Integrating Information and Communication Technology (ICT) into Senior Secondary Physics Education in the Context of Educational Reforms: The Journey So Far

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Abstract

The study investigated the extent of integrating Information and Communication Technology (ICT) into senior secondary Physics education in the context of educational reforms. Simple random sampling technique was used to draw eighty (80) Physics teachers from forty (40) purposively selected secondary schools in Uyo Senatorial District of Akwa Ibom State to participate in the study. ICT Resources Availability Questionnaire (ICTRAQ) and ICT Competence Check List (ICTCL) were used for data collection. Percentage analysis of data revealed that: Overall, a paltry 27.5% of modern ICT resources were available; overall, a colossal 85.0% of physics teachers lacked basic ICT competence; overall, a staggering 96.2% of Physics teachers lacked didactical ICT competence. It was therefore concluded that, in the face of lack of basic and didactical ICT competence among Physics teachers, the Physics teachers in Uyo Senatorial District of Akwa Ibom State are not yet ready to integrate modern ICT, and hence unprepared to incite any meaningful reforms into senior secondary Physics education. It was recommended that: All Nigerian secondary schools should be adequately equipped with relevant and appropriate modern ICT resources; follow-up mechanisms should be put in place to ensure implementation of government policy to incorporate modern ICT into the teaching and learning of senior secondary Physics.

Quick (1995) defined reform as a change made to a system or organization in order to improve it. To Wikipedia, the Free Encyclopedia, educational reform can broadly be construed to mean the change in the way individuals are exposed to information. According to Webster's Universal Dictionary and Thesaurus (2005), 'to reform' is to improve or transform, especially an institution. Synthesizing these three

definitions, educational reform can be construed to mean a restructuring, rebranding or repositioning of some internal elements or critical issues resulting in a re-organized combination and utilization of people, materials, facilities, equipment and procedures, to better achieve the desired educational objectives or lofty ideals.

The Need for the Reforms

It is irrefutable that our education sector is in a state of crisis that manifests in various forms, including poor/inadequate facilities/resources, production of half-baked graduates, ill-equipped and poorly-motivated teachers, abysmal performance of our children in public examinations, perpetration of exam malpractices by virtually all stakeholders in education industry (Udoh, 2009). Investment in education appears not to have yielded the expected results. So there is a serious need for reforms in order to achieve a turn-around in the education sector.

The Federal Republic of Nigeria (2004) believes in an educational system that:

1. Provides **access** to **quality** education for all, regardless of gender, ethnic, social background and geographical location.
2. Develops the individual into a social and **effective** citizen.
3. Is **relevant** in terms of identifying, developing and responding to individual needs, talents and aspirations.
4. Is **sustainable**, providing life-long opportunities, in terms of being relevant to the 21st century and needs of the Nigerian economy.

This belief will translate into the Millennium Development Goals (MDG) formula Access + Quality + Effectiveness + Relevance = Sustainable Opportunity

The Current Reforms

The Federal Ministry of Education has undertaken several reforms in the education sector. Significant among these include: a change from a 4-tier, 6-3-3-4 system of education to a 3-tier, 9-3-4 system. The former system caters for 6 years of primary education, 3 years of junior secondary, 3 years of senior secondary and 4 years of University education. The latter (9-3-4) system is a new innovation trend in Nigerian education system programmed to be: 9 years of free and compulsory education (comprising 6 years of primary education and 3 years of junior secondary education), a 3-year (senior) secondary education and a 4-year university education.

Modern education reforms are increasingly driven by a growing understanding of what works best in education and how to go about successfully improving teaching and learning, setting new bench-marks, that conform with global best practices in educational affairs. There is an effective deployment of ICT in both teaching and learning worldwide. The development and deployment of e-learning at

the senior secondary level is part of the reform put in place by Nigeria. Capacity-building, in the area of computer appreciation for senior secondary teachers is an integral part of the reform agenda.

Information and communication technology have a direct role to play in education and if appropriately used, can bring many benefits to the education sector (Government of Kenya, 2005). In recognition of the prominent role of ICT in advancing knowledge and skills necessary for effective functioning in the modern world, the Federal Republic of Nigeria (2004) adduced that there is the need to integrate ICT into education in Nigeria. Modern ICT is used for solving educational problems, creation of wealth, poverty eradication, job creation and global competitiveness. Critical thinking, information handling skills, high level conceptualization, better problem solving, have been added as factors that are important for effective learning using ICT resources (Olele, 2008), particularly in Physics education.

Regan (2008) attesting to the profitability of the use of ICT in Physics posited that: ICT makes Physics more interesting, more enjoyable and relevant to students everyday lives; stimulates students and helps them to understand difficult concepts and become more creative; students acquire a variety of different skills when taught using ICT tools.

In the context of educational reforms, ICT Physics classrooms are expected to be equipped with computers, instructional softwares, electronic references, LCD projectors, video players, television sets, etcetera. Policy makers expect that the introduction of ICT into formal education settings will improve Physics education outcomes. Contrary to expectation, Akwa Ibom State teachers seem imperceptibly slow to adopt ICT as integral tool within the classroom. Several reasons for this lethargy have been purported in literature (Akpabio, 2005; Ochoyi and Ukwumonu, 2008; Olele, 2008). These include: unreliable power supply, prohibitive cost of obtaining/maintaining computers, paucity of relevant softwares and quick damage or spoilage of information system. Others are: acute shortage of trained personnels in application softwares, operating system, network administration and local technicians to service and repair computer facilities; paucity of ICT teachers, in-service program of good quality; and long duration of training required for full utilization of computers.

There is yet a major determinant of ICT integration into Physics education. Oliver and Shapiro (1993) identified self-efficacy as a major predictor of innovation (Rogers, 1995). According to Moerseh (2001), the implementation of ICT could be related to a teacher's self-efficacy. Self-efficacy theory, as proposed by Bandura

(1997) suggests that individuals with a low level of self-efficacy will often choose a level of innovation that they believe they can handle, which might not be the best or most effective option. Conversely, those individuals with high levels of self-efficacy are most inclined to accept change and choose the best option. The implication of this theory is that the Physics teacher must be ICT competent to accept the change and properly guide the students under the new dispensation.

Two levels of ICT competence have been accentuated, viz: basic and didactical ICT competence.

Basic ICT Competence

The basic ICT abilities underlie the core ICT usage; and consist of computer literacy, knowledge, information and skills to operate the acquired data, knowledge of law and appropriate moral attitudes (Shapiro & Hughes, 1996; Morkauskaibe, 1999). Basic competence comprises ability to use and manipulate ICT, be informationally literate and knowledgeable about how to apply social, ethnical and legal issues concerning ICT (Peciuliauskiene and Barkauskaite, 2007).

Didactical (Educational) ICT Competence

These are the extended abilities which fulfill the basic ones and cover knowledge and skills necessary to rationally apply information technology to different fields of sciences, culture and social life (Shapiro & Hughes, 1996; Markauskaite, 1999). Educational ICT Competence covers the ability to apply ICT in educational practices and to develop learners computer literacy including ability to plan, operate and analyse the processes of applying ICT (Peciuliauskiene and Barkauskaite, 2007).

Scrutinizing the afore going factors of ICT integration by placing them on the continuum of importance range 0 to 1, within the context of educational reforms, an interesting scenario is discernible: level of availability of ICT resources and teacher's ICT competence (basic and didactical), will compete to fall at 1 or nearly so. The implicit implication of this reality is that these two factors (level of availability of ICT resources and competent ICT teachers) conspire to promote or deter ICT integration into Physics curriculum delivery (as the case may be); and hence the current strategic reforms agenda in senior secondary Physics education. This implication motivated this research study against the backdrop of our serious educational crisis with its attendant poor performance in senior secondary Physics.

Research Questions

To guide the research study, the following research questions were posed:

1. To what extent are the relevant ICT resources available to incite the needed reforms in senior secondary Physics education?

2. What is the level of the basic ICT competence of Physics teachers in the context of the current reforms in senior secondary Physics education?
3. What is the level of didactical ICT competence of Physics teachers in the context of the current reforms in senior secondary Physics education?

Research Design, Population and Sample Size

Survey research design was adopted for the study. All the estimated 120 professionally trained, secondary school Physics teachers in Uyo Senatorial District of Akwa Ibom State constituted the population of the study. Simple random sampling technique was used to obtain a sample size of eighty (80) Physics teachers from forty (40) purposively selected secondary schools in the Senatorial District to participate in the study.

Research Instruments

The instruments used for the study were: ICT Resources Availability Questionnaire (ICTRAQ) and ICT Competence Check List (ICTCL). The ICTRAQ and ICTCL were constructed by the researcher and validated by two university lecturers (one lecturer is an expert in Physics education while the other is an expert in Information Technology). The research instruments were administered on the respondents by the researcher, with the aid of a research assistant.

To evaluate the level of availability of ICT resources, frequency counts of teachers reporting the research availability were converted to percentage availability. To evaluate the ICT competence of Physics teachers, frequency count were taken of Physics teachers responding on a 4-point Check List of: Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). Data analysis was based on "Strongly Agree "and "Agree" categorized as 'Agree'; while "Disgree" and "Strongly Disagree" were categorized as "Disagree".

Results

The results of data analysis are presented in tables below.

Table 1: ICT Resources in Uyo Senatorial District, N = 80

S/N	ICT Resources	Availability	
		Available	**Not Available**
1.	Computers	76.0 (95.0)	4.0 (5.0)
2.	Internet facility	Nil (Nil)	80.0 (100.0)

3.	CD-Rom	Nil (Nil)	80.0 (100.0)
4.	Computer software Programmes	Nil (Nil)	80.0 (100.0)
5.	Uninterrupted Power Supply (UPS)	66.0 (82.5)	14.0 (17.5)
6.	Support staff in the form ofcomputer maintenance/servicing staff	Nil (Nil)	80.0 (100.0)
7.	Computer printing machine	76.0 (95.0)	4.0 (5.0)
8.	LCD Projector	3.0 (3.75)	77.0 (96.25)
9.	Computer laboratory	5.0 (6.25)	75.0 (93.75)
10.	Qualified computer teacher (with B.Sc. or HND in computer studies)	5.0 (6.25)	75.0 (92.5)
11.	Experienced computer teacher (having at least 3 years of experience)	5.0 (6.25)	75.0 (93.75)
	Overall	22.0 (27.5)	58.0 (72.5)

* values in brackets are percentage values

Table 1 reveals three ICT resources which could be adjudged satisfactorily available. These are: computers (95.0% available), UPS (82.0% available) and computer printing machine (95.0% available). Otherwise, ICT resources, including qualified and experienced ICT teachers were virtually not available. Overall, an unimpressive percentage (27.5%) availability of ICT resources is revealed.

Table 2: Basic ICT Competence of Physics Teachers, N = 80.

S/N	Basic ICT Competence	Teachers' Responses SA	A	D	SA
	I …..				
1.	am knowledgeable in social, ethical and legal issues concerning ICT	2.0 (2.5)	10.0 (12.5)	60.0 (75.0)	8.0 (10.0)
2.	am computer literate	10.0 (12.5)	10.0 (12.5)	35.0 (43.75)	25.0 (31.25)
3.	have appropriate ICT moral attitude	4.0 (5.0)	6.0 (7.5)	42.0 (52.5)	28.0 (35.0)
4.	can use the internet for the purpose of educational material	10.0 (12.5)	12.0 (15.0)	30.0 (37.5)	28.0 (35.0)
5.	can use the internet for effective communication	2.0 (2.5)	8.0 (10.0)	40.0 (50.0)	30.0 (37.5)
6.	create personal websites on the internet	Nil (Nil)	Nil (Nil)	50.0 (62.5	30.0 (37.5)
	Overall		12. 0 (15.0)		68.0 (85.0)

* values in brackets are percentage values

Data in table 2 reveals a sorry percentage (27.5%) competence among Physics teachers in the use of internet for the purpose of educational material; and a paltry 25.0% computer literacy; otherwise basic ICT competence of physics teachers in Uyo Senatorial District of Akwa Ibom State is virtually nil.

Table 3: Didactical ICT Competence of Physics Teachers, N = 80

S/N	Didactical ICT Competence	Teachers' Responses SA	A	D	SA
1.	I can ….. use educational Software	Nil (Nil)	Nil (Nil)	65.0 (81.25	15.0 (18.75)

2.	use internet in the classroom	Nil (Nil)	Nil (Nil)	45.0 (56.25)	35.0 (43.75)
3.	use enriched ICT learning environments in the classroom (Multimedia, hypertext)	Nil (Nil)	Nil (Nil)	10.0 (12.5)	70.0 (87.5)
4.	apply ICT to evaluate students achievement	4.0 (5.0)	8.0 (10.0)	45.0 (56.25)	23.0 (28.75)
	Overall		3.0 (3.75)		77.0 (96.25)

* values in brackets are percentage values

Data in table 3 reveals a meager (15.0%) ability to apply ICT to evaluate student's achievement; otherwise, didactical ICT competence of Physics teachers in Uyo Senatorial District of Akwa Ibom State is nil.

Discussion of Findings

Data in table 1 reveals that modern ICT resources such as internet facility, computer software programme, qualified and experienced ICT Physics teachers, including support staff are (virtually) not available in schools. This research finding is supported by Ochoyi and Ukwumonu's (2008) research report of (i) lack of relevant and appropriate software as a bottle neck obstructing application of computer in schools (ii) lack of human skills and knowledge to fully intergrate ICT into secondary education (iii) acute shortage of trained personnel in application software, operating system, network administration and local technicians to service and repair computer facilities.

Table 2 reveals that a colossal percentage (85.0) of the Physics teachers are without the basic ICT competence. This is comparable to Peciuliauskiene and Barkauskaile's (2007) two- fold research report, viz: (i) that would be teachers manage to implement the basic ICT competence (ii) that nearly all the surveyed respondents neither produced educational soft ware (95.8%) nor create personal website (97.0%). This is consistent with Ball *et al.* (1987) research finding that nearly three-quarters of the secondary school mathematics teachers use computers either rarely or never at their work. This implies that although computers are (95.0%) available in almost all the schools under investigation (Table 1), these computers are merely used to advertise or promote such schools.

Data in table 3 reveals that a staggering percentage (96.2%) of Physics teachers are without didactical ICT competence. This research finding is in consonance with Peciuliauskiene and Barkauskaile's (2007) research finding which showed that: more than a half of the surveyed participants missed an opportunity of using educational software (54.8%), the internet (63.1%) and enriched environment (71.1%) in the classroom.

Summary/Conclusion

So far, the extent of integration of modern ICT into senior secondary Physics education is minimal (if any), uncoordinated and lacking in innovation. In the face of lack of basic and didactical ICT competence among senior secondary Physics teachers, coupled with non-availability of modern ICT resources, the Physics teachers in Uyo Senatorial District of Akwa Ibom State are not yet ready to integrate modern ICT, and hence not prepared to incite any meaningful reforms, into senior secondary Physics education.

Recommendations

Arising from the findings of the study, the following recommendations are made.

(i) All Nigerian secondary schools should be adequately equipped with relevant and appropriate modern ICT resources.

(ii) The use of modern ICT for instructional delivery should be incorporated into teacher training programmes of pre-service and in-service Physics teachers.

(iii) Follow-up mechanisms should be put in place to ensure implementation of government policy to incorporate modern ICT into the teaching and learning of senior secondary Physics.

(iv) Physics teachers should be part of the decision-making process with respect to the implementation of ICT innovations in schools so that they may be committed to innovation with conviction.

(v) As a precondition to incite reform in senior secondary Physics education, every senior secondary Physics student and teacher should be assisted to own a laptop computer. This will motivate and quicken their readiness to integrate modern ICT into senior secondary Physics education.

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