Perceived Effect of Practice on Secondary School Chemistry Students: The Case Study of Selected Schools in the Ovia North East Local Government Area, Edo State, Nigeria

Kennedy Imasuen & Stanley O. Ebuwa

University of Benin

ABSTRACT

This study investigated the perceived effect of practical senior secondary school students' performance in chemistry: the case study of selected schools in Ovia North East Local government area, Edo state. To achieve this, three research questions were raised. The study design was quasi-experimental, using pre-test and post-test approaches. The study population consisted of all public senior secondary schools in the Ovia North East Local Government, Edo State, while the study sample size was 400 students drawn from the twenty- seven (27) public senior secondary schools in the local government area. Simple random sampling techniques were used to select fourteen schools representing fifty percent. Purposive sampling was used to determine 400 students from the fourteen schools. The instrument for the study was an achievement test drawn from past questions from the West African Examinations Council (WAEC) and the National Examinations Council (NECO).

Keywords: chemistry, practical, predictor, science, performance.

Classification: LCC Code: LB1585

Language: English

Great Britain Journals Press

LJP Copyright ID: 573351
Print ISSN: 2515-5785
Online ISSN: 2515-5792

London Journal of Research in Humanities and Social Sciences

Volume 23 | Issue 15 | Compilation 1.0

Perceived Effect of Practice on Secondary School Chemistry Students: The Case Study of Selected Schools in the Ovia North East Local Government Area, Edo State, Nigeria

Kennedy Imasuen[α] & Stanley O. Ebuwa[σ]

ABSTRACT

This study investigated the perceived effect of practical senior secondary school students' performance in chemistry: the case study of selected schools in Ovia North East Local government area, Edo state. To achieve this, three research questions were raised. The study design was quasi-experimental, using pre-test and post-test approaches. The study population consisted of all public senior secondary schools in the Ovia North East Local Government, Edo State, while the study sample size was 400 students drawn from the twenty- seven (27) public senior secondary schools in the local government area. Simple random sampling techniques were used to select fourteen schools representing fifty percent. Purposive sampling was used to determine 400 students from the fourteen schools. The instrument for the study was an achievement test drawn from past questions from the West African Examinations Council (WAEC) and the National Examinations Council (NECO). Two teachers of Chemistry and three Measurement and Evaluation experts validated the test items. The reliability of the instrument was checked using the Kuder-Richardson formula 20 reliability statistics and gave an index of 0.89. The collected data were analyzed using the mean and standard deviation, the t-test, and two-way analysis of variance.

The result that emanated from the study revealed that senior secondary school students who were taught Chemistry with practicals performed better than those who were trained without practicals. It accounted for about 63.9% of student's learning of Chemistry, teaching Chemistry with practicals had a significant effect on the performance of senior secondary school students in Chemistry, as it contributed about 63.9% of students' learning of Chemistry, and that there was no significant difference between male and female students exposed to teaching Chemistry with practicals and those without. That is, sex was not a determining factor in student' performance in Chemistry practices. It was recommended that teachers use more practical work during teaching and learning Chemistry in secondary schools and that chemistry teachers undergo intensive continuing education in practical work management and recent research to improve their practices.

Keywords: chemistry, practical, predictor, science, performance.

Author α: Institute of Education, University of Benin, Nigeria.
σ: ICTU Department, University of Benin, Nigeria.

I. INTRODUCTION

Chemistry is the branch of pure science that deals with the study of the composition, properties of matter, its uses, changes, and the laws and principles that govern these changes (Ebbing, 1996). It is one of the subjects offered all over the world including, Nigeria. It is an integral part of what is called science and an active and continuously growing science that is of vital importance for the world as a whole, both in the field of nature and the realm of society (Anaso, 2010). Chemistry is the science that has the most direct and dramatic impact on us and the science that shapes the world in which we live. Therefore,

student performance in the subject is a significant concern for any developing country (Khan et al., 2011). The uniqueness of Chemistry and the role it should play in the development of any nation is not seen in the students' performance. Around the world, student academic performance and achievement in science have shown a decline. For example, in the United States of America (USA), this decline over the years prompted the focus and urgency of school reform efforts for science education (Mupanduki, 2009). Hofstein (2004) reported that this decline led to a new era of science education reform where both the content and pedagogy of science were being examined and new standards were emerging aimed at shaping meaningful science education. Student performance in Chemistry in Nigeria has also been poor and unimpressive. (Anasod, 2010).

Over the years, some authors have argued that science cannot be meaningful to students without valuable hands-on experiences or hands-on experiences in the school laboratory (Hofstein et al., 2007). This means that experiences in the school setting should make students to interact with materials to observe and understand the natural world. Practical brings about practice which are designed and conducted to engage students individually or in small groups, (a method called a class experiment), or in large group demonstration settings (known as teacher demonstration methods).

Since chemistry is a practical science, the teaching and learning of chemistry must include practices. Practicals on chemistry is an essential part of effective science education, and science educators have suggested that there are such benefits to learning through the use of laboratory activities (Millar, 2009). Anaso (2010) reported that lack of chemistry practicals by chemistry students resulted in poor student communication and poor observation skills, leading to poor student performance. For Dillon (2008), quality chemistry practices help develop students' understanding of scientific processes and concepts, hence the substantial investment made in the provision and equipment of chemistry laboratories in secondary schools.

Achimugu (2012) described the goal of practical activities in Chemistry as helping students develop scientific process skills such as observing, classifying, predicting, measuring, drawing, recording data, and hypothesizing, which promotes the development of scientific attitudes such as objectivity, honesty, curiosity, patience and open-mindedness'. Chemistry labs are an essential feature of senior secondary school science education. Therefore, a large proportion of high school chemistry class time is devoted to labs that are presumed to lead to distinctive student achievement (Abraham & Millar, 2008). According to them, some science educators have questioned its effectiveness as a teaching and learning strategy. However, this has yet to be thoroughly studied in Nigeria. While the hands-on (practicals) approach is generally effective in getting students to do things with objects and materials, it is considered ineffective in developing their conceptual understanding of associated scientific ideas and concepts. In countries such as the UK, a tradition of chemistry practicals in school chemistry teaching is seen by teachers and scientists as fundamental to the attractiveness and effectiveness of chemistry learning (Abraham & Millar, 2008). Although many science teachers believe that students' chemistry practicals lead to better knowledge and, indeed, better education; things are better understood and remembered quickly and easily, if done by individuals and thus promote effective understanding (Millar, 2009).

Instruction in Chemistry is carried out through practical and theoretical work. Practicals are mainly done as student experiments in the lab and the teacher demonstration either in the lab or in the classroom, while theory is often done in the school (Twoli, 2006). Wellington (1998) describes Chemistry practicals as teacher demonstrations or class experiments in which all students perform similar tasks, working in small groups or experiment circles with small groups of students engaged in different activities, rotating on the carousel. In senior secondary school, laboratory activities are designed and conducted to engage students individually or in small groups (student experiments) and large group demonstration

settings (teacher demonstrations) (Hofstein et al, 2007). The successful learning of Chemistry depends partly on the correct use of a teaching method whose activities address most of the learning senses. Twoli (2006) opined that chemistry is a subject that encourages "hands-on" experiences, hence more practice-oriented modes of instruction should be selected. Science practicals are a very prominent feature of school science in many countries, and a large proportion of class time is devoted to them. Thus, it is a feature of the school's science curriculum. For example, the West African Examination Council (WAEC) syllabus had over the years recommended that the teaching of all science subjects listed in the syllabus should be practically based. After several decades of emphasizing the assumed importance of practicals in science teaching and learning, the importance became elevated to the level of a dogma (Abimbola, 1994).

Poor performance in Chemistry is not unique to Nigerian secondary school students. In the Caribbean, for example, the biggest challenge facing science teachers and researchers is low achievement in science subjects among senior secondary school students (high school students). A review of the high school certification examination results in Biology, Chemistry, and Physics had fallen below 50% in these science subjects (Ogunkola & Fayombo, 2009). Similarly, International Studies of Educational Performance revealed that students in the United States of America consistently rank near the bottom in science and mathematics (Rutherford & Ahlgren, 1991), an indication of poor performance in these subjects. In general, chemistry has been a prerequisite subject for offering science-oriented courses in tertiary institutions (Ava & Odomwonyi-Out, 2011).

Teaching Chemistry with practice has continued to help achieve meaningful learning and increase student interest in Chemistry (Okeke, 2019). Several studies have been conducted to reinforce the benefits of teaching chemistry with practical. Okeke (2011) found that using a hands-on approach has always helped students score highly in the theory part of Chemistry. For their part, Oloyede (2010) and Okeke (2015) found that students score low in the theoretical aspect of Chemistry using the conventional (traditional) teaching method. They attributed this low performance to the inability of the students to find a link between the skills learned in the practical class with the theoretical teaching of Chemistry. For his part, Usamani (2011) observed that students with practical orientation/ experience were more likely to perform better than those with limited practical skills.

While chemistry is supposed to be necessary for students, some studies have shown that boys and girls differ in their perception of the practical approach. For example, Trumper (2006) opined that boys and girls of the same age tend to have different attitudes toward similar teaching styles in Practical Chemistry. However, Kibirige and Tsamago (2013) showed that the attitude of boys and girls towards science when similar methods were used in Chemistry teaching was not different. However, Okeke (2019) showed that there was a significant difference between male and female students in Chemistry practices. The result also revealed that the girls showed more interest in the practicals than the boys.

II. PROBLEM STATEMENT

The development of a scientific base in a country depends mainly on the application of Chemistry, and Nigeria is not an exception. The teaching of Chemistry will be complete if not done with practicals. A cursory look at the performance of students in Chemistry over the years showed a downward trend even in the enrolment and performance of Chemistry. Chemistry is taught as a theoretical subject in the classroom; the laboratory where it is supposed to be is not properly utilized. Students recorded low skill acquisition and poor performance in Chemistry despite the fact that it plays an important role in the economic and technological advancement of a nation. This poor or inadequate performance of students in Chemistry may be attributed to the fact that teachers teaching Chemistry do not give adequate attention to practical activities. Could this be why students are failing and running away from Chemistry? If Chemistry is introduced with a

practical orientation, will it increase students' performance? This is the crux of the study.

III. RESEARCH QUESTIONS

1. Do secondary school students learning Chemistry using a practical approach perform better than those teaching without practicals?
2. Does teaching Chemistry with a practical approach affect student performance in Chemistry?
3. Is there a significant difference in the performance of boys and girls who are exposed to the teaching of Chemistry with practical and those who are not?

IV. METHODS

The study was a survey that adopted quasi-experimental, using pre-test and post-test designs. This design was adequate for the study because the performance in Chemistry of the group of students who integrated the Chemistry practicals (experimental group) was compared with those in Chemistry of the group taught without practices (control group). In both groups, a pre-test and a post-test were used to determine the performance of the groups before and after treatment. The study population consisted of twenty - seven (27) public senior secondary schools in the Ovia North East Local Government Area, Edo State. The study sample size was 400, while simple random sampling technique was used to select fourteen schools representing fifty percent. Purposive sampling was used to determine 400 students from the fourteen schools.

The instrument for the study was an achievement test, with questions drawn from the West African Examinations Council (WAEC) and the National Examinations Council (NECO). The questions were administered to both groups. In group one (control group), 200 students from seven (7) schools were selected, and from the remaining seven (7) schools, another 200 students were chosen to constitute the experimental group. Both were previously pre-tested. Subsequently, the control group was taught using the conventional method, while the experimental group was led using the practical. Both groups were post-test. The test consisted of 20 items based on "Qualitative and volumetric analysis." This topic was chosen because it is usually taught as part of the work scheme of the three Higher Secondary students.

The validity of the test items was conducted by two Chemistry teachers and three Measurement and Evaluation experts. Some of the items were restructured and corrected before the instrument was produced. The reliability of the instrument was determined using the Kuder-Richardson formula 20 reliability statistics and gave an index of 0.89. The researcher assisted be the Chemistry teachers in the schools sampled, helped to administer the test. They also help in marking. The collected data were analyzed using the mean and standard deviation, the independent sample t-test, and the two-way analysis of variance.

V. RESULTS

Table 1: Mean and standard deviation of the performance of Secondary School students in Chemistry

Learning Chemistry	N	Mean	Standard deviation	Mean difference
With practicals	200	31.28	4.48	3.34
Without practical	200	27.94	3.60	

Table 1 shows the mean and standard deviation of the performance of Secondary School students in Chemistry as 31.28 and 27.94 for those taught with practicals and those without practicals, with a mean difference of 3.34 in favor of those students taught with practicals. This implies that students taught Chemistry with practicals performed better than those taught without practicals.

Table 2: Analysis of variance of the effect of Chemistry practical on the learning of Chemistry

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1110.771	3	370.257	110.065	0.000
Intercept	161411.250	1	161411.250	47981.94	0.000
Chemistry Learning	1084.050	1	1084.050	322.250	0.000
Error	3328.916	398	8.364		
Total	175540.000	400			
Corrected Total	4439.686	399			

R Squared = 650 (Adjusted R Squared = 0.639)

Table 2 shows an F value of 322.250 and a p-value of 0.000. This implies a significant effect of practicals on the teaching and learning of Chemistry ($p < 0.05$). The adjusted R square of 0.639 indicated that the practical approach in the teaching and learning of Chemistry contributed about 63.9% to the total variance of students' knowledge of Chemistry.

Table 3: Mean and standard deviation of the performance of Secondary School male and female students that are exposed to the teaching of Chemistry with practicals and those without

Chemistry learning	Sex	N	Mean	Standard deviation
Without practical	Male	124	26.86	3.41
	Female	76	26.28	3,91
	Total	200	26.64	3.60
With practical	Male	124	31.19	4.66
	Female	76	31.44	4.23
	Total	200	31.28	4.48
Total	Male	248	29.02	4.61
	Female	152	28.86	4.81
	Total	400	28.96	4.68

Table 3 shows the mean and standard deviation of public Secondary School students that were exposed to the teaching of Chemistry with practical and those without as 26.86 and 3.41; 26.28 and 3.91; 31.19 and 4.66; and 31.28 and 4.48 for male and female students respectively.

Table 4: Analysis of variance of the effect of sex on the learning of Chemistry

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1110.771	3	370.257	110.065	0.000
Intercept	161411.250	1	161411.250	47981.94	0.000
Chemistry Learning	1084.050	1	1084.050	322.250	0.000
Sex	1.309	1	1.309	0.389	0.533
Chemistry learning * Sex	8.109	1	8.109	2.411	0.121
Error	3328.916	398	8.364		
Total	175540.000	400			
Corrected Total	4439.686	399			

Table 4 shows an F value of 0.389 and a p-value of 0.533. This implies that there was no significant difference between male and female students exposed to Chemistry teaching with practical and those without ($p > 0.05$). Table 4 also revealed that sex was not a determining factor in students' performance in Chemistry ($F_{0.05,1,398} = 2.411$; $p = 0.121$).

VI. DISCUSSION OF THE FINDINGS

The study revealed that senior secondary school students who were taught Chemistry with practicals performed better than those taught without practicals. This indicated a significant difference between the two categories of students. Employing the use of practicals in the teaching Chemistry to students, aids to increase students' interest in Chemistry (Okeke, 2019). This led to a significant difference between those taught Chemistry with practicals and those without practicals, which was observed in this study. This confirmed previous studies by Millar (2004) and Usmani (2011).

Another finding from the study, was that teaching Chemistry with practicals had a significant effect on the performance of senior secondary school students in Chemistry. It accounted for about 63.9% of the total variance of student knowledge in Chemistry. Using practicals in the teaching of Chemistry according to Achimugu (2012), offers various opportunities to students, such as: handling chemicals safely and with confidence, gaining skills such as observing, classifying, predicting, measuring, and recording data, and also helping students develop scientific attitudes such as objectivity, curiosity, patience, and open-mindedness. This was in tandem with Hofstein (2004), Okeke (2011), and Oloyede (2011).

The study also showed no significant difference between male and female students exposed to chemistry teaching with practicals and those without. That is, sex was not a determining factor in students; performance in Chemistry practicals. This was in line with Kibirige and Tsamago (2013), who showed that boys' and girls' attitudes towards science were not different, when similar methods were used. It also corroborated the opinion of Trumper (2006), whose study showed that boys and girls of the same age tend to have different attitudes towards similar teaching styles in Practical Chemistry. But disagree with Okeke (2019), who showed that there was a significant difference between male and female students in Chemistry practicals, with girls showing more interest in practices than boys. The study did not also align with Akpan (2005), who found that gender played a crucial role in determining different attitudes and learning styles, and this impacted differently on individuals. The stereotype of the sexual function to which the

students were linked could influence their performance in both the practical and theoretical aspects of the Chemistry examination. The slight difference in the result of the present study could be attributed to the students' exposure to the same experimental period using the same method. Hence gender could not play a significant role in their assimilation of what they were taught.

VII. CONCLUSION AND RECOMMENDATIONS

Chemistry is an essential subject in science, that help in the scientific and technological development of any nation. Therefore, it must be properly taught adequately, so that the student can assimilate it. To achieve this emphasis should be placed on teaching Chemistry using the practical approach as it enhances the knowledge and understanding of students in a better way as compared to teaching Chemistry in a conventional manner (traditional method). The study also showed that when students are exposed to practicals in the learning of Chemistry, it has a positive effect on their performance. Above all, it was observed that regardless of gender (sex), students perform better in Chemistry using the practical approach.

In light of the above, teachers should use more practical work during the teaching and learning of chemistry in secondary schools. Chemistry teachers must undergo intensive in-service training in practical work management and recent research to improve their practices. Public senior secondary schools must have well-equipped laboratories with modern facilities so that students can learn the desired practical skills and underlying theory.

REFERENCES

1. Abimbola, IO (1994). A critical appraisal of the role of laboratory chemistry practices in science education in Nigeria. *Journal of Curriculum and Instruction*, 4(2), 59-65.
2. Abrahams, I. & Millar, R. (2008). Do Chemistry practices really work? A study of the effectiveness of Chemistry practices as a teaching and learning method in school sciences. *International Journal of Science Education,* 30 (14), 1945 - 1969.
3. Achimugu, L (2012). Strategies for effective completion of practical Chemistry work in Nigerian senior secondary schools. *Journal of the Nigerian Science Teachers Association*, 12(6), 1-9.
4. Akpan USA (2005) *Qualitative analysis issues in SSCE chemistry guide to improve student achievement* , paper presented at a refresher course for secondary chemistry teachers by the Nigerian Chemical Society, Jos Chapter 11-12 November
5. Anaso, JN (2010). Strategies *to improve the performance of Chemistry students at the tertiary level*. Abuja, Nigeria. National Center for Mathematics.
6. Ava, A. and Odomwonyi-Otu (2011). *The challenges of effective teaching of Chemistry*: A case study
7. Dillon, J. (2008). *A review of research on practical science in school* . London: King's College
8. Reflux, DD (1996). *General Chemistry* . Fifth edition. Boston, United States; Houghton Mifflin Company.
9. Hofsein, A. (2004). The laboratory in Chemistry Education: Thirty years of experience with developments, implementation and research. *Chemistry Education Research and Practice* , 5(3), 247–264.
10. Hofstein, A. & Mamlok-Naaman, R. (2007). The laboratory in science teaching: the state of the art. *Research and practice in chemical education* . 8(2), 105-107.
11. Khan, MS, Hussain, s., Ali, R., Majoka, MI, & Ramzan, M. (2011). Effect of the inquiry method on the performance of Chemistry students at the secondary level. *International Journal of Academic Research* . 3(1), 955-959.
12. Kibirige, I. & Tsamago, H. (2013). Performance of learners in physical sciences using laboratory investigations. *International Journal of Educational Sciences* , 5(4): 425-432.
13. Miller, R. (2004). *The role of Chemistry practices in science teaching and learning* . Senior secondary school Science Lab: Role

and Vision. Washington, DC: National Academy of Sciences.
14. Miller, R. (2009). *Practical Activity Analysis to Evaluate and Improve Effectiveness: The Practical Activity Analysis Inventory (PAAI)*. York: Center for Innovation and Research in Science Education, University of York.
15. Mupanduki, BT (2009). *The effectiveness of a standards-based integrated chemistry-mathematics curriculum in improving academic achievement in chemistry for senior secondary school students in Southern California*, California, USA: Azusa Pacific University.
16. Ogunkola, BJ and . Fayombo, GA (2009) Investigating the Combined and Relative Effects of some Student Related Variables on Science Achievement between Secondary School Students in Barbados. *European Journal of Scientific Research*. 37(3), 481-489
17. Okeke, D.O. (2011). *Effect of mind map teaching strategy on student interest, performance, and retention in upper secondary school Chemistry* . Unpublished doctorate. Thesis, University of Nigeria, Nsukka.
18. Okeke, D.O. (2015). *Influence of the practice of Chemistry on the interest and performance of students in upper secondary schools* . A paper presented at the 4th South East Academy Conference held at Enugu State College of Education (Technical), 9-12 September 2015.
19. Okeke, D.O. (2019). Influence of the practice of Chemistry on the interest and performance of students in upper secondary schools. *Southeast COEASU Teacher Training Magazine*. 3(1), 205-211.
20. Oloyede, O.I (2010). Improvement of the domain learning acquisition strategy on achievement and self-concept in Senior secondary school Chemistry . *Humanities and Social Sciences Journal* . 5(1), 19-24.
21. Rutherford , F.J. and Ahlgren , A. (1991) *Science for all Americans* , Oxford University Press.
22. Trumper, R. (2006). Factors affecting senior secondary school students' interest in biology. *Science Education International* . 17(1) 31-48.
23. Twoli, N. (2006). *Teaching chemistry in secondary school* : a textbook for chemistry teachers in developing countries. Nairobi: Nehema Publishers.
24. Usmani, A. (2011). Teaching physics skills A2. Retrieved from http://www.scrib.com/doc/6469292/teaching-22-physics-practical-skills.
25. Wellington, J. (1998). *Practical work in science. It's time for a reassessment* . In J. Wellington (Ed.). Practical work in school sciences: where to now? London: Routledge. doi:10.4324/9780203267059.