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PATTERN OF ACCESS AND ICT USAGE AMONG SCIENCE TEACHERS IN FEDERAL UNITY SCHOOLS IN NIGERIA

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Abstract

This study investigates the pattern of ICT access and use among science teachers in Federal Unity Schools (FUSs) in Nigeria. A total of 464 copies of the questionnaire were administered on science teachers in 25 FGUSs that were systematically selected from the 104 FGUSs in Nigeria out of which only 353 copies were returned with useful responses. The findings of the study revealed a low level of access to laboratory-based ICT facilities (Mean = 2.18). Moreover, the findings of the study revealed specialized classroom/laboratory (Mean = 0.52), library (Mean = 0.52), and science laboratory (Mean = 0.25) as the most preferred location of ICT access by science teachers in FUSs in Nigeria. The study further revealed a low level of ICT use among science teachers while also revealing a low level of ICT use for laboratory-based/experiment-based activities. Also, positive relationships were established between location of access and ICT use (r = 0.186) and degree of accessibility and ICT use (r = 0.438). A positive relationship was also established between location of access and degree of accessibility (r = 0.374). Also, a joint significant relationship was established among location of ICT access, degree of ICT accessibility, and ICT use (F = 61.61, p<0.05) though degree of accessibility was found to contribute more to ICT use among the science teachers than location of ICT access. Location of access and degree of accessibility were found to be responsible for 25.6% of the total variance in ICT use among science teachers in FUSs in Nigeria

Keywords: location of ICT access, degree of ICT access, ICT use, Federal Unity Schools.

Introduction

Science is a universal subject with no boundaries and the claim for its inclusion in the school curriculum was established based on its ability to revolutionise human life as well as the society. Evidence on relevance of science in schools suggests that science has been found to have influence on every field of human endeavour. Prakash (2005) while arguing for the inclusion of science in school curriculum described science as a subject that provides unique training in observation and reasoning for students and enables them to form an objective judgment. This is corroborated by Armstrong (2001) who emphasised that science is taught to provide training in and knowledge of scientific method that is useful in life pursuits.

Turner (2003) presented four arguments to support the teaching and learning of science in schools viz: economic argument, democratic/humanistic argument, skills argument, and cultural argument. The economic argument of teaching science in schools is based on the need to produce more scientists to meet the supply demands in science-related fields. The economic argument is considered as the dominant reason why science is taught especially in advanced and prosperous countries (Hassard, 2010). The democratic/humanistic argument for the introduction of science in schools is based on the need to prepare students to be informed

citizens and knowledgeable consumers while the skills argument suggests that study of science instills certain transferable skills that are important to students' understanding of science. The skills argument claims that students should be involved in hands-on activities, be able to analyse data, and plan open-ended investigations (Turner, 2003). Moreover, the cultural argument of teaching science in schools suggests the need to consider the history and philosophy of science, and try to bring to students' experiences how science discoveries are made.

Studies {Keane, 2002; Jenkins, 2008) on academic achievement of students in science subjects revealed that there is need for teachers to change their mode and style of teaching from the old conservative and traditional approach to modern technology mediated approach. Jenkins (2008) suggested that the introduction of ICT resources in the teaching of science may bring about the required change in style and of teaching science in schools. .

In many developed countries, classroom use of ICT resources for teaching science has increased dramatically in recent years and ICT has proved to be very effective tool in the teaching of science related subjects. The most common use of ICT in teaching science involves the use of applications where computers are used to simulate or animate specific scientific phenomena. This enables pupils to engage in hands-on-activities which are directed toward increasing their understanding and insight of the principles involved. This is corroborated by Kirschner and Davis, (2003) as they emphasised considerable additional advantage to be gained by the integration of the various ICT and concepts available in teaching and laboratory experiments. In addition, ICT based teaching applications and tools provide an opportunity for a greater level of integration of different science disciplines.

With all the resources invested in acquiring and developing ICT resources for teaching and instruction delivery in Nigerian schools, ICT resource may still remain largely unused or seriously underutilized by teachers in schools. Thus, it is important to examine factors that can affect the use of ICT for teaching. Therefore, the focus of this study is to investigate the pattern of access and ICT usage level among science teachers in federal unity schools in Nigeria.

Objectives of the Study

The objective of this study is to investigate the pattern of access and ICT usage level among science teachers in Federal Unity Schools (FUSs) in Nigeria. Specifically, the study is aimed at:

i. investigating the pattern of ICT access (i.e location of access and degree of accessibility) among science teachers in FUSs in Nigeria;ascertaining the pattern of use of ICT by science teachers in FUSs in Nigeria;

ii. determining the relationship among location of access, degree of accessibility and ICT use by science teachers in FUSs in Nigeria.

Research Questions

i. What is the degree of ICT accessibility among science teachers in FUSs in Nigeria?
ii. Where is the preferred location of ICT access among science teachers in FUSs in Nigeria?
iii. For what purposes do science teachers in FUSs in Nigeria use ICT facilities?
iv. What is the level of ICT usage among science teachers in FUSs in Nigeria?

v. What relationships exist among location of access, degree of accessibility and ICT use by science teachers in FUSs?

Research Hypotheses

The following hypotheses were tested at 0.05 level of significance:

H_{01}. There is no significant joint relationship among location of access, degree of accessibility and ICT use among science teachers in FUSs

H_{02}: There is no significant relative contribution of location of access, degree of accessibility to ICT use by science teachers in FUSs in Nigeria

Literature Review

Education today relies heavily on technology and over the past decade, schools have invested greatly in computers, networking and related technologies to enhance teaching and learning processes (Sylvia & Sylvia, 2002). In other words, technology has become a prevalent part of the educational culture and its impact on the changing face of curriculum can no longer be dismissed (Bennedeto, 2005). As a result of the diffusion of computer in schools, teachers' role has also changed, such that textbook is no more the only resource for the student's knowledge. Acknowledging the benefit of technology in enhancing education, Privateer (2002) emphasised that expenditure to supply schools with computers and related technologies has increased throughout the world.

The role of teachers is pivotal in the use of ICT in education, as is the case with most educational innovations (Demitriadis, Barbaras, Molohides, Paleigeorgious, Psiltos, Vlahavas, Tsoukalas, & Pombortsis 2003). Information and communication technology is considered to have the power to improve teaching and learning in schools (Lundall, Howell, and Patrick, 2000; Hardman, 2005; Louw, et al., 2008). The purported positive impact of technology on education is particularly noted in developing countries where most schools are tackling issues such as lack of resources and under-qualified teachers (Koo, 2008). This perception has resulted in a growing investment in government initiatives implementing ICT in schools in developing countries. Realizing the effect of ICT on the workplace and everyday life, today's educational institutions try to restructure their educational curricula and classroom facilities, in order to bridge the existing technology gap in teaching and learning. This restructuring process requires effective adoption of technologies into existing environment in order to provide learners with knowledge of specific subject areas, to promote meaningful learning and to enhance professional productivity (Tomei, 2005).

Kumar, Subramainam, and Mukherjee (2005) presented a five-stage model of using ICT for practical work in science to include the use of; interactive CDs, on-line tutoring, virtual laboratories, home experiment, and laboratory sessions. The model, according to Basson (2010) reduces the dependency on real laboratories. Through interactive CDs that feature video clips on science experiments, students will learn how science experiments are conducted and the general rules of conducting an experiment along with the science observations that are featured (Zacharia, 2007). Video clips also have the tendency to motivate and increase the interest of the students to learn science (Woodley, 2009). In addition, multimedia can through its power to animate communicate dynamic information more accurately than a diagram, and can help students visualize phenomena that cannot be seen (Basson, 2010). Online tutoring can also help the teaching and learning process in teachers and students through acative discussions. de Jong (2006) reiterated that that online tutoring enables tutors and learners to bring the face-to-face classroom into virtual environment that ultimately generate new ideas and cultivate innovation. According to Goulding and Kurtacou (2008), teachers' use of ICT

simulations helped students to improve their understanding of science ideas more effectively compared to the use of non-ICT teaching activities. The use of ICT simulations would be more effective than using non-ICT teaching activities, for improving basic science ideas including science understanding and the scientific approach. The gains in students' learning when ICT simulations were used can further be enhanced when teachers actively scaffold or guide students through ICT simulations.

Osborne and Hennesy (2003) discussed a number of reasons for using technology in science teaching and learning. These reasons include supporting exploration and experimentation; fostering self-regulation and collaborative learning and improved motivation and engagement. Boqula (2004) opined that teaching with ICT applications would promote higher order thinking and enable students to construct knowledge based on their experiences rather than based on the experience of the teachers. Sulton (2006) corroborated this by affirming that the use of computers and related technologies affects the motivation of students in the learning and enjoyment of science and mathematics, and that appropriate use of ICT can enrich, support, and mediate the learning of science and its concepts.

However, for teachers to effectively use ICT for teaching in classrooms, they must have easy access to the various types of ICT resources. Alston, Miller, and Williams (2003) found that in North Carolina schools, certain types of technology were widely available and accessible for teachers use, meaning the various types of ICT resources were located in the classroom or were easily accessible within the building. Access to ICT within the school is an important component when implementing its use into the classroom (Alston, Miller, & Williams, 2003). Therefore, without adequate access to various types of technology, including computers, internet, and technology experts (Alston, Miller, & Williams, 2003; Cohen, et al, 1999; U.S. Department of Education, 2005), teachers are unable to provide ICT-enriched lessons to their students. It is expected that if science teachers can follow the eight criteria set forth by Eisenberg and Johnson (1996), they will have an easier time accessing resources available to them within their school and community.

The researchers at the Center for Applied Special Technology (2006) pointed out that acquisition of computers and other related resources is not enough to guarantee the use of ICT resources by teachers but adequate access should be guaranteed. This can be in form of making the ICT resources available in allocation where the teachers can easily have make use of them without any difficulties. This ease of access may end up increasing the frequency of use of the resources. Ertner (2005) describes schools acquisition of computers as just the beginning of ensuring use.

Research Method

This study adopted the *ex-post-facto* type of survey method. The population of the study comprises all the science teachers (1,761) in all the 104 Federal unity schools (FUSs) spread across the thirty six states and Federal Capital Territory, Abuja, in Nigeria. The multi-stage sampling technique was adopted in selecting the sample size for the study. At the first stage of selecting the sample, the systematic sampling technique was used in selecting 25 out of the 104 FUSs in Nigeria. At the second stage of the sampling size, the total enumeration method was adopted to select all the 464 science teachers in the selected FUSs. The science teachers selected include teachers of mathematics (154), physics (106), chemistry (101), and biology (103).

Data Analysis and Discussion of Findings

Out of 464 copies of the questionnaire administered on the respondents, only 353 were returned with useful responses giving a response rate of 76.1%.

Research question 1: What is the degree of ICT accessibility to science teachers in FUSs in Nigeria?

Table 1 shows the finding of the degree of ICT accessibility to science teachers in FUSs.

Table 1: Response on Degree of ICT accessibility

Statement	Response				Mean	S.D
	VEA	EA	OA	NA		
Computer Aided Instructional Software	76 21.5%	64 18.1%	45 12.7%	168 47.6%	2.14	1.23
Individualized tutorials (e.g) Science for Student	63 17.8%	81 22.9%	20 5.7%	189 53.5%	2.05	1.22
Instructional video/audio tapes	100 28.3%	39 11.0%	70 19.8%	144 40.8%	2.27	1.26
Multimedia projectors	119 33.7%	77 21.8%	12 3.4%	145 41.1%	2.48	1.32
Presentation software(Power Point, KidPix)	105 29.8%	41 11.6%	17 4.8%	190 53.8%	2.40	1.38
Computers	158 44.8%	85 24.1%	10 2.8%	100 28.3%	2.85	1.26
Word Processor	154 43.6%	41 11.6%	9 2.5%	149 42.2%	2.57	1.40
E-mail (for Online communication with students)	114 32.3%	54 15.3%	43 12.2%	142 40.2%	2.40	1.30
Interactive whiteboard/Smart board	72 20.4%	39 11.0%	45 12.7%	197 55.8%	2.64	1.33
Spreadsheet program (Excel etc)	151 42.8%	44 12.5%	37 10.5%	121 34.3%	2.64	1.33
Online databases	132 37.4%	85 24.1%	14 4.0%	122 34.6%	2.64	1.29
Models/Modeling software	82 23.2%	31 8.8%	11 3.1%	229 64.9%	2.37	1.34
Simulation programmes and Games	61 17.3%	22 6.2%	10 2.8%	220 62.3%	2.44	1.44
Graphical visualizing tools	115 32.6%	25 7.1%	11 3.1%	202 57.2%	2.49	1.43
Concept mapping software	111 31.4%	21 5.9%	37 10.5	184 52.1%	2.49	1.36
Multimedia resources	141 39.9%	75 21.2%	6 1.7%	131 37.1%	2.64	1.33
Discussion list/Newsgroup	92 26.1%	39 11.0%	7 2.0%	215 60.%	2.45	1.41
Web-based Internet laboratories	86 24.4%	46 13.0%	17 4.8%	204 57.8%	2.48	1.38
Weighted Mean Average					**2.18**	

Key: (VEA) Very Easily Accessible (EA) Easily Accessible (OA) Occasionally Accessible, (NA) Not Accessible

Table 1 above present's information on ICT accessibility by science teachers in FUSs in Nigerian and it revealed that ICT facilities are accessible by science teachers in FUSs. However, not all the ICT facilities were found to be accessible. Computers (253or 71.7%) spreadsheet program (232 or 65.8%), online database (231 or 65.5%), multi-media resources (222 or 62.8%), instructional video or audio tapes (209 or 59.1%), multimedia projectors (208 or 58.9%), and computer aided instructional software (185 or 52.4%) were found to be ICT facilities that are commonly accessible to the science teachers. However, the level of accessibility of science-based ICT such as web-based laboratories, simulation programs and games, model/modeling software, graphical visualizing tools, (and science presentation software was found to be very low. The implication to be drawn from this is that science based ICT facilities are not readily accessible to the science teachers in FUSs

Research question 2: Where is the preferred location of ICT access among science teachers in FUSs in Nigeria?

Table 2 presents the finding on the preferred location of ICT access among science teachers in FUSs in Nigeria.

Table 2: Preferred location of ICT access by science teachers

Location of access	Frequency	Percentage	Mean	Std Dev
Classroom	55	15.6	0.16	0.363
Library	91	25.8	0.26	0.438
Specialised classroom/laboratory	185	52.4	0.52	0.880
Science laboratory	89	25.2	0.25	0.435
Teachers' office	88	15.3	0.15	0.360
Staff room	54	12.5	0.12	0.331
Meeting room	44	12.2	0.12	0.328
Multimedia classroom	43	19.5	0.20	0.397
Cybercafé	69	19.3	0.19	0.395
At home	68	12.2	0.12	0.328
ICT laboratory	43	9.3	0.09	0.292
Other locations	33	27.2	0.27	0.446

Table 2 above presents information on the preferred location of ICT access by the science teachers. It revealed the most preferred location of ICT access by science teachers as specialized classroom/laboratory (185 or 52.4%, $\bar{x}$ = 0.52). Other location preferred by the science teachers include, library (91 or 25.8%, $\bar{x}$ = 0.52), science laboratory (89 or 25.2%, $\bar{x}$ = 0.25), teachers' office (88 or 15.3%, $\bar{x}$ = 0.15), cybercafé (69 or 19.3%, $\bar{x}$ = 0.19), and at home (68 or 12.2%, $\bar{x}$ = 0.12). This implies that the most used location of access to ICT facilities by the science teachers is the specialized classroom/laboratory within the school.

Research question 3: For what purposes do the science teachers in FUSs in Nigeria use ICT facilities?

Table 3 shows the findings on the purposes of use of ICT by science teachers in FUSs in Nigeria.

Table 3: Purpose of use of ICT facilities by science teachers

Purpose of use	Frequency	Percentage	,Mean	Std Dev
Tutorials	85	24.1	0.24	0.428
Testing	81	22.9	0.23	0.421
Presentation of new materials	74	21.0	0.21	0.408
Remediation and acceleration	65	18.4	0.18	0.388
Drill and Practice	82	23.2	0.23	0.423
Recreational and educational games	79	22.4	0.22	0.417
Enrichment activities	91	25.8	0.26	0.438
Experimentation/Simulations	63	17.8	0.18	0.383
Information access via CD-ROM	80	22.7	0.23	0.419
Authoring	59	16.7	0.17	0.374
Multimedia application	89	25.2	0.25	0.435
Problem solving	80	22.7	0.23	0.419
Collaborative learning	94	26.6	0.27	0.443

From Table 3 information on the purpose of use of ICT facilities by the respondents revealed collaborative learning (Mean=0.27, SD = 0.443), enrichment activities (Mean =0.26, SD =0.438), and multimedia application ($\bar{x}$ = 0.25, SD = 0.435) as being of top of the list of purposes for which the science teachers use ICT facilities. Other purposes for which the science teachers use ICT facilities, as revealed from the table include, tutorials ($\bar{x}$ =0.24, SD =0.428) problem solving ($\bar{x}$ =0.23, SD=0.419), and information access is a CD-ROM ($\bar{x}$ =0.23, SD =0.419). This implies that the science teachers use ICT facilities mainly for teaching, learning, and classroom-based activities at the expense of experimentation and simulation activities which is a major element of science teaching

Research question 4: What is the level of ICT use among science teachers in FUSs in Nigeria?

Table 4 reveals the findings on level of use of ICT among science teachers in FUSs in Nigeria.

Table 4: Level of use of ICT facilities by science teachers

Statement					Mean	S.D
	HU	U	FU	NU		
Use of ICT for tutorials, word processing, instructional video/audio tapes	87 24.6%	60 17.0%	30 8.5%	176 49.9%	2.16	1.28
Use of ICT for Remediation/acceleration of instruction	93 26.3%	42 11.9%	27 7.6%	191 54.1%	2.10	1.31
Use of ICT for Testing (Computer based testing, drill and practice, etc)	81 22.9%	55 15.6%	12 3.4%	205 58.1%	2.03	1.29
ICT use for presentation of new materials (use of presentation software)	187 53.0%	38 10.8%	32 9.1%	96 27.2%	2.12	1.31
Use of ICT for drill and practice	84 23.8%	43 12.2%	38 10.8%	188 53.3%	2.07	1.27
Use of recreational and educational games	90 25.5%	45 12.7%	31 8.8%	187 53.0%	2.11	1.29
Use of ICT in preparation of lesson notes	179 50.7%	47 13.3%	25 7.1%	102 28.9%	2.20	1.33
Enrichment activities (Video and simulations, model, databases)	99 28.0%	28 7.9%	33 9.3%	193 54.7%	2.09	1.32
Problem solving (simulations, virtual laboratory, discussion lists/newsgroup, graphical visualization)	101 28.6%	40 11.3%	16 4.5%	196 55.5%	2.13	1.34
Use of ICT for information access (CD-ROMs, Internet, databases in finding and accessing information and educational resources)	182 51.6%	37 10.5%	20 5.7%	114 32.3%	2.24	1.37
Use of ICT for experimentation/simulation models, virtual laboratory	87 24.6%	34 9.6%	14 4.0%	218 61.8%	1.97	1.31
Collaborative learning (Internet, wikis)	94 26.6%	26 7.4%	31 8.8%	202 57.2%	2.03	1.31
I use online communication tool such as e-mail to facilitate communication between the teacher and students	208 58.9%	41 11.6%	10 2.8%	94 26.6%	2.06	1.33
I use Web cam to monitor distant location	87 24.6%	30 8.5%	22 6.2%	214 60.6%	1.97	1.30
Online discussion board is used in facilitating discussion between the teacher and students	100 28.3%	37 10.5%	16 4.5%	200 56.7%	2.10	1.33
I use online database to access science based content online	163 46.2%	71 20.1%	18 5.1%	101 28.6%	2.84	1.30
Use of data collection probes is to collect data online	47 13.3%	69 19.5%	24 6.8%	213 60.3%	2.78	1.28
Weighted Average Mean					**1.95**	

Key: HU = Highly Used, U = used, FU = Fairly Used, NU = Not Used

Information on the level of ICT use by science teachers in FUSs in table 4 above, revealed that majority of the respondents affirmed the use of ICT for tutorials, (177 or 51.0%) and use of online database to access science based content online (252 or 71.4%). This revealed a low use of ICT facilities for teaching by science teachers. Furthermore, the weighted average estimated means of the level of use of ICT by science teachers in FGUSs in Nigeria is 1.95 which is lesser than the expected mean of 2.13 and it implies a low level of ICT use by the science teachers.

Research question 5: what is the relationship between degree of ICT accessibility, location of access, and ICT use?

Table 5 reveals findings aimed at determining the relationship between degree of ICT accessibility, location of access and ICT use by science teachers in FUSs.

Table 5: Correlation Coefficient between degree of ICT accessibility, location of ICT access, and ICT use in FGUSs in Nigeria

Correlation Matrix

S/N	Variable	Mean	SD	1	2	3
1	ICT Use	1.32	1.591	1.000		
2	Degree of accessibility	1.99	1.021	.438	1.000	
3	Location of accessibility	1.44	0..497	.186	.374	1.000

N.B: **Sig p<0.05

Analysis on the relationship between degree of accessibility, location of ICT access and ICT use in table 5 above revealed a positive relationship between degree of accessibility (r = 0.458) and ICT use (r = 0.458), and location of ICT access and ICT use (r = 0.186). This implies that increase in ease of access and ease of locating ICT access would lead to increased use of ICT in teaching of science by science teachers in FUSs. A positive relationship was also established between degree of accessibility and location of access (r = .374) which may mean that ease of location of ICT would lead to increase in degree of ICT accessibility among science teachers. Location of access and degree of accessibility were found to have contributed 25.6% to the total variance in ICT use.

Hypotheses Testing

The null hypotheses were tested at 0.05 significant levels.

H_{01}: There is no significant joint relationship between location of access, degree of accessibility of ICT, and ICT use by science teachers.

The analysis is presented in table 6.

Table 6: Summary of regression analysis showing significant status of joint relationship of location of ICT access, degree of ICT accessibility, and ICT use by science teachers in FUSs

Model	Sum of Squares	Df	Mean Square	F	Sig
Due to Regression	231.96	2	115.98	61.61	.000
Due to Residual	658.87	350	1.88		
Total	890.83	352			

r = 0.510

r^2 = 0.260

Adjusted r^2 = 0.256

Std Error Estimate = 1.372

From Table 6 it was observed that there is a significant joint relationship between location of ICT access, degree of ICT accessibility, and ICT use by respondents ($F = 61.61$, $p<0.05$). Therefore, the null hypothesis is rejected. Considering the result from the Table, degree of ICT accessibility, and location of access was found to significantly related to ICT use for science teaching.

H_{02}: There is no significant relative contribution of location of access and degree of ICT accessibility to ICT use by science teachers in FUSs in Nigeria.

The analysis is presented in table 7.

Table 7: Multiple regression analysis showing relative contributions of independent variables to dependent variable

Model	Unstandardised Coefficients'		Standard Coefficients	t	Sig
	B	Std Error	Beta		
ICT Use	-.014	.151		-.096	.924
Location of access	.109	.025	.200	4.280	.000
Degree of accessibility	.510	.055	.435	9.313	.000

Further analysis to investigate the relative contribution of each of the independent variables (i.e degree of accessibility and location of ICT access) to ICT use among science teachers from Table 7 revealed that degree of accessibility significantly contributed more to ICT use ($B = 0.435$, $t = 9.313$, $p<0.05$) that location of access ($B = 0.200$, $t = 4.280$, $P<0.05$). This implies that location of access has more influence on ICT use than degree of accessibility.

ICT Access by Science teachers in FUSs

This study investigated the degree of accessibility of ICT facilities and location of ICT access among science teachers in FUSs and the findings from the study revealed only few ICT facilities such as computers, spreadsheet program; online database, multimedia resources and projectors, instructional video or audio tapes, and computer aided instructional software are easily accessible to the science teachers while other ICT facilities such as simulations, models, web-based laboratories, and graphical visualizing tools were found not to be frequently accessed by the science teachers. This implies that there is high level of accessibility to general ICT facilities among science teachers in FUSs but a low level of accessibility to science-based ICT facilities such as web-based laboratories, simulation programs and games, model/modeling software, graphical visualizing tools, and science presentation software. This implies that science-based ICT applications are not easily accessible to science teachers in FUSs in Nigeria.

On the location of ICT access among the science teachers, the findings from the study revealed specialized classroom/laboratories as the most preferred location of ICT access by science teachers in FUSs. This may be due to the fact that the specialised classroom/laboratories are adequately equipped with ICT facilities and easy to access by the science teachers. The fact that most of the teachers in FUSs are resident within the school premises may also be responsible for the preference for the specialized classroom/laboratories by the science teachers. Observations on ICT access by science teachers revealed that ICT facilities are located in specialized buildings, for example CISCO building, ICT building, or Computer building, in the FUSs selected for the study. This corroborates Edward's (2005) finding which reiterated the importance of making ICT resources available in locations within the school

where teachers can easily have access if the teachers are to make use of ICT without difficulties. A major external variable that can affect the use of ICT is access to ICT facilities. This study established a significant relationship between location of access and degree of accessibility.

ICT Use by Science Teacher in FUSs

The findings of the study revealed a low level of ICT use among the science teacher in FUSs in Nigeria. This is evident from the fact that less than one-third ($^1/_3$) of the science teachers affirmed the use of ICT facilities for one purpose or the other. The study further revealed a low level of use of ICT facilities for experimentation/simulation activities which is core to science teaching. Majority of the science teachers make use of ICT facilities basically for classroom-based activities (i.e tutorial, enhancement activities, multimedia application use in classroom, and collaborative learning) at the expense of laboratory-based activities (i.e experimentation /simulation). This is in contrast to Hogarth et.al.'s (2006) and Goulding and Kurtacou's (2008) findings that affirmed high use of simulations and models among Jordanian and Australian teachers. According to them (Hogarth et al. 2006; Goulding and Kurtacou, 2008) simulations and models have great potential value in the teaching of science as it can improve students' understanding and make science and concepts and understanding of science more effectively compared to use of non-ICT teaching activities.

Moreover, findings from the study on the extent of use of ICT facilities among the science teachers revealed that they make regular use of ICT basically for tutorial, presentation of new materials, information access via CD ROM, internet, and database, and online communication via e-mail. This implies that the regular use of ICT facilities for science-based teaching activities among the science teacher in FUSs in Nigeria is very low. Observations also revealed that laboratory-based ICT applications are not readily available and accessible for use by science teachers in FUSs. The ICT resources available and accessible for use by science teachers in FUSs are those for classroom-based activities only. The low level use of ICT facilities among science teachers in FUSs in Nigeria corroborates Al-Zaidiyeen et.al.'s (2010) findings that reported low level of ICT use among teachers.

Conclusion and Recommendations

The study investigated the pattern of ICT access and use as well as the relationships among location of access, degree of accessibility and ICT use among science teachers in FUSs in Nigeria. The study established a low level of access to and use of science-based ICT applications such as web-based laboratories, simulation programs and games, model/modeling software, graphical visualizing tools. Science teachers were found not to make use of ICT facilities for laboratory-based/experimentation activities. This is based on the fact that the few science teachers that make use of ICT facilities do so mainly for classroom based activities. However, ICT facilities are mostly needed in the area of investigating science concepts and ideas in the laboratories to enhance clarification of concepts and ideas.

The study established positive relationships among location of ICT access, degree of ICT accessibility and ICT use by science teachers in FUSs in Nigeria. However, location of ICT access and degree of ICT accessibility are jointly responsible for 25.6% of the total variance in ICT use. Provision of access to ICT facilities in an easily accessible location is a necessary ingredient for higher level of ICT accessibility and use of ICT by science teachers in FUSs. Inadequate provision of relevant and useful ICT facilities within the easy reach of teachers may hinder the use of such facilities by the teachers. In other words, the location of ICT access point

within the schools premises such as specialised classroom/laboratory and/or school library media centres would facilitate use of ICT by teachers.

The following recommendations were made based on the findings of the study:

1. Provision should be made for access to ICT facilities within the school environment to guarantee ease of locating and accessing them by the teachers.
2. The school management and government should ensure the provision of latest relevant technologies that would enhance effective teaching and learning in FUSs. This would enable the teachers to use the technologies in meeting the different learning styles of the students.
3. Government should also make provision for science-based ICT applications such as simulations, modeling, and graphic visualizing tools that do make teaching meaningful and real. Science-based ICT applications ensure the replacement of the abstract nature of teaching that characterized traditional teaching with meaningful and real teaching.
4. Science teachers should endeavour to use ICT facilities for laboratory-based and experimentation activities.

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