is quite obvious that chemistry cuts across all spheres of life and thus determines the well-being of the people and the society. As a central science, chemistry performs the function of gate keeper for the future study of both Pure and Applied sciences, Medicine, Pharmacy, Engineering, Agriculture and all other professions at the secondary school level (Aliyu, 2017).

In spite of the significance of chemistry in the development of science, students' performance in the subject at the secondary school level has always been an issue in Nigeria. Reports from the West African Examination Council Chief Examiner for May/June Senior Secondary School Certificate Examination, (SSCE) in Chemistry also indicate a persistent trend of students' poor performance over the years in SSCE (2020-2023) (Okafor, 2017).

This has made teachers of chemistry, parents/guardians, the government and all education stakeholders condemned, cry out, seeking for the causes and what could possibly be done to arrest the ugly situation. In order to address this issue of below-excellent performance, researchers over the years have carried out studies on factors that affect the achievement scores of students in chemistry (Anamezie, 2018; Astalini & Kurniawan, 2019).

Various factors can significantly impact students' academic performance in Chemistry, both positively and negatively. As highlighted by Joseph (2019), these factors range from student-specific influences to teacher-related variables. A critical determinant of academic success is the school's location, which can have a significant impact on students' performance. The school is a social and learning agent that provides the environment upon which a child may be formally educated in order to attain educational goals (Oredein, 2016).

Similarly, Joseph (2019) defines school as one of the institutions that is responsible for the development and training of the mind and skill of man. School is also for the preparation of man for the challenges and responsibilities in the society at large. Okorie and Ezeh (2016) defines school location as a particular place, relation to other areas in the physical environment (rural or urban), where the school is sited. Human beings have unlimited capacity to learn from any location, but

many however can be limited by the behavior patterns and facilities that the immediate environment offers (Oredein, 2016; Okafor, 2017; Mohammed, Chado & Dalhatu, 2021).

One of these variables is school location. School location refers to the place where the school is situated, whether in urban or rural area. Urban schools are those in the municipalities, while rural schools are those located in the villages or semi-urban areas, that is, schools at the out sketch of the cities and towns. The location of a school has a big role to play in the academic achievement of student at school. Owoeye and Agbaje (2016) asserted that students in urban schools generally perform better than those in rural schools due to superior educational resources and infrastructure, yet, research by Igbo and Leaton (2022) challenges this direct relationship, highlighting that school location may not universally dictate academic success. Urban schools typically offer a more conducive learning environment, characterized by well-equipped libraries, advanced technology, adequate instructional materials, and comprehensive evaluation processes. These resources foster a more favourable academic climate, enabling students to thrive (Yaro et al., 2016; Okechukwu & Ukeh, 2022).

Conversely, rural schools face numerous challenges, including limited access to educational materials, inadequate infrastructure and significantly, a language barrier. In rural settings, local dialects often dominate, creating an additional obstacle for students whose academic curriculum is delivered in English, Nigeria's official language. This linguistic divide is less of an issue in urban areas, further contributing to the performance gap between urban and rural students (Kuyenum et al., 2018; Ugwanyi et al., 2020). In Nigeria, schools located in a rural area are usually faced with problems like shortage of teachers, lack of laboratories, poorly equipped laboratories among others. These shortcomings negatively affect students' achievement. Evidence abound that the educational aspirations of students who study in rural areas are weaker than those of their urban counterparts. Macmillan (2012) found that students in rural areas place less value on their studies, such that their achievements are affected.

Kuhfeld, Soland, Tarasawa, Johnson, Ruzek and Liu, (2020) submitted that the location of schools could also be a factor that affects the performance of students in science subjects. According to the researchers, urban areas are those with moderate population and better life, which indicates that schools in urban areas have electricity, water supply, more teachers, more learning facilities and infrastructure for better instructional processes that may lead to student's higher achievement levels in urban schools than rural schools (Okafor, Okunuga & Ojo, 2020; Mohammed, Chado & Dalhatu, 2021).

In Cross River State, Nigeria, where this study is situated, the rural-urban divide in chemistry education is pronounced. Students from rural schools face numerous challenges, including inadequate laboratory facilities, lack of qualified teachers, and limited access to educational resources (Aliyu, 2017). From the foregoing, it is clear that findings on the influence of school location on the performance of students in chemistry, over the years, have produced disagreeing results. While some maintain that urban students perform better in examinations than their rural counterparts, others have found that rural students perform in similar manner when compared to their urban counterparts. It is therefore, necessary to carry out further research to ascertain the actual effect of school location on students' academic achievement in chemistry in Calabar education zone, Cross River State, Nigeria.

Okorie and Ezeh (2016) examined the influence of gender and location on students' achievement in chemical bonding. The researcher started by posing a question whether students' achievement in chemical bonding is a function of their gender and school location. This question and two hypotheses guided the study. Pre-test-post-test non-equivalent control group quasi-experimental design was used, with a population of 5,966 senior secondary class one (SS I) chemistry students in 57 senior secondary schools in Nsukka education zone of Enugu State, Nigeria. Adopting purposive sampling technique, nine schools were selected to draw 311 SS I students. Intact classes were used. Instruments for data collection were Students' Interest Scale on Chemical Bonding (SISCB) and Chemical Bonding Achievement Test (CBAT). The instruments were validated

and had reliability coefficients of 0.68 and 0.87 respectively. Regular chemistry teachers of the selected schools taught the students using instructional software package method of teaching (ISPMT). Research questions were answered, using descriptive statistics. The hypotheses were tested using analysis of covariance (ANCOVA) at $P < 0.05$ level of significance.

Result of the study showed that mean achievement score of female students was higher than that scored by the male students. It was also discovered that the mean achievement score of rural students was higher than those of urban students, gender as a main effect on students' achievement in chemical bonding was significant. The result also showed that location as a main effect on students' achievement in chemical bonding was significant. This study found that school location had significant implication on students' achievement in chemistry as they were during chemical bonding classes. A similar position was found by Ratamun and Osman, 2(018);

Tugtekin and Dursun, (2022).

Ugwu, (2021) set out to investigate the relationship between location and achievement of SS III students in Physics. Correlation research design was employed. Stratified proportionate random sampling technique was used. The study used 494 subjects randomly selected from 25 secondary schools across the six education zones of Enugu State. Intact classes were used. For schools that have more than one stream studying Physics, one intact class was selected by balloting. Test of Understanding of Physics concepts (TOUPC) was the instrument in the study. Both TOUPC and School Certificate Physics Examination (SSCE) results were the achievement tests or the study. Results showed from the simple correlation and regression analysis a work positive relationship between location and students' attainment in TOUPC and SSCE respectively. The conclusion is that location of students was significantly related to senior secondary school Physics students understanding of Physics concepts and also significantly related to their level of achievement in SSCE.

Similarly, Anamezie (2018) investigated the interaction effects of method and location on academic achievement of secondary school biology students using constructivist teaching method, pretest-

posttest non-equivalent control group design was adopted. The study was conducted in Enugu North and East Local Government Areas of Enugu state. The population of the study was 5,104 senior secondary one (SS I*)* Biology students. The sample size was 118 (60 males and 58 females). Stratified random sampling was used to draw two co-educational schools, one from Urban Schools and the other from rural schools. In each of the two schools sampled, two intact lasses sampled was assigned to constructivist teaching method while control group was assigned to lecture method. Data generated were analyzed using mean with standard deviation. Analysis of Covariance (ANCOVA) was used in testing the hypothesis at $P < 0.05$. The result of the study showed that the students' achievement in Biology was better than when they were taught basic concept in ecology using constructivist teaching method than when they were taught using lecture method. The result also showed that location had a significant influence on academic achievement of Biology students in favor of urban schools.

Oluseye, (2018) carried out a case study on Akure south local government area, Ondo state Nigeria to explored how location and gender influence the performance of students in Physics in Akure South Local Government, Ondo State, Nigeria. The sample consisted of four schools randomly selected from the co- educational schools in the public schools. Data were collected through interviews, classroom observation, focus group interviews of the students and documents obtained from the school principals on students' academic performance in the West African Senior Secondary Certificate Examination (WASSCE) from 2011-2015. The validity and the reliability of all these instruments were established. The data obtained through interviews were interpreted qualitatively. The documents obtained from the selected schools were also analyzed. The results of the study revealed that the urban students perform better in Physics than the rural students. The study also revealed that the gender of the students affects their performance in Physics with male students performing better than female students. Frantic efforts should be made to ensure conducive learning environment and equivalent learning opportunities to both male and female students.

In another development, Agbaje, Awodun and Omotade (2024) studied the impact of school location on academic achievement of science students in senior secondary school certificate

examination. The purpose was to determine whether geographical location has any impact on the achievement of the students in Biology, Chemistry and Physics. The design adopted for the study was an ex - post facto survey type. A total of one hundred and twenty (120) science students that were randomly selected from six (6) public secondary schools in Ekiti West Local Government Area of Ekiti State, Nigeria for the study. Computerized result sheets sent to each school by the West African Examination Council (WAEC) were collected on the 2020-2023 May/June West African Senior Secondary School certificate examination (WASSSCE) from all the selected schools for the study (WASSCE, 2018).

The average of the scores of each candidate selected for participation in this study was computed in Biology, Chemistry and Physics. These served as the achievements in science. Three research hypotheses were formulated and tested using t-Test statistical analysis at $p<0.05$ level of significant. The findings revealed that there was statistical significant difference in the achievement mean scores of students in rural and urban school.

Abamba, (2021) carried out research to examined the effects of school location on secondary school students" academic achievement in Physics based on the 5E learning cycle. The design of the study was a non - randomized pre-test, post-test control group quasi experimental design. The population of the study was 66,345. Two hundred and forty-three students were sampled from six schools. Four hypotheses were tested at 0.05 level of significance. The hypotheses state that there is no significant difference in mean achievement scores in Physics between urban and rural students taught using 5E leaning cycle among others. The statistical tools used were mean, standard deviation and Analysis of Covariance (ANCOVA) were used in testing the hypotheses formulated. The result amongst others showed there is no significant difference between rural and urban students' achievement taught using 5H learning circle (F-cal. (113) - F crit (0.005), $p>0.05$). Based on the findings, it was recommended among others, that 5E learning cycle be adopted in Nigeria secondary schools as a teaching method and that faculties of

education in various schools of higher learning should ensure that 5E learning cycle is included as a method of teaching Physics

Ella and Ita (2017) conducted a study to determine the relationship between school location and students' academic performances in chemistry in secondary schools in Ogoja Local Government Area. It adopted a survey research design. The population of the study comprised all the 836 senior secondary two (SS2) students of the 2016/2017 academic session in all the 46 public and private secondary schools in Ogoja local government through stratified random sampling, a sample of two hundred (200) students were drawn for the study. Out of this number, 124 representing 62% were males; while 76 students representing 38% were females. The instrument used for data collection was achievement test tagged Chemistry Achievement Test (CAT) carved from 2015 Chemistry mock' examination. The data obtained was analysed using independent t-test. The results revealed that there is a significant difference in students' academic performance in chemistry on the basis of school location.

Similarly, Onoyase (2015) carried out a study on the academic performance of students in urban, semi-urban and rural secondary school in Ikono Local Government Area of Akwa Ibom State, Nigeria. A survey design was employed in the study, hypotheses were formulated to guide the study. The researcher collected data on the Senior Schools Certificate Examination results conducted by the West African Examination Council (WAEC) in the year 2001. The subjects selected for analysis were English Language, mathematics and biology. Others were chemistry and geography. 3 out of 6 secondary schools in the study area were used for the study. 90 out of 220 students in the three secondary schools were used for the study representing 49.1 percent. One way analysis of variance (ANOVA) was used to analyze the data. The findings of the study showed that; there was a significant difference in the academic performances among students in urban, semi-urban and rural secondary schools.

Soliu, Badmus, Akanbi and Omosewo, (2020) carried out research to investigate the influence of school location and school type on senior school achievement in physics in Ilorin,

Kwara State. The study specifically examined the influence of school location and school type on students' academic achievement in WASSCE physics examinations from 2010-2014. SSCE results of 1124 senior school students that sat for WASSCE examinations from 2010- 2014 were collected from eight schools in both rural and urban areas of Ilorin East, Kwara State. Two hypotheses were formulated. The t-test statistical tool was used to test both hypotheses at 0.05 level of significance. This study reveals statistical significant difference in the achievement of senior school students in WASSCE physics examinations based on school location from 2010-2014 in favor of rural schools, t (1122) =3.404, $p<0.05$; there was also a significant difference in the achievement of senior school students in WASSCE examinations based on school type from 2010-2014 in favor of private schools, t(1122)=12.12, $p<0.05$. Recommendations and conclusions were made in line with the findings of this study.

Purpose of the Study

The purpose of this study is to do comparative analyses of the effects of school location (urban and rural) on student's academic achievement in chemistry in Cross River State, Nigeria.

Research Question

In line with the above purpose, one research question was asked in this study thus;

How does the location of schools influence students' academic achievement in chemistry in cross river state?

Statement of Hypothesis

There is no significant difference in the mean achievement scores of urban and rural secondary school students in chemistry.

Research designs and Methods

A pretest-posttest control group quasi-experimental non-randomized factorial design was adopted for this study, so that the researcher could evaluate the effect of the independent variables (school location) on the dependent variable (students' academic achievement in kinetic theory of gases).

The population consisted of all senior secondary one (SS1) chemistry students in the eighty-five (85) public secondary schools in Calabar Education Zone (grouped into rural and urban areas). The sample for the study comprised of 220 senior secondary one (SS1) chemistry students drawn from six secondary schools through simple random sampling technique. There were 118 from urban location and 102 from rural location.

The instrument used for data collection in this study was Chemistry Achievement Test (CAT) developed by the researcher to measure student's achievement in kinetic theory and states of matter. The CAT comprised fifty (50) multiple choice test items which focused on all areas taught. The CAT was designed to measure students' achievement after treatment and the test items were distributed among the six intellectual levels of Blooms taxonomy. The instrument was subjected to face and content validity.

Sample Distribution of Students

Schools	**Number of Students**	**Sample Selected**	**Percentage ratio**
A (Urban)	280	42	15%
B (Urban)	200	30	15%
C (Urban)	258	38	15%
D (Rural)	227	34	15%
E (Rural)	267	36	15%
F (Rural)	213	40	15%
Total	1,472	220	

To ascertain the reliability of the instrument, a pilot study was carried out. The reliability coefficient obtained using Kuder Richardson Formula (KR-20) was 0.88. The sample distribution is shown on table 1.

Results and discussion

There is no significant difference in the mean achievement scores of urban and rural secondary school students in chemistry.

Independent variable: School location (urban and rural)

Dependent variable: Academic achievement in chemistry

Statistical tool: Independent t-test

The result on table 2 revealed that the calculated t-value (t-cal) is greater than the critical t-value (t-tab) =1.96, df = 218; p<0.05>. Hence the null hypothesis was rejected. This implies that there is a significant difference in the mean academic achievement scores of students in urban and rural secondary schools, taught chemistry using laboratory method. The greater achievement is in favour of students from schools located in urban areas (with a mean score of 65.02) which is greater than that of their counterparts in schools located in rural areas (having mean score of 58.65)

Table 2: Independent t-Test analysis of academic achievement of students in schools located in urban and rural areas

Groups/Variables	**n**	**$\bar{x}$**	**SD**	**df**	**t-cal**	**Remark**
Urban	118	65.02	6.41			
				218	8.20	*
Rural	102	58.65	5.52			

Critical t = 1.960

This finding agrees with that of Okorie and Eze (2016), whose study showed a significant influence of school location on the academic achievement of students. The finding of this study is also in line with that of Anamezi (2018) whose finding showed that school location had a significant influence on academic achievement of Biology students in favor of urban schools. Similarly, Ellah and Ita (2017), also found statistically significant differences in science students' achievement in favor of urban schools as compared to rural schools.

Furthermore, in separate studies by Ugwu, (2021), and Oluseye (2018), they found a significant relationship between school location and students academic achievement in physics. These findings are in line with the findings of the present study which concludes that location of schools has significant effects on the academic achievement of students in chemistry.

On the contrary, the findings of this study disagrees with the findings of Abamba (2021) whose result showed no significant difference between rural and urban students' achievement when taught using 5E learning cycle. Also, the findings of this study is in disagreement with the findings of Soliu et al., (2020) whose findings statistical significant difference in the achievement of senior school students in WASSCE physics examinations based on school location in favour of rural schools.

Conclusion

The findings of this study has established that school location had significant effect on the academic achievement of chemistry students taught kinetic theory of gases in favor of schools located in the urban areas. Based on this finding, it is concluded that students in the urban areas performed academically better than their rural counterparts.

Recommendations for policy directions

Based on the research findings that urban students performed better than rural students, and in order to close the urban-rural performance gap and ensure equitable education opportunities for all students, the researchers recommends that;

1. Schools in the rural areas should be provided with necessary learning facilities such as well-equipped laboratories for effective teaching and learning of the subject chemistry in the area.
2. Education board, Directors and all Heads of schools in the state should ensure that teachers are posted to the rural areas to ensure curriculum implementation in such areas.

3. Government and stakeholders in the education sector should invest in modern classroom facilities, libraries and science laboratories in the rural schools to create a conducive learning environment.
4. Policy makers should establish early childhood education programmes in rural areas to prepare students for formal schooling.
5. Education stakeholders should partner with tech companies to provide affordable digital devices for rural students.
6. Government and chemistry educators should focus more attention in terms of necessary facilities and pedagogy on the schools located in rural areas for them to have the same opportunity like their counterpart in the urban school location areas and to enhance students' academic achievement in chemistry irrespective of the geographical school location.

References

Akpan, E. A. (2012). Entrepreneurship Education Policy. An Intervention Strategy for Economic Development in Nigeria. *Business & Entrepreneurship Journal*, *1(2),101-110*

Ali, N. & Ullah, S. (2020). Review to analyze and compare virtual chemistry laboratories for their use in education. *Journal of Chemical Education, 97(10), 3563–3574*. https:// doi. org/ 10. 1021/acs. jchem ed. 0c001 85

Aliyu, M. M. (2017). Challenges of teaching and learning Chemistry in rural secondary schools in Nigeria. *Journal of Education and Practice, 8(10), 122-128*

Alkhaldi, T., Pranata, I. & Athauda, R. I. (2016). A review of contemporary virtual and remote laboratory implementations: Observations and findings. *Journal of Computers in Education, 3(3), 329–351*. https:// doi. org/ 10. 1007/ s40692- 016- 0068-z

Anamezie, R. (2018). Utilization of constructivist method in teaching Biology in secondary schools: Interactive effect of method and location. *World Journal of innovative Research (WJIR) 5(2) 4-12.*

Asare, A.H.Y., Annan, J.N. & Ngman Wara, E.I. (2022). The effect of virtual laboratory on student teachers‟ achievement in integrated science in Bagabaga College of Education, Tamale, Ghana. *European Journal of Research and Reflection in Educational Sciences, 10(1), 26-39.*

Astalini, A. & Kurniawan, D. A. (2019). Pengembangan instrument sikap siswa sekolah menengah pertama terhadap mata pelejaranm IPA. *Journal pendidiakn Sains (IPS) 7(1), 1-7.*

Duran, P. A., Castillo, A. J., Walson, C; fuller, putvin, G. & Pathon, H. (2021). Gender and perception implementation of web-based character assessment in science learning. *Journal of education research and evaluation 6(1), 131-142*

Ellah, K. E., and Ita, P. M. (2017). Correlational relationship between school location and students' academic performance in English Language in Nigerian Secondary Schools. *International Journal of Scientific and Research Publications, 7(9), 381 – 384.*

Faulconer, E.K. & Gruss, A.B. (2018). A review to weigh the pros and cons of online, remote, and distance science laboratory experiences. *The International Review of Research in Open and Distributed Learning, 19(2), 155-168.*

Igbo, E., & Leaton, L. (2022). A comparative study on academic performance between urban and rural secondary school students in Nigeria. *Journal of Educational Research and Development, 12*(2*), 48 -59.*

Intergovernmental Panel on Climate Change (IPCC) (2022). Climate change 2022: Societal life and Adaptation, Cambridge University Press.

Joe Project Store (2018). Effect of School location on the academic performance of secondary school students (A case study of onward secondary school, Mbiokporo). Online: Education (https://iproject.com.ng/education/project-topics:html). Retrieved on 29/05/2020.

Joseph, E. A. (2019). The influence of student and teacher-related factors on academic performance in secondary schools. *Educational studies review, 8(2), 45 – 58.*

Kapici, H.O., Akcay., H. & de Jong., T. (2019). Using hands-on and virtual laboratories alone or together which works better for acquiring knowledge and skills? *Journal of Research on Technology in Education.* https://doi. org/ 10. 1007/ s10956- 018- 9762-0

Kapici, H.O., Akcay., H. & de Jong., T. (2020). How do different laboratory environments influence students‟ attitudes toward science courses and laboratories? *Journal of Research on Technology in Education.* https://doi.org/10. 1080/15391 523. 2020. 17500 75

Kerzie, D. & Zorko, V. (2023). Effect of the student learning approach on social annotation.

Kuhfeld, M., Soland, J., Tarasawa, B., Johnson, A., Ruzek, E. & Liu, J. (2020). Projecting the potential impact of COVID-19 school closures on academic achievement. *Educational Researcher 49(8), 549- 565.*

Kuyenum, F. O., Odozi, J. & Ogini, P. (2018). Educational inequality and performance gaps in Nigerian schools. *Educational Review Journal* (*62)1, 23 – 35.*

Mohammed, S., Chado, A. & Dalhatu, B. (2021). Effects of virtual laboratory package on students‟ achievement in chemistry practical among senior secondary schools in Minna Metropolis, Niger State

Okafor, N.P. (2017) Effects of computer animation and flipped learning pedagogies on secondary school students‟ acquisition of problem solving skills in chemistry. Nigerian Journal of

Curriculum Studies. *Journal of Curriculum Organization of Nigeria (CON), 24(4), 38-57.*

Okafor, N.P; Okunuga, R.O & Ojo, T.O. (2020). Effect of virtual chemistry laboratory software (VCLS) on secondary school students‟ achievement in acid-base titrations experiment. *Journal of the Nigerian Academy of Education 16(2), 38-48.*

Okechukwu, O. & Ukeh, B.O. (2022). Awareness of cloud computing services in Tertiary Institutions in Enugu State. *International Technology Research Journal, 8(1): 27-34.*

Okorie, E. U. & Ezeh, D. N. (2016). Influence of gender and location on students' achievement in chemical bonding. *Mediterranean Journal of Social Sciences, 7(3), 309-318.*

Omiko, A. (2016). An evaluation of classroom experiences on basic science teachers in secondary schools in Ebonyi State of Nigeria. *British Journal of Education, 4 (1), 64 -76.*

Onyinye, C., Egbo & 3Agujiobi, U.P., (2023). Effect of Virtual Chemistry Laboratory on Senior Secondary School Chemistry Students' Academic Achievement in Enugu Education Zone of Enugu State. *ESUT Journal of Education (EJE), 6(1), 215-227*

Oredein, O. (2016). Effects of school variables on students' academic performance in Calabar Municpal Area of Cross River. Online. Retrieved 29/05/2020.

Owoeye, J. S., & Agbaje, K. (2016). School location and students' academic performance: Implications for education policy in Nigeria. *International Journal of Educational Research, 5*(2), *87 – 99.*

Putra, D.S & Wiza, O. H. (2019). Analysis Sikap Siswa Terhadap Mata pelajaran fisika di SMA feirdy ferrypulia kola jambi. Uptj unnes. *Physic Education Journal.8(3),243-259*

Ratamun, M.M. & Osman, K. (2018). The effectiveness comparison of virtual laboratory and physical laboratory in nurturing students‟ attitude towards chemistry. *Creative Education, 9,1411-1425*. https://doi.org/10.4236/ce.2018.9910

Soliu, I. P., Badmus, O. T., Akanbi, A. O. & Omosewo, E. O. (2020). Influence of school location and school type on senior school students' achievement in physics in Ilorin, Kwara State, *Academic Journal Article, Ife Psycholigia 21(1), 1-4.*

Tagbo G. (2014). *Effects of 5Es Constructivist instructional approach on students' achievement and attitude to chemistry*. An M.Sc thesis submitted to Department of Science Education, University of Nigeria, Nsukka.

Tiam, M., (2023). The Influence of online learning environments, self-efficacy and interaction in learning achievement. The case of international students in China. *Interactive learning environments 1 – 22.*

Tugtekin, E. B. & Dursun, O. O. (2022). Effect of animated and interactive video variations on learners‟ motivation in distance education. *Education and Information Technologies, 27, 3247–3276.* https://doi. org/ 10. 1007/ s10639- 021- 10735-5

Ugqu, D. U. (2021). Gender and achievements in senior secondary school physics, *The Nigerian Journal of Research and production 18(1), 55-69.*

World Health Organization (WHO) (2021). "Vaccines and Immunization". Retrieved from www.who.int.

Yaro, B. A., Oladele, R., & Adebayo, O. (2016). Educational infrastructure and gender disparities in academic performance: *Nigerian Journal of Educational Development 18(3), 92 – 105.*