

EFFECT OF EDUCATIONAL TECHNOLOGY ON THE TEACHING AND LEARNING OF CHEMISTRY IN SECONDARY SCHOOLS IN NIGERIA.

Ovie, Adarighofua Faith

*Department of Curriculum and Instruction.
College of Education, Mosogar, Delta State, Nigeria.*

Abstract

This study investigated the effect of educational technology on the teaching and learning of the Chemistry in secondary schools in Nigeria,. The study adopted pre-test, post-test non-equivalent control group quasi-experimental design. Population of the study was 18,879 SSII Chemistry students in all the public mixed senior secondary schools in Delta State. The sample size for this study was three 338 SSII Chemistry students (167males and 171females) selected from six (6) public Secondary Schools in using purposive sampling techniques. The instrument used for data collection in this study was Chemistry Achievement Test (CAT). The reliability of the Chemistry Achievement Test (CAT) was established using Kuder Richardson 21 formula which yielded a reliability coefficient of 0.79. Data obtained were analyzed using mean, standard deviation and ANCOVA. Results revealed that: there was a significant difference between the mean achievement scores of students taught Chemistry using educational technologies and those taught without educational technologies, in favour of those taught with educational technologies, there was a significant sex influence on students' Chemistry achievement when exposed to educational technologies. It was recommended that government should provide adequate and functional educational technologies to all schools in the country to facilitate learning.

Keywords: Educational technology, teaching and learning.

Introduction

Education is the acquisition of knowledge, skills and attitude by an individual in order to effectively adapt to his/her society and contribute to the development of the society. Education fosters socio-economic development all over the world. Nations and individuals all over the world now agree that the way out of series of bondages plaguing them is through education (Gbenu, 2012). Thus, the educational standards set up for the school must be challenging to meet the needs of the students and the society (Olaniyonu, Adekoya & Gbenu, 2008). In many developed countries of the world, science, technical and vocational education is the major form of education that has transformed their economies with modern facilities provided to effect the required change. It has been found that the major cause of differences between the economies of developed and developing countries lie in the quality and quantity of education offered (Gbenu, 2012).

In the quest of educating Nigerian citizens, different subjects are taught at the secondary school level. Chemistry is one of the Senior Secondary School subjects taught

in Nigeria. Chemistry is an integral part of the Science Curriculum both at the Senior Secondary School and at the Tertiary Education level. The contribution of Chemistry to social, industrial, technological and economic development of the world in general and Nigeria in particular, can be felt in all facets of human endeavour (Ebiguwere, 2018). Odesina (2017) defined Chemistry as a Science that is concerned with the composition and the structure of matter, and with the forces that hold the structures together. They further noted that Chemistry as a Science subject has as its primary objectives as; the determination of the nature and properties of the non-living matter, which surround us and the preparation of new substances that are scientifically interesting, or generally useful.

Considering the role of Chemistry in national development, the National Policy on Education (Federal Republic of Nigeria, 2013) stated the following as the objectives of teaching Chemistry at the Senior Secondary school level:

- i. to facilitate a transition in the use of scientific concepts and techniques acquired in integrated science to Chemistry;
- ii. to provide the students with basic knowledge of Chemistry concepts and principles through efficient selection of content and sequencing;
- iii. to show Chemistry and its inter-relationship with other subjects;
- iv. to show Chemistry and its link with industry, everyday life, benefits and hazards; and
- v. to provide a course which is complete for pupils not proceeding to higher education, while it is at the same time a reasonably adequate foundation for a post-secondary Chemistry course.

To achieve these objectives, the use of educational technologies in the implementation of the Chemistry curriculum becomes necessary in the sense that educational technologies reduces abstraction, enhance lesson clarity, capture students attention and interest, ensures students' active participation and improve students ability to remember learnt concepts by providing students with real life experiences.

The application of technology in education has become an increasingly important field of research during the past several decades (Qaiser, Hassan, Shakeel, Main-Muhammad, Farooq, & Ishtiaq, 2011). During this period, technology has been used for analysis, enhancement of communication, construction of teaching aids and for the assistance of student's self-expression (Beak, Jung, & Kim, 2008). Educational technologies are those tools, machines, devices, ideas, procedures, people, organization, and books etc, which make teaching learning process more effective, successful and interesting. They play a vital and effective role in teaching of science subjects. According to the Henessy (2006), the significance of technology for teaching of science disciplines in schools is inevitable to ignore because the application of technology plays a contributory role in the teaching of science by accelerating and improving work production, supporting exploration and experimentation, supporting collective knowledge-building, improving motivation and engagement, offering more responsibilities and control to learners through individual exploration and experimentation, and assisting students to visualize processes more clearly.

The role of educational technology is very effective in moving from teacher-centred learning activities to student-centred learning activities. However, the role of a teacher remains essential to the successful and effective use of educational technologies (Zhao, Hueyshan, & Mishra, 2001). If a teacher succeeds in providing a sound base of scientific aptitude to the students of secondary level, then it is right to say that they can make even atomic bomb (Suleman, Aslam, Habib, Javed, & Umbrin, 2011). Keeping in view this statement it is concluded that science subjects at secondary level occupy the most crucial position in the entire educational system. Therefore, it is required to pay proper attention to this area of education.

Educational technology plays a crucial role in teaching learning process and makes it more effective, successful and productive. As we know that science subjects especially Chemistry requires conceptual study and it is not possible without competent teachers and sufficient teaching aids. If educational technology is used in teaching of Chemistry then it is certain that it will be proved more beneficial and effective in clarifying complicated concepts and other chemical reactions. Therefore, educational technology should be used appropriately and consistently in teaching of Chemistry to ensure quality classroom teaching. This will go a long way in improving students' poor academic achievement in Chemistry.

According to Emerhiona (2018), academic achievement is the status of a student's learning with respect to knowledge attained and skills developed during their academic career which are assessed by school authorities with the help of teacher made or standardized tests. Academic achievement generally refers to the degree or level of success or proficiency attained in some academic work (Arora, 2016). Arora (2016) further stated that academic achievement encourages the students to work hard and learn more. Othman, Sernarak and Leng (2011) defined achievement as the extent to which a learner is profiting from instruction in a given area of learning. Empirical studies have shown that educational technology improves students' academic achievement (Qaiser, *et al.*, 2011; Halil & Onder, 2018) irrespective of students' sex.

Sex is the classification of people as male and female, typically assigned at birth based on the appearance of external sex organs (Your Dictionary, 2018). The issue of sex influence on students' academic achievement is inconclusive. Therefore, another rationale for this study is to find out if educational technology affects male and female students' achievement in Chemistry differently. Against this background, the study sought to investigate the effect of educational technology on the implementation of the Chemistry curriculum.

Research Questions

Three research questions guided this study. They are:

1. What is the difference between the Chemistry mean achievement scores of students taught with educational technologies and those taught without educational technologies?
2. What is the difference between the Chemistry mean achievement scores of male and female students taught with educational technologies?

3. What is the interaction effect of treatment and sex on students' achievement in Chemistry?

Hypotheses

Three hypotheses were formulated and tested at 0.05 level of significance. They are:

1. There is no significant difference between the Chemistry mean achievement scores of students taught with educational technologies and those taught without educational technologies.
2. There is no significant difference between the Chemistry mean achievement scores of male and female students taught with educational technologies.
3. There is no significant interaction effect of treatment and sex on students' achievement in Chemistry.

Methodology

The study adopted the pre-test, post-test non-equivalent control group quasi-experimental design. The design model is shown in Table 1.

Table 1: Design of the Study

Group	Pre-test	Treatment	Post-test
Experimental	O ₁	X ₁	O ₂
Control	O ₃	X ₂	O ₄

Where,

O₁ = pre-test of experimental group

O₂ = post-test of experimental group

O₃ = pre-test of control group

O₄ = post-test of control group

X₁ = Treatment with exposure to educational technologies

X₂ = Treatment without exposure to educational technologies

Population of the students was 18,879, SSII Chemistry students in all the public mixed senior secondary schools in Delta State. The sample size for this study was 338 SSII Chemistry students (167males and 171females) selected from six (6) public Secondary Schools in using purposive sampling techniques. The instrument used for data collection in this study was Chemistry Achievement Test (CAT). The reliability of the Chemistry Achievement Test (CAT) was established using Kuder Richardson 21 formula which yielded a reliability coefficient of 0.79.

The treatment in this study involve teaching the students in the experimental group some selected Chemistry concepts using educational technologies such as CD plate, Video-CD player, Computer, Power point and Projector, and the students in the control group were taught the selected Chemistry concepts without using educational technologies. Pre-tests were administered before the treatment and post-test thereafter with the Chemistry Achievement Test (CAT). The scores obtained were collated and analyzed using mean, standard deviation, t-test and Analysis of Covariance (ANCOVA).

Results

Ho₁: There is no significant difference between the Chemistry mean achievement scores of students taught with educational technologies and those taught without educational technologies.

Table 2: t-test comparison of pre-test scores of students taught chemistry using educational technologies (experimental) and those taught without educational technologies (control)

Group	N	\bar{x}	SD	df	t-cal.	Sig. (2-tailed)	Decision
Students taught with Edu Tech.	163	21.42	9.05	336	0.626	0.532	Not Significant
Students taught without Edu Tech.	175	22.02	8.73				

Table 2 shows that there is no significant difference in the pre-test mean achievement scores between students taught Chemistry with educational technologies and those taught without educational technologies, $t = 0.626$, $P(0.532) > 0.05$. Thus, H_{o1} was tested with t-test.

Table 3: t-test comparison of post-test scores of students taught chemistry using educational technologies (experimental) and those taught without educational technologies (control)

Group	N	\bar{x}	SD	df	t-cal.	Sig. (2-tailed)	Decision
Students taught with Edu Tech.	163	56.28	11.08	336	7.274	0.000	H_{o1} is rejected
Students taught without Edu Tech.	175	47.55	10.97				

Table 3 shows that there is a significant difference in the post-test mean achievement scores between students taught Chemistry using educational technologies and those taught without educational technologies, $t = 8.366$, $P(0.000) < 0.05$. Thus, H_{o1} is rejected. Therefore, there is a significant difference between the Chemistry mean achievement scores of students taught using educational technologies and those taught without using educational technologies, in favour of students taught chemistry using educational technologies.

Ho₂: There is no significant difference between the chemistry mean achievement scores of male and female students taught with educational technologies.

Table 4: t-test comparison of post-test scores of male and female students taught chemistry using educational technologies

Sex	N	\bar{x}	SD	df	t-cal.	Sig. (2-tailed)	Decision
Male	76	60.82	11.58	161	5.269	0.000	Ho ₂ is rejected
Female	87	52.32	8.96				

Table 4 shows that there is a significant difference in the post-test mean achievement scores between male and female students taught Chemistry using educational technologies, $t = 5.269$, $P(0.000) < 0.05$. So, the null hypothesis is rejected. Therefore there is a significant difference between the Chemistry mean achievement scores of male and female students taught Chemistry using educational technologies, in favour of male students taught Chemistry using educational technologies.

Ho₃: There is no significant interaction effect of treatment and sex on students' achievement in Chemistry.

Table 5: ANCOVA summary on interaction effect of treatment and sex on students' achievement in chemistry

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	18241.069 ^a	4	4560.267	52.346	.000
Intercept	66814.143	1	66814.143	766.946	.000
Pre-test	8106.632	1	8106.632	93.054	.000
Edu tech	6897.911	1	6897.911	79.180	.000
Sex	1063.392	1	1063.392	12.206	.001
Edu tech * Sex	.263	1	.263	.003	.956
Error	29009.997	333	87.117		
Total	952902.000	338			
Corrected Total	47251.065	337			

Table 5 shows that there is no significant effect of treatment and sex on students' achievement in Chemistry, $F(1,333) = 0.003$, $P(0.956) > 0.05$. Thus, Ho₃ is not rejected. Therefore, there is no significant interaction effect of treatment and sex on students' achievement in Chemistry.

Discussion

The first finding of the study revealed that there is a significant difference between the mean achievement scores of students taught Chemistry using educational technologies and those taught without educational technologies, in favour of students taught with educational technologies. The significant improvement of students' achievement scores by educational technologies may be predicated on the fact that educational technologies expose students to practical experiences. These practical experiences not only reduces

abstraction in concept learnt but also stimulate students' interest in learning thereby enhancing students' subject matter conceptualization. This may have accounted for the higher achievement score of students taught Chemistry using educational technologies over their counterpart taught without educational technologies. This finding corroborates with the views of Halil and Onder (2018) that the achievement levels of the experiment group with the technology enriched science teaching applications increased significantly and was higher at a meaningful level than the achievement of the control group students without enriched technology. This finding also gives credence to the finding of Qaiser, et al. (2011) who reported that the students of experimental group (students exposed to educational technologies) showed extraordinary performance.

Another finding of the study revealed that there is a significant difference between the mean achievement scores of male and female students taught Chemistry using educational technologies, in favour of male students. This implies that educational technologies enhance the achievement of male students than their female counterparts. This may be predicated on the fact that male students were more active dominating their female counterparts during instruction. This finding concurs with that of Chinyere and Omiko (2015) who found that instructional resources have no significant gender bias in relation to students' achievement in Physics.

The study finally revealed that there is no significant interaction effect of treatment and sex on students' achievement in Chemistry. This suggests that educational technologies did not combine with sex to influence students' achievement in Chemistry. This finding confirms that of Oladejo, Olosunde, Ojebisi and Isola (2011). Oladejo, Olosunde, Ojebisi and Isola (2011) reported that there was no significant interaction effect of treatment and gender on student achievement in Physics.

Conclusion

The study concludes that educational technologies positively facilitate the implementation of the Chemistry curriculum by enhancing students' Chemistry in Chemistry. However, the use of educational technology seems to enhance male students' academic achievement in Chemistry more than their female counterparts.

Recommendations

Based on the findings, the study recommended that:

1. Government should provide adequate and functional educational technologies like overhead projectors, standard laboratories, computers and soft wares for simulations during teaching and learning to all schools in the country to facilitate learning.
2. Funds should be provided to secondary schools in Delta State for the procurement of science related materials and apparatus for the teaching and learning of chemistry.
3. Chemistry teachers should endeavour to utilize the available educational technologies during instruction.

References

- Arora, R. (2016). Academic achievement of adolescents in relation to study habits. *International Journal of Indian Psychology*, 3(2), 2349-3429.
- Beak, Y., Jung, J., & Kim, B. (2008). What makes teachers use technology in the classroom? Exploring the factors affecting facilitation of technology with a Korean sample. *Computer & Education*, 50, 224-234.
- Chinyere, A. O., & Omiko, A. (2015). Effect of instructional resources on student's achievement in physics and chemistry in secondary schools in Ebonyi State, Nigeria. *European Journal of Training and Development Studies*, 2(2), 56-65.
- Ebiguwere, A. I. (2018). *Effects of guided inquiry instructional strategy on students' achievement and interest in senior secondary school chemistry in Delta North Senatorial District*. Unpublished M.Ed Dissertation, Delta State University, Abraka.
- Emerhiona, F. (2018). Effects of problem- and discovery-based instructional strategies on students' achievement in chemistry. Unpublished M.Ed. Dissertation Submitted to the Department of Science Education, Delta State University, Abraka.
- Federal Republic of Nigeria. (2004). *National policy on education*. Abuja: NERDC.
- Gbenu, J. P. (2012). State of Nigerian secondary school and need for quality sustenance. *Greener Journal of Educational Research*, 2(1), 007-012.
- Halil, I. Y., & Onder, S. (2018). The effect of science teaching enriched with technological applications on the science achievements of 7th grade students. *Journal of Education and Training Studies*, 6(9), 53-68.
- Hennessy, S. (2006). Integrating technology into teaching and learning of school science: a situated perspective on pedagogical issues in research. *Studies in Science Education*, 42, 1-48.
- Odesina, I. A. (2017). *Essential chemistry for senior secondary schools (7th ed.)*. Ikeja, Lagos: Tonad Publishers.
- Oladejo, M. A., Olosunde, G. R., Ojebisi, A. O., & Isola, O. M. (2011). Instructional materials and students' academic achievement in Physics: Some policy implications. *European Journal of Humanities and Social Sciences*, 2(1), 113-126.
- Olaniyonu, S. O. A., Adekoya, S. O. A., & Gbenu, J. P. (2008). *Fundamentals of educational planning (revised & enlarged)*. Lagos: Oshidex Printing Press.
- Othman, N., Semarak, J., & Leng K.B. (2011). The relationship between self-concept, intrinsic motivation, self-determination and academic achievement among Chinese primary school students. *International Journal of Psychological Studies*, 3(1), 90-98.
- Qaiser, S., Hassan, D. A., Shankeel, S., Main-Muhammad, N. S., Farooq, S., & Ishtiaq, H. (2011). Effectiveness of educational technology in teaching chemistry to secondary school students in Khyber Pukhtunkhwa (Pakistan). *American Journal of Scientific Research*, 41, 115-131.
- Suleman, Q., Aslam, H. D., Habib, M. B., Javed, T., & Umbrin, S. (2011). Evaluative study of the effectiveness of teaching performance of in-service promoted secondary

- school teachers in Khyber Pukhtunkhwa (Pakistan). *International Journal of Humanities and Social Science*, 1 (1), 136-149.
- Your Dictionary. (2018). *Definition of sex*. Retrieved 08/07/2019 from <http://www.yourdictionary.com/sex>.
- Zhao, Y., Hueyshan, T., & Mishra, P. (2001). Technology: Teaching and Learning: whose computer is it? *Journal of Adolescent and Adult Literacy*, 44, 348-355.