Teachers' Literacy and Gender Disparity towards ICT as Correlate of Students' Academic Performance in Chemistry in Education District V, Lagos State, Nigeria

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ABSTRACT

This study investigated teachers' ICT literacy and gender disparity as a correlate of academic performance of chemistry students in Lagos State, Nigeria. The study employed both survey and quasi-experimental research designs involving a total of fifteen chemistry teachers (15) and four hundred (400) senior secondary school one (SSS I) chemistry students randomly selected from eight (8) senior secondary schools in Education District V of Lagos State, Nigeria. This study was guided by four research questions and three research hypotheses. Research data gathered were analysed using charts, chi-square, t-test, and regression analysis. The findings of the research showed that chemistry teachers have high literacy levels in the majority of the ICT packages used in the study and they often use them in their lesson preparation and classroom instruction. Results also showed that teachers' gender has no influence on their literacy level in ICT; and that teachers' literacy level in ICTs has significant impact on student learning outcomes in chemistry. Based on the research findings, recommendations were made which include that chemistry teachers and students should be encouraged to acquire computer skills and avail themselves to attend self-efficacy workshops and seminars with a view for them to improve their teaching and learning abilities in chemistry using ICT.

Keywords: ICT, chemistry, teachers' literacy, gender disparity, ICT packages, students' performance

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INTRODUCTION

Education is a vital tool for the development of a nation and education in whatever form it takes is not complete without effective communication. Information and Communication Technologies (ICTs) have in recent time become a household name in educational sector all over the world. In particular, most of the developed countries have exploited the potential of ICT to transform their educational landscape at the tertiary, secondary and primary school levels, particularly in the delivery of instructional processes, (Kalu and Ekweme, 2003; Yusuf, 2012; Saibu et al., 2015). Adomi and Kpangban (2010) observed that there are developments in the Nigerian education sector, which indicate some level of ICT application in secondary schools in Nigeria. Adomi and Kpangban traced the introduction of computer education in secondary schools to 1988 when the Nigeria government enacted a policy on computer education. ICT covers any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form. For example, personal computers, digital

television, email, internet and so on (Yusuf et al., 2013). ICT in education means teaching and learning using ICTs. Abolade and Yusuf (2005) described information and communication technologies as essential tools in any educational system. They have the potentials of being used to meet the learning needs of individual students, promote equality of educational opportunities; offer high-quality learning materials, increase self-efficacy and independence of learning among students, and improve teachers' professional development. ICT has been found to have the potential of addressing the need of equalizing educational opportunities, and it is currently being used to provide educational services to millions of people around the world defying their geographical distance or time, (Smith, 2000; Terry, 2003).

In fact, the World Bank (2002) affirmed that ICT holds out the opportunity to revolutionize pedagogical methods, expand access to quality education and improve the management of the education system. The National Policy on Information Technology (IT) also emphasizes the integration of ICT at every level of our educational institution to play a leading role in the actualization of the goals of education (FRN, 2004). Ayodeji (2004) observed that there are developments in the Nigerian education sector, which indicate some levels of ICT application in secondary schools in Nigeria. Ayodeji traced the introduction of computer education in secondary schools to 1988 when the Nigerian government enacted a policy on computer education. The National Policy on Education recognizes the prominent role of ICTs in the modern world and has integrated ICTs into education in Nigeria. To actualize this goal, the document states that government will provide basic infrastructure and training at the primary school level. At the junior secondary school level, computer education is made a pre-vocational elective and a vocational elective at the senior secondary school level of Nigerian Education (Federal Government of Nigeria, 2013). But, how literate are the teachers in the use of ICTs?.

According to Taparchi and Whitaker (2004), computer literacy refers to an understanding of computer characteristics capabilities and its applications. International ICT Literacy Panel Report (2002) defined ICT literacy as "using digital technology, communication tools, and networks to access, manage, integrate, evaluate, and create information to function in a knowledge society. ICT literacy also refers to people's skills and predisposition to the use of computer and information technology (Ibrahim, 2010).

Makinde et al.(2013) affirmed that the demand for computer and ICT literacy is increasing in Nigeria because employers realize that computers and other ICT facilities can enhance efficiency. On the other side, employees have realized that lack of computer knowledge can be a threat to their jobs and that the only way to enhance job security is for them to become computer literate. With the high demand for computer literacy, teaching and learning these skills are concerns among professionals, (Adomi and Kpangban, 2010).

Meanwhile, it is a known fact that the teachers are recognized as the kingpin and most important factor in education delivery worldwide. They are seen as implementers of the curriculum and a dynamic force in the classrooms who help to direct learning to enable learners to achieve both personal and societal goals. The quality of education of any nation, therefore depends largely on the general characteristics of teachers as well as their relationships with individual learners and classes (Otagbugu, 2006; Saibu, 2013). Teachers are the primary agents of educational innovation. Therefore, ICT skills among secondary school teachers should be seen as an invaluable prerequisite that would help facilitate the teaching and learning procedure in this modern age of information explosion (Yusuf et al., 2013). Teachers need to be confident, competent and fully understand their roles in educational service delivery if innovations and the goals of the education are to be achieved or have the desired impact (Ogunmade and Saibu, 2010). According to Tahir (2006), Philomina and Amutha (2016), the continued deepening of knowledge and skills of science teachers is an integral part of the development of teaching and learning in schools, especially in primary and secondary science. Teachers' professional development, therefore, has been the major focus of all systematic reform initiates (Cuban, 1998; Corcovans, 1995; Ogunmade and Saibu, 2010b).

The World Bank (2002) reported that low education, inadequate literacy levels and lack of awareness about the capabilities of the technology and absence of skills to develop and use ICT application represent significant obstacles to its adoption; even when the physical and instructional infrastructure is available. The use of ICT, therefore, requires some skills to enhance the access and retrieval of the required information without undue stress (Makinde et al., 2013).

Available empirical studies in the area of ICT in education in Nigeria tend to focus mainly on the area of the effect of computer-aided instruction on students' performance, students' level of internet use, assessment of available ICT facilities, feasibility of integrating ICT into education and instruction, and teachers' ICT literacy level (Onasanya, 2002; Cirfat, Zumyil and Ezema 2003; Busari, 2003). To the best of the researchers' knowledge, attention has not been given to the level of ICT literacy of teachers as it affects students' performance in Nigeria, and this represents the yearning gap the present study intends to fill.

Research Questions

1. What are the chemistry teachers' literacy level and use of ICT facilities in secondary schools?

2. Does the chemistry teachers' level of ICT literacy vary based on gender?

3. What is the effect of ICTs on students learning outcome in chemistry?

4. Does teachers' ICT literacy level predict students' learning outcome in chemistry?

Hypotheses

Research questions 2 to 4 were transformed into testable hypotheses.

H_{o1}: Gender disparity has no significant effect on chemistry teachers' level of ICT literacy in secondary schools.

H_{o2}: There is no significant difference in the performance of students taught using ICTs and those taught without ICTs.

H_{o3}: Teachers' ICT literacy is not a significant predictor of students' learning outcome in chemistry

RESEARCH METHODOLOGY

The designs adopted in this study were both survey and quasi-experimental designs. The survey involved the use of investigators designed questionnaire to collect necessary information on chemistry teachers' ICT literacy level and use of ICTs while the quasi-experimental involved the use of an achievement test.

The population of the study comprised all chemistry teachers and students in co-educational secondary schools in Education District V, Agboju of Lagos State, Nigeria. Eight senior secondary schools within the Education District were randomly selected using balloting system. Fifteen (15) chemistry teachers and four hundred (400) Senior Secondary School 1 (SSS1) chemistry students were randomly selected as sample for the study. The researchers used two instruments to collect data for the study: A questionnaire tagged Chemistry Teachers' ICT Literacy and Use Assessment Questionnaire (CTILUAQ) and Chemistry Students' Achievements Test (CSAT). The CTILUAQ was in sections: Section A sought information on the background information of the teacher respondents, section B contained a list of ICT devices, and teachers were asked to rate their level of competency on a 5-Likert Scale of Very Good, Good, Average, Poor, and Very Poor. While section C contained ten (10) statement items on the use of ICT in chemistry teaching and learning structured on 4-Likert Scale of Not at all (NA), Occasionally (OC), Often (OF) and Very often (VOF). The CSAT contained twenty multiple choice questions on four topics drawn from SSS 1 Nigeria chemistry curriculum.

Meanwhile, these instruments were validated by three experts in the field of computer, ICT, research methodology and science education in two tertiary

institutions in Lagos State: Adeniran Ogunsanya College of Education, Otto/Ijanikin and Lagos State University, Ojo. A split half approach using Pearson Product Moment Correlation (PPMC) was used to establish the reliability of the questionnaire. The reliability coefficient was 0.87. Meanwhile, Kuder Richardson Formula-21 was used to test the reliability of the achievement test which yielded a coefficient of 0.79.

The researchers administered the CTILUAQ to the teachers first to determine their literacy level in ICTs and ensured that only those teachers participated in the administration of the experimental treatment to the students. The teachers applied some of these ICTS packages to teach the students some chemistry concepts, and this lasted for four weeks. The researchers monitored the teachers to ensure that the treatment was carried out as planned.

The data collected in respect of research question 1 was answered using charts. While hypothesis 1 was tested using chi-square, hypothesis 2 using a t-test, and hypothesis 3 simple using regression.

Data Analysis and Results

Figures from Table 1 show that 46.7% of the respondents are between the ages of 21 and 30, 20% fall between 31 and 40, 20% are between 41 and 50 while 13.3% are 50 and 60 years. It is also shown that 60% of the respondents are male, while 40% are female. None of the respondents is NCE holder; meanwhile, 86.7% hold a first degree, and 13.3% of the respondents are a masters degree holder. 26.7% of the respondents have spent 1 to 5 and 6 to 10 years in teaching service respectively. 13.3% of them have spent 11 to 15 years, 13.3% of them have spent 16 to 20 years while 20% have spent 21 years and above in secondary schools as chemistry teachers.

Research Question 1: What is the chemistry teachers' level of literacy and use of ICT facilities in secondary schools?

The figure 1 shows that chemistry teachers have high literacy levels in some of the ICT packages ranging from Microsoft Word, word star, online library, internet browsing, e-mailing and www. Meanwhile, some of them have poor knowledge of video recording, satellite and interactive Compact discs.

Figure 2 shows that chemistry teachers very often and often use ICT in browsing for current chemistry materials; exchange of mail with students; download and purchase of chemistry materials; source for literature in chemistry; improve lesson preparation; and chatting and collection of assignments from students. In addition, some of them do not use ICT at all for preparation of results, examination, and CA questions, and for keeping and

Table 1: Demographic Information of the Teacher Respondents.

Item	Factor	Percentage
Age	Age Range (Year)	Percentage
	21-30	46.7
	31-40	20.0
	41-50	20.0
	51-60	13.3
Sex Distribution	Sex	Percentage
	Male	60
	Female	40
Educational Qualification	NCE	0
	B.Sc.Ed, B.Sc plus PGDE, B.Sc, HND	86.7
	M.Ed, M.Sc	13.3
Years of Teaching Experience	1-5	26.7
	6-10	26.7
	11.15	13.3
	16-20	13.3
	21 Years and above	20.0
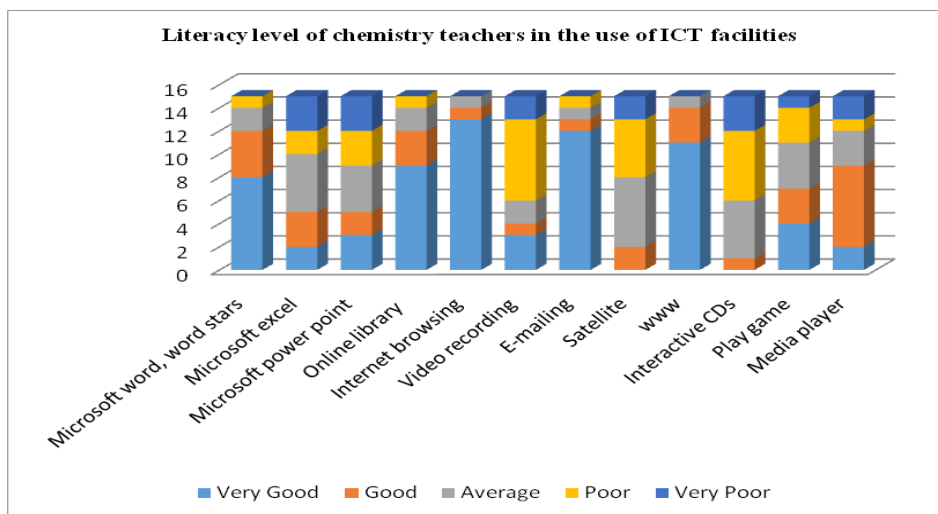
Figure 1: Literacy level of chemistry teachers in the use of ICT facilities.

storing of students' record.

Hypothesis One

Ho$_1$: Gender disparity has no significant effect on teachers' level of ICT literacy in secondary schools
A Pearson Chi-square in Table 2 shows no gender disparity in chemistry teachers' level of ICT literacy in junior secondary schools [Chi-Square (4) = .9720; P > 0.05]. Therefore, the hypothesis which states that there is no gender difference among chemistry teachers' level of ICT literacy in secondary schools is not rejected.

Hypothesis Two

H$_{o2}$: There is no significant difference in the performance of students taught using ICTs and those taught without

ICTs.
Table 3 shows the statistical significant effect of teachers' ICT literacy level of students' learning outcome in chemistry [t (98) = 11.82; p<0.05]. This implies that the hypothesis which stated that Teachers' ICT literacy level has no significant effect on students learning outcome in chemistry is rejected.

Hypothesis Three

H$_{o3}$: Teachers' ICT literacy level is not a significant predictor of students' learning outcome in chemistry.
Table 4 depicts summary model using multiple regression to show how much the predictors (Microsoft Word/Word Star, Microsoft Excel, Microsoft PowerPoint, Online Library, internet Browsing, Video Recording, E-Mailing, Satellite, www, Interactive CDs, Play Game, and Media
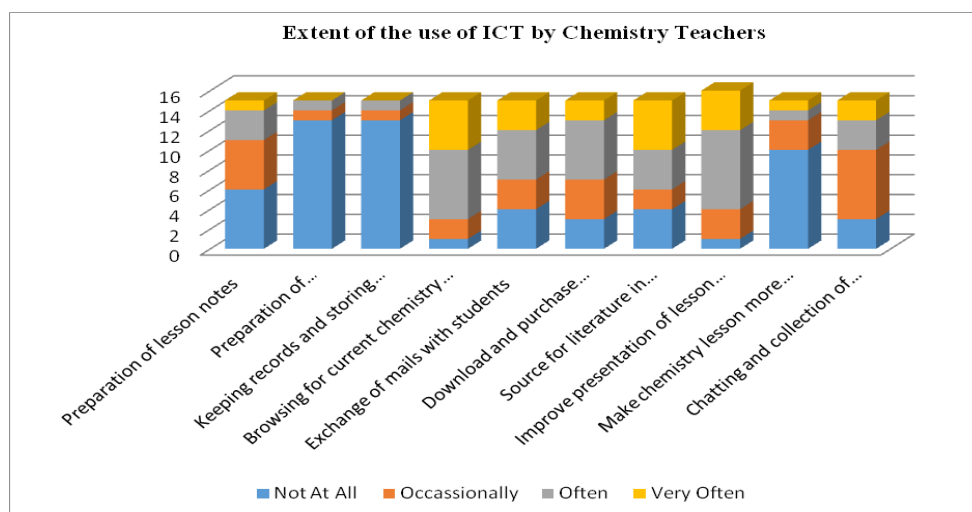
Figure 2: Extent of the use of ICT by Chemistry Teachers.

Table 2: Gender difference in science teachers' level of ICT literacy in secondary schools.

	Value	df		Asymp. Sig. (2-sided)
Pearson Chi-Square	.9720	4	.914	
Likelihood Ratio	1.323	4	.857	
Linear-by-Linear Association	.074	1	.786	
N of Valid Cases	15			

Table 3: Mean, SD, and t-test showing difference in the performance of students taught with ICT packages and students taught with conventional method of teaching.

Mean	N	Std. Deviation	t	p
14.1600	200	2.41897	11.82	.000
8.3400	200	2.35268		

Table 4: Regression Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.954[a]	.910	.372	3.61523	.910	1.691	12	2	.431

a. Predictors: (Constant), Media Player, Video Recording, Online Library, E-Mailing, Microsoft PowerPoint, Microsoft Word, Word Star, www, Satellite, Interactive CDs, Microsoft Excel, Play Game, Internet Browsing.

Player) explain the predicted variables (Achievement Test). It shows that all the predictors contribute 91% to the achievement test (R^2 = .910).

Furthermore, the coefficient of the regression was run to know the types of ICTs packages that mostly predict the students' academic achievement in chemistry. The result shows that internet browsing shows the highest contribution to the achievement of the learners (Beta weight = 1.15) followed by e-mailing (Beta weight = -1.01) (See Annexure 1).

DISCUSSION OF FINDINGS

The findings from the study revealed that chemistry teachers have high literacy levels in the majority of the

ICT packages, ranging from Microsoft Word, word star, online library, internet browsing, e-mailing and www. Meanwhile, some of the teachers displayed poor knowledge of video recording, satellite and interactive Compact discs. The finding is in line with the study of Oyeronke and Fagbohun (2013) on the computer and ICT skills of secondary school teachers in Ota, Ogun State of Nigeria, which revealed that teachers are aware of the fact that being computer and ICT literate is very important in their profession.

The study also showed chemistry teachers either very often or often use ICT in browsing for searching current chemistry materials; exchange of mail with students; download and purchase of chemistry materials; source for literature in chemistry; improve lesson preparation; and chatting and collection of assignments from students. But, some of them mostly do not use ICT at all for preparation of results, exam and CA questions, and keeping and storing of students' record. The study is in contrast with Obakhume (2012) who found that most teachers in secondary do not use ICT teaching students, for administrative purpose and for their purpose. It observed that most of these teachers lack the knowledge, competence to use ICT to facilitate the teaching-learning process. This Fakeye (2010) attributed to non-availability of ICT facilities. He believed that the non- availability of these facilities greatly hinders access and inadequate training of teachers on the use and application of the computer.

More so, the study found no significant gender disparity among chemistry teachers' ICT literacy level in secondary schools. This finding agrees with the earlier finding of Landa (2010) in his study on an assessment of the availability of ICT facilities and teachers' literacy level in secondary schools that there is no significant gender difference in the literacy level of teachers in the use of ICT. Anunobi (2014) and Nwosu (2005), in their separate findings also found that the student-teachers' level of ICT literacy does not vary based on gender. Meanwhile, the finding contradicts Awodeji, (2007) and Graybill, (2003) who found gender disparity in ICT literacy in favour of males. More so, it has been established that when female and male students and teachers have the same type of experience of a computer, female achievement scores and attitudes are similar to that of males at all educational levels, (Derbyshire, 2003; Kirkpatrick and Cuban, 1998).

The findings also showed that teachers' ICT literacy significantly influenced students' learning outcomes in chemistry. Science teachers' use and knowledge of both the subject and how students understand the subject with their use of ICT have more direct effects on students' academic attainment. Therefore, teachers who favoured ICT are likely to have well-developed ICT skills which will, in turn, affect their lesson delivery and students' performance (UNESCO, 2003). Yusuf (2002) and Ibrahim (2010) acknowledged that science teachers' knowledge

and use of ICT improve the quality of teaching and learning in the school system and affirmed that the teachers ICT literacy level and the availability of ICT gadgets in schools play a significant role in the teaching and learning process. Hence, teacher's adequate knowledge of ICT and its incorporation into the instructional process will go a long way to enhance students' understanding of concepts to be learned.

More so, the internet browsing showed the highest contribution to the achievement of the learners in chemistry. Saibu, (2013), and Kennewell and Morgan (2003) agreed to this finding that teachers have a positive attitude and are highly enthusiastic about internet browsing as an important feature of teaching and learning, and this motivated them to practice using the technology.

Conclusion

The teacher who is at the centre of any educational process needs to possess necessary pedagogical knowledge and strategies for effective learning to occur. Therefore, it is glaring from the study that ICT plays a significant role in the teaching and learning process and as such teachers as instructors need to have adequate knowledge of ICT for effective lesson delivery, especially in chemistry classrooms.

Importantly, there is need to mention that most chemistry teachers in Lagos State secondary schools have high literacy levels in ICTs and often they use them in teaching to enhance their instructional process. Also, the study findings indicated that there is no gender disparity in ICT literacy among science teachers and pointed out that if male and female science teachers are given the same opportunity to access and use a computer, they both will have a similar experience at all educational levels.

Finally, teachers ICT literacy level have a significant impact on students' learning outcome in chemistry. When students are taught with varieties of ICT packages, especially multimedia packages, their understanding of concepts vis-a-vis their academic achievement tend to be high. Learning in this realm becomes real and permanent in their repertoires.

Recommendations

The following recommendations were made to brighten the prospect of ICT application in science pedagogy.
1.There is a need to improve the access of the teachers to ICT in order to improve their level of use. Hence, more ICT equipment and other computer software should be made available to the teachers and students by the school authorities, stakeholders in education and government for instructional purposes.

2.The schools should help the teachers by giving them capacity building training on the use of ICT facilities such as computers to boost their ICT literacy level. Teachers should be encouraged to expand their ICT literacy to the level of being able to produce instructional software for their lessons.

3.Increase demands should be made by the Federal and State Ministries of Education on science teachers to make effective use of ICT in schools.

4.Students especially science students should be encouraged to develop the attitude of browsing and making use of the super-highway to information for them to be abreast with recent developments in chemistry and measure-up with their counterparts elsewhere in the world.

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ANNEXTURE 1

Table 5: ICT Resources Descriptive Statistics.

ICT Resources	Mean(	SD	N
Achievement Test	13.6667	4.56175	200
Microsoft Word, Word Star	4.2667	.96115	15
Microsoft Excel	2.9333	1.33452	15
Microsoft PowerPoint	2.9333	1.43759	15
Online Library	4.3333	.97590	15
Internet Browsing	4.8000	.56061	15
Video Recording	2.7333	1.38701	15
E-Mailing	2.7333	1.38701	15
Satellite	4.6000	.91026	15
Social Networks	2.5333	.91548	15
Interactive CDs	4.6667	.61721	15
Play Game	2.2667	.88372	15

Table 5 shows number, mean, and standard deviations of teachers' literacy level as well as students' learning outcome in science. As shown (Table 5), Achievement Test (N = 200, X = 13.67, S.D = 4.56), Microsoft Word /Word Star (N = 15, X = 4.27, S.D = .96), Microsoft Excel (N = 15, X = 2.93, S.D = 1.33), Microsoft PowerPoint (N = 15, X = 2.93, S.D = 1.44), Online Library (N = 15, X = 4.33, SD = .97, Internet Browsing (N = 15, X =4.80, S.D = .56), Video Recording (N = 15, X = 2.73, S.D = 1.39), E-Mailing (N = 15, X = 2.73, S.D = 1.39), Satellite (N = 15, X = 4.60, S.D = .91), www (N = 15, X = 2.53, S.D = .92), Interactive CDs (N = 15, X = 4.67, S.D = .61), Play Game (N = 15, X = 2.27, S.D = .88), and Media Player (N = 15, X = 3.40, S.D = 1.30).

Table 6: Co-efficient for ICT literacy skills.

Model	Beta	T	Sig.
Microsoft Word	-.535	-.705	.554
Microsoft Excel	.464	.552	.637
Microsoft PowerPoint	-.119	-.236	.835
Online Library	.722	.604	.607
Internet Browsing	1.152	.618	.932
Video Recording	.919	1.047	.405
E-Mailing	-1.017	-.910	.459
Satellite	.117	.111	.922
Social Networks	.228	.716	.548
Interactive CDs	.161	.097	.600
Play Game	.180	.125	.912
Media Player	-.184	-.286	.802

Table 6 reveals that the degree of individual predictor towards the predicted variable. Internet browsing shows the highest contribution to the achievement of the learners (Beta weight = 1.15) followed by e- mailing (Beta weight = -1.01).