IMPLICATIONS OF INNOVATIVE CHEMISTRY TEACHING ON STUDENTS' ACHIEVEMENT

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Abstract

The study investigated implications of innovative Chemistry teaching on students' achievement in chemistry. Senior Secondary I (SS1) Chemistry students in Uyo Municipality of Akwa Ibom State constituted the population of about 2,109 for the study. One hundred students who formed the sample for the study were randomly selected. 2 out of 4 public secondary schools were randomly selected for the study. Two hypotheses guided the study. Chemistry Achievement Test (CAT) was the instrument used to gather data. CAT had a reliability coefficient of 0.91. Data collected were analysed using t-test, Mean and Standard Deviation. Results showed that there was a significant influence in academic achievement between the students utilizing ICT gadgets and those that did not utilize ICT gadgets. There was gender related differences in students' achievement in ICT utilization with females out performing their male counterparts. The study therefore recommended among others that students be properly positioned to effectively utilize ICT gadgets in chemistry learning experiences to meet with changing global trends.

A new culture of education is emerging with an increase in the development of new information communication technology. Many educational institutions the world over are using modern available resources to enhance teaching and learning. Utilizing information and communication technologies in chemistry teaching will enhance the achievement of the Nigeria's philosophy of education that stipulates as one of its aims; the development of learners into sound and effective citizens having equal access to educational opportunities (NPE, 2004). ICT is bringing about attitudinal change and is significantly influencing the way we learn, think, communicate and to a large extent the way economics and educational activities are carried on in the production of goods and services. It is the gateway to skill acquisition and knowledge-based learning. Improving the quality of education and training is a critical issue, particularly at a time of educational expansion. ICTs can enhance the quality of education by increasing learner motivation and engagement, by facilitating the acquisition of basic skills, and enhancing teacher training (Haddad and Jurich, 2002).

Information and communication technology (ICT) utilization in chemistry can be understood as the application of digital gadgets into all aspect of teaching and learning as it affects the attainment of its educational objectives. ICT is described as the combination of technologies for collecting, sorting, processing, communicating and delivering of information related to teaching and learning activities (Onwumere, 2010). Its utilization in all concepts of chemistry teaching and learning will facilitate the achievement of national goals and objectives. The National Policy for Information Technology (2001) describe ICT as any equipment that is used in the acquisition, storage, manipulation, management, control, display, switching on and off and transmission of information. Chukwuemeka and Agreen (2009) conceptualized ICT as communication in whatever forms that are used, assessed, relayed and transmitted to communicate, send and receive information. ICTs are transformational tools, which when appropriately applied can promote the shift to a learner-knowledge-based centred environment. The effective application and utilization of ICT devices/gadgets, promote students' activities, increase knowledge bank that enhances clear consumption of chemistry concepts. Effective utilization of ICT

devices influences learners' behaviours through interactive activities such submission of assignments, solving questions and quizzes together with these gadgets within and outside the classroom. Learners learn through activities. It is therefore imperative that the curriculum provide a holistic coverage and application of concepts of chemistry using different ICT devices.

ICT utilization has been identified as a major means through which teaching and learning activities could be promoted, encouraged and facilitated (Akinola, 2010) if they are properly utilized in chemistry instructional processes. ICT utilization provides opportunities for learners to be actively engaged on practical-based activities which promote meaningful learning outcomes. The utilization of various devices of ICTs promote knowledge – based skills, builds new knowledge for creating and improving new ideas which are supported by using different collaborative technologies.

Etiubon, (2010) and Gibson (2001) opined that ICT utilization engage and stimulate learners interest in learning activities that challenge them to build new knowledge like creating and improving ideas. ICT equips the learner with capabilities like understanding, skills acquisition and attitudes to maximally utilize ICT for improvement of learning and life in the society. ICT utilization is gender-involving and user friendly.

There are different views on sex differences and intellectual abilities. While some researches agree that sex differences have a significant influence on academic performance, others disagree. Gender issue is occurring in every facet of life and it is an emerging global issue that influences education.

Without careful deliberation, introduction of ICTs in education can result to marginalization of those already disadvantaged. Teandon (1998) observed that females have less access to ICTs and fewer opportunities for ICT-related training compared to men because of illiteracy, lack of time, lack of mobility and poverty. Boys are more likely than girls to have access to computers in schools and at home. Not surprisingly, boys tend to enjoy working with computers more than girls (Mark, 2002). Girls also need to have female role models to inspire them to participate in technology-related activities (Haddad and Jurich, 2002). Okoro & Ononugbo (2010) opined that both male and female students have access to ICT gadgets and that barriers to learning are resolvable through the use of ICTs.

Unfortunately, ICT utilization in the teaching of chemistry concepts in senior secondary schools in Nigeria is stale and low. This is so because major constraints militate against access and use of ICTs. These include; operational challenges, teachers' level of resistance to change, knowledge of relevant use of devices of ICTs, learning supports such as well-equipped school laboratory for ICT application and utilization, complaints of lack of time, insufficient/lack of computers for students' practice in relevant subject areas. A number of factors could be attributable to students' underachievement in chemistry. These factors include in adequate exposure to instructional resources, insufficient facilities of ICT equipment in studios/laboratories, large and difficult-to-breakdown concept contents, students' interest and attitude on the subject, large class size without adequate instructional materials and facilities, classroom space, poor classroom environment, teachers' teaching methods.

It has been observed that many Nigerian Secondary school teachers are still unable to use ICTs in their science teaching classes (Ololube, 2006) and so the desired impact of ICT utilization is not observed in learners. This may be due to the fact that Nigeria is coming late into ICT use as Nigerian teachers are still largely unprepared for ICT utilization for classroom activities and this has largely influenced the slow-pace of students skill utilization of ICTs gadgets. There is also a growing concern on shortage of qualified teachers competent on ICT utilization with large students' enrolment and inadequate learning space. Majority of teachers teaching chemistry cannot operate the computer; let alone use available information from the internet and as such these teachers are operating within a very limited source of information. Offorma (2006) buttressed this point, that inability of teachers to apply basic

information technology tools would render education dysfunctional in international settings. This makes it difficult for teachers and learners to come into the mainstream of aligning ICT devises for appropriate utilization to meet worldwide benchmark for classroom chemistry activities. Chemistry teachers must be well groomed to be able to use effective instructional resources like ICT devices, methods, and techniques that meet educational and instructional challenges as no educational system can rise above the quality of its teachers. Students of chemistry are expected to develop skills in the use of ICT devices for carrying out various activities on the internet such as browsing for wider knowledge on difficult concepts in chemistry; sending-emails to friends for collaborative/interactive studies which can help them to update information on new discoveries on concepts, practical and theoretical aspects of different requirement of subject content areas of chemistry. Chemistry students are observed as not acquiring the needed skills on ICT utilization as expected (Katcha, 2010).

ICT utilization is fairly new among senior chemistry students. Its effectiveness in secondary school students' achievement therefore requires urgent attention as there is need to make room for different creative and stimulating pedagogical approaches to improve students' performance. Students need to acquire enabling and relevant skills to effectively utilize ICT gadgets. This paper investigates the influence of ICT utilization in the learning of different chemistry concepts. It involved the use of ICT gadgets such as power-point, computer, flash drive, camera snaps, CD/DVD, and cell-phones for internet browsing. Chemistry concepts of SS1 science curriculum content taught were Acid and Bases, Periodic Table, Nature of Matter and Separation Techniques.

Purpose of the Study

The purpose of this study is to determine the influence of ICT on students' achievement in chemistry. It also examines the influence of ICT utilization among male and female students of chemistry.

Research Hypotheses

Two hypotheses were tested:

Ho_1: There is no significant influence in the academic achievement of students in chemistry when taught with and without ICT.

Ho_2: There is no significant influence in the mean gain achievement scores of male and female students in chemistry when taught with and without use of ICT.

Research Method

Population and Sampling Procedure

The pretest-posttest matched group design was adopted for the study. The population for the study comprised all senior secondary I (SS1) chemistry students in Uyo municipality of Akwa Ibom State numbering 2,109. The students were exposed to different gadgets of ICTs for utilization on different chemistry concepts. One hundred students randomly sampled from 2 schools out of 4 public schools were assigned to two groups as those utilizing ICTs devices/gadgets and those taught conventionally, having 50 subjects in each group. The two schools selected are coeducational with mixed ability grouping. Group using ICT gadgets and those taught conventionally were comparable judging from the pretest scores. The instrument used was a 25-item-four-options, multiple choice test chemistry Achievement Test (CAT). The Chemistry Achievement Test (CAT, lesson packages and marking scheme were validated by two lecturers of Curriculum Planning and Statistics from Faculty of Education, University of Uyo and two experienced secondary school chemistry teachers. CAT was pilot-tested using two schools which were not part of the main study. Reliability coefficient of 0.91 using Kudar-Richardson Formulae – 21 was established for CAT. The study was carried out in steps:

The first step covered pre-treatment period during which permission was sought from school and subject teachers who were requested to help as research assistants.

The next step was the treatment period that lasted for four weeks during which research assistants trained on the use of ICT for the lesson packages engaged the group utilizing ICT gadgets in chemistry lesson. The same lesson package was used for the conventional group. The trained research assistants used the prepared lesson packages on concepts to be taught with validated treatment procedures and processes. The research assistants received a week-training on different ICT gadgets. Pretest was administered and the result used to establish equivalence between the two groups. The ICT group received treatment which was withheld from the conventional group. However, the conventional group was taught the same chemistry concepts using the conventional method. They were taught by the trained research assistants.

The third step was the posttest period which was served to both groups. The same CAT used for pretest was reshuffled and re-administered as posttest. The null hypotheses were tested using t-test analysis, mean and standard deviation.

Presentation of Results
Data Analysis: The data were Analysed Using T-Test, Mean and Standard Deviation

Hypothesis 1

There is no significant influence in the academic achievement of students in chemistry when taught with and without ICT.

Table 1: T-Test Analysis of Students' Achievement in Chemistry Using ICT Gadgets and those without ICT

Group	N	$\bar{X}$	SD	df	t_{crit}	t_{cal}	Decision at P<0.05
ICT utilization	50	62.77	14.53				
Conventional	50	47.29	9.43	98	1.98	6.35	* significant

* Significant P < 0.05

Result in Table 1 indicates that students utilizing ICT gadgets had a mean score of 62.77 while those taught without ICT had 47.29. The Table show a tcal value of 6.35 and a tcrit value of 1.98 indicating a significant influence between the two. Thus hypothesis 1 is rejected at $p < 0.05$ level of significance. This implies that, there is a significant influence between students utilizing ICT gadgets and those not utilizing ICT gadgets.

Hypothesis 2

There is no significant influence in the mean gain achievement scores of male and female students in chemistry when taught with and without use of ICT.

Table 2: Mean and Standard Deviation of Male and Female Pretest and Posttest Scores Taught with and Without ICT

Variable Experimental	N	Pretest mean	SD	Posttest mean	SD	Achievement Gain
Male	25	46.50	8.33	60.08	13.37	13.58
Female	25	41.36	10.52	57.56	13.24	16.20
Conventional						
Male	23	34.68	6.69	46.38	8.49	11.70
Female	27	40.63	5.73	47.26	9.41	6.63

A comparison of the mean scores of students in both pretest and posttest in Table 2 above show that the Achievement Gain were as follows for Experimental and conventional group for males to be

13.58 and 11.70 respectively. The mean Gain for the females in the experimental and conventional group was 16.20 and 6.63 respectively. The result reveal that there is a significant influence on male and female students achievement in chemistry taught using ICT and those taught without. Hence, the null hypothesis 2 was rejected. This implies that there is a significant influence on achievement between male and female students in chemistry utilizing ICT gadgets for understanding different concepts in chemistry.

Discussion of Result

The result shown in Table 1 revealed a significant influence in the academic achievement of students utilizing ICT gadgets and those taught by conventional means. This indicates that a significant influence existed in the scores of chemistry students utilizing ICT gadgets and the conventional group. This may be as a result of the students activity-based exposure to ICT gadgets. This finding is in agreement with the findings of (Gibson, 2001 and Etiubon, 2010) that ICT utilization engage and stimulate learners interest in learning activities that challenge them to build new knowledge like creating and improving on ideas that help to solve other problems. ICT equips the learner with capabilities of understanding, skills and attitudes that maximally utilize ICT for improvement of learning and life in the society (Gibson, 2001).

From the results shown in Table 2, using the pretest mean score, the female students in the experimental group achieved significantly higher than the male students though the scores of the male students compared favourably with those of the females. This may be due to motivation, exciting new learning experience and interest in frequent interaction on use of phones and other ICT devices for calls done more frequently by the females than the males. This implies that ICT utilization is gender-involving and user-friendly. The finding is in disagreement with (Mark, 2002) who found that boys are more likely than girls to have access to computers in schools and at home because they enjoy working with computers more than girls. Today, both male and female students have access to ICT gadgets and barrier to learning are resolvable through the use of ICTs. ICT gadgets utilization may or may not be sex dependent.

Implications of Findings for Innovative Chemistry Teaching

The findings from this study have some implications for teaching and learning of chemistry at senior secondary schools. Utilizing ICT gadgets for the eaching and learning of chemistry has the potential to enhance students' academic achievement in chemistry. It is imperative therefore for chemistry teacher to consider utilizing ICT gadgets in chemistry teaching. The utilization of ICT gadgets by learners facilitates activity-based classroom participation as students learn the process of learning and engage in knowledge construction of creative ideas. Students' ability to connect knowledge and engage in knowledge construction might be due to the fact that there is ample classroom interaction and exchange of ideas using different skills, abilities and competences when utilizing ICT gadgets in teaching and learning. This study also indicates gender differences in terms of achievement. The females benefitted more from the use of ICT in terms of improved academic performance, though boys compared favourably with the use of ICT also. Thus, achievement in chemistry utilizing ICT gadgets is not sex-dependent as ICT gadgets are gender and user-friendly.

Conclusion

There is need for teaching strategies to be mapped out for the utilization of different ICT gadgets. This is to ensure that the lofty goals of education are attainable and innovative to facilitate knowledge and skill acquisition in chemistry and other science-based courses

Recommendations

Based on the findings from this study, the following recommendations are made:

1. ICT gadgets utilization by teachers in the effective teaching of chemistry and other science-based courses should be encouraged by all stakeholders of education

2. Workshops, seminars and conferences needed to train and prepare teachers for ICT gadgets utilization should be encouraged at all levels of education to make the teaching of chemistry effective.
3. ICT gadgets should be provided and made adequate as instructional materials for the teaching and learning of chemistry in all secondary schools.
4. Teachers and students should be encouraged to innovate and acquire computer skills as this would enhance and facilitate the teaching-learning process.

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