The Conditions and Level of ICT Integration in Science and Technology Classrooms in Nigerian Junior and Senior Secondary Schools in Lagos State, Nigeria.

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Abstract
The study addressed how ICT was being integrated in science and technology classrooms in Nigerian junior and senior secondary schools at four levels: Exploration, Experimentation, Adoption, and Integration. The study utilized Kotrlik Pierson’s model of technology integration and Rogers’ technology diffusion model. It attempts to describe the conditions that facilitated the implementation of Information Communication Technology (ICT) integration in science and technology classrooms in Nigerian junior and senior secondary schools and the problems that emerge during the process of integration. A focus group consisting of fifty secondary school teachers was interviewed. Based on data analysis, it was revealed that the participants employed three major levels of approaches in integrating ICT in the schools. Time, level of competency, poor infrastructure, and lack of technical support were found to be the main problems that the teachers faced in the utilisation of ICT in teaching.

Key words: Information Communication ICT, teaching and learning process, Junior and Senior Secondary Schools in Lagos State, exploration, experimentation, adoption, and integration.

Introduction
Technology is changing the way we teach and learn more rapidly than ever before. The integration of Information and Communication Technology (ICT) into the teaching and learning process has lead to a higher level of learning around the world. ICT helps in providing opportunities for students to learn meaningfully and for teachers to teach effectively. Pierson (1999) defined technology integration as teachers utilizing content and technological and pedagogical expertise effectively for the benefit of students' learning. Technology integration means application of an instructional tool for delivering subject matter in the curriculum already in place.

Many studies on the integration of ICT in secondary schools in Nigeria have revealed positive outcomes; for instance, Oyelekan and Olorundare (2009) carried out a study to develop and validate a computer instructional package on electrochemistry for secondary schools in Nigeria. Their study was based on the theoretical foundations of instructional design as provided by the Dick, Carey, and Carey, (2005) model and the social constructivist learning theory. They found that the package was found to produce a very good performance level in the students when used for electrochemistry instruction.

Also, Olalere (2005) investigated teachers' perceived self-efficacy in the implementation of computer education in Nigerian secondary schools and also examined the influence of gender on teachers' perceived self-efficacy. In his study, one hundred and sixty-one male
and 148 female teachers were asked to indicate their experience and level of proficiency in the use of computers. Percentage analysis indicated that over 60% of male and female teachers do not have minimum experience in the use of computers, in basic computer operations, and in the use of application software. Chi-square analysis indicated no significant difference between male and female teachers’ competence in the use of computers, basic computer operations, and in the use of application software.

Statement of the Problem
Technology integration in the classroom promotes learning in both informal and formal settings, thereby building the connections that cause out-of-the-classroom experiences to contribute to in-the-classroom achievement. According to the Office of Technology Assessment’s 1995 report on teachers and technology, schools have made significant progress in implementing technology and helping teachers to use basic technology tools, but they still struggle with integrating technology into the curriculum. “Curriculum integration is central if technology is to become a truly effective educational resource, yet integration is a difficult, time consuming, and resource-intensive endeavor”. Even though many studies (Bailey, (1997); Kotrlik, & Redmann, (2002) have been conducted about how teachers use ICT in the classrooms, few studies have been conducted on how teachers are integrating ICT in the teaching and learning process. It is critical to ensure that ICT integration achieves its maximum level of effectiveness and impact. Hence the need for a comprehensive study on the subject with a focus on conditions and level of ICT integration in our junior and senior secondary schools.

Theoretical Framework
The study utilized the four levels of Kotrlik Pierson’s model of technology integration (Kotrlik & Redmann, 2002) and Rogers’ technology diffusion model (1995). The four levels of Kotrlik Pierson’s model are summarised below:

1. Exploration - Teachers seek to learn about presentation software and how to do a few instructional exercises using spreadsheets, databases, word processors, games, simulations, the Internet, and/or other computer tools.
2. Experimentation - The use of technology is becoming obvious in the in classrooms and laboratories as teachers focus more on using technology in instruction by presenting information using presentation software and doing a few instructional exercises using spreadsheets, databases, word processors, games, simulations, the Internet, and/or other computer tools.
3. Adoption - Teachers begin to use technology regularly. Physical changes are very evident in the classroom and/or laboratory with the computers becoming a focal point in the classroom and/or laboratory organization. Teachers employ ICT tools as a regular and normal feature of instructional activities while student shared responsibility for learning emerges as a major instructional theme. Rogers’ technology diffusion model was also used to explore how the teachers adopt technology. Rogers (1995) defined diffusion as “the process by which an innovation is communicated through certain channels over time among the members of a social system”. An innovation is “an idea, practice, or object that is perceived as new by an individual or other unit of adoption”. Rogers’ rate of adoption model, most applicable to this study, states that innovations are diffused over time in a
pattern that resembles an S-shaped curve. An innovation goes through a period of slow, gradual growth before experiencing a period of relatively dramatic growth. Rogers established that individuals could be divided into innovation adopter types: innovators, early adopters, early majority, late majority, and laggards. He then specified that the early adopters are the key players in bringing the innovation to the point of being self-sustaining.

4) Advanced Integration - Teachers begin to use technology innovatively as they pursue innovative ways to use technology to improve learning. Students also take on new challenges beyond traditional assignments and activities. Learners use technology to collaborate with others from various disciplines to gather and analyze information for student learning projects.

Purpose
The purpose of this study was to explore how ICT was being integrated in the teaching and learning process in Junior and Senior Secondary Schools in Lagos State at four levels: exploration, experimentation, adoption, and integration.

Research Questions
1. What activities indicate that teachers have been exploring the use of ICT in the classroom?
2. What activities indicate that teachers have been experimenting the use of ICT in the classroom?
3. To what extent have the teachers been adopting the use of ICT in the classroom?
4. To what extent have the teachers been integrating the use of ICT in the classroom?

Methodology
The study adopts phenomenographic research approach. This approach involves “the empirical study of the differing ways in which people experience, perceive, apprehend, understand and conceptualise various aspects of the world around us” (Marton, 1994). The approach emerged from the question of why some people are better learners than others and involves an understanding of the distinction between “what” people understand and “how” they understand it (Marton & Dalghren, 1976). This method enables us to identify how ICT was being integrated in the teaching and learning process in junior and senior secondary schools in Lagos State at four levels: exploration, experimentation, adoption, and integration.

Sample and Sampling Technique
The study covered five secondary schools in Lagos state. These schools were selected for a number of reasons. Firstly, they have computer education in their curriculum. There are computers in all the schools with the least of being one in a school. One of the schools has 15 and another 12. They all have rooms designated as computer laboratories. Secondly, the schools are equivalent in human and materials resources and thirdly majority of the students come from the low income group.
From these five schools a stratified random sampling was adopted to select 50 science and technology teachers used for the study. They comprised 20 male and 30 female teachers. All of them are university graduates with either a B.SC or B.SC(Ed) degree. Their years of experience range between 3-20 years. Some either possess some or are enrolled in a master's degree programme. They have all been exposed to the use of ICT in their undergraduate and postgraduate studies.

**Data Collection**
A focused group interview was employed to collect information for the study. The selected teachers in each of the five schools were assembled in a convenient room. The researchers wrote the bio-data of each respondent and proceeded to ask the questions as outlined in the interview guide. Each respondent was given the opportunity to respond to the question as it implies to him or her. Their responses were recorded as summarized in the data analysis section.

**Data Analysis**
The transcripts of 50 semi-structured, open-ended interviews with a group of secondary school teachers were combined to form a pool of decontextualized statements about learning technologies. Also, frequency count of the subjects' responses to each questionnaire item was carried out in the analysis. The percentages of responses to each of the options were then calculated as shown in Tables 1 and 2. The statements were analyzed using a phenomenographic research approach. A limited number of qualitatively different insight of the conditions and level of ICT integration in Nigerian junior and senior secondary schools in Lagos state were identified. The insight varied with respect to ICT exploration, experimentation, adoption, and integration. The “exploration component concerned how teachers have been exploring the use of ICT in the classroom; experimentation concerned how they have been experimenting the use of ICT in the classroom. Also, the adoption component emphasised the use of ICT as a learning tool in the classroom, while integration component focused on activities that show how they have been integrating the use of ICT in the classrooms.

**Results**
Four questions were asked during the interview of the teachers. The responses are stated below.
Research Question 1 - What activities indicate that teachers have been exploring the use of ICT in the classroom? Table 1 presents the relevant data:

<table>
<thead>
<tr>
<th>Responses</th>
<th>%</th>
</tr>
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<tbody>
<tr>
<td>The use of the Internet for information gathering</td>
<td>60</td>
</tr>
<tr>
<td>Typing Documents</td>
<td>4</td>
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</tbody>
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Showing of pictures of tools, machines not available in schools in the teaching of intro tech, agric science and biology classes 14
Display of geographical features that cannot be found within the locality 2
Has not been exploring the use of ICT 20
Planning to take courses or attend trainings to learn how to use ICT 100

With the same question (What activities indicate that you have been exploring the use of ICT in the classroom?), most of the participants answered as stated below:
“I use the Internet for information gathering”
“I use it for typing documents”
“I use it to show pictures of tools, machines not available in schools in the teaching of intro tech, agric science and biology classes”
“I use it to display geographical features that cannot be found within the locality”
“I have not been exploring the use of ICT”
“I am planning to take courses or attend trainings to learn how to use ICT”
“I have talked recently to my principal and fellow teachers about using ICT to enhance instruction several times”

Research Question 2 - What activities indicate that teachers have been experimenting with the use of ICT in the classroom?

Table 2: Teachers response on Experimenting with the Use of ICT in the Classroom

<table>
<thead>
<tr>
<th>Responses</th>
<th>%</th>
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<tbody>
<tr>
<td>Getting information from the internet to use in teaching</td>
<td>80</td>
</tr>
<tr>
<td>Teaching students how to type in business studies</td>
<td>50</td>
</tr>
<tr>
<td>Showing of pictures of tools, machines not available in schools in the teaching of intro tech, agric science and biology classes</td>
<td>14</td>
</tr>
<tr>
<td>Display of geographical features that cannot be found within the locality</td>
<td>4</td>
</tr>
<tr>
<td>Not been experimenting the use of ICT</td>
<td>20</td>
</tr>
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About 80% of the participants indicated that they have actually been using ICT for a long period while 20% of them have not been using ICT for teaching and learning. Fifty percent also indicated that they use computer for assignment, 4% use Projectors and PowerPoint to teach French and Chemistry, 8% use CD on related topics in teaching of Biology and Agric Science, and 40% use the Internet for assignment.

When research question 2 was asked, most of the participants also answered as stated below:
“I use ICT to get information from the internet to use in teaching”
“For teaching students how to type in business studies”
“For showing of pictures of tools, machines not available in schools in the teaching of intro tech, agric science and biology classes”
“To display geographical features that cannot be found within the locality”
‘I emphasized the use of ICT as a learning tool in the classroom and the laboratory”
“I occasionally assign students to use the computer to do content related activities on a regular basis”

Research Question 3 - To what extent have the teachers been adopting the use of ICT in the classroom?
“ICT were adopted in some areas, but not in all topics; we often use computer in typing of documents, storing information, and in browsing on the Internet”
“We use the Internet to download information for research purposes”
“We browse on the Internet for information”
“Typing of documents (business studies), assignments to be done by students and printed out, speech work, words and spelling in English language”.

Research Question 4 - To what extent have the teachers been integrating the use of ICT in the classroom?
When asked of the activities that indicate the teachers have been integrating the use of ICT in the classroom, majority of the participants (75%) indicated they have not been integrating ICT in the classroom. However, 25% indicated that, they have integrated ICT by having group discussions on discovery of students’ outcome from using the Internet and by giving assignments to students to do on the Internet.
When asked further the reasons for lack of integration of ICT in teaching, most of the participants indicated lack of time, level of competency, poor infrastructure, and lack of technical supports were the main problems that they faced in utilizing of ICT in teaching.

Conclusions
The study addressed how technology was being integrated in the teaching/learning process for four distinct and independent phases - exploration, experimentation, adoption, and integration. The phases in which teachers in secondary schools are most active are exploration of the potential of using technology in the teaching/learning process, and experimenting technology for use in instruction; however, they are functioning at a moderate level in both phases. Rogers innovation attributes help to explain teachers’ different rate of adoption in the study; the use of ICT in the classroom will get better as time goes on. They are not very active in the adoption and integration stages. The reasons for these may be attributed to problems that the teachers faced during the process of integrating ICT in the schools. Also, according to Roger (1995), an innovation goes through a period of slow, gradual growth before experiencing a period of relatively dramatic growth. Some of the problems are attributed to poor ICT infrastructures in the schools, lack of basic ICT knowledge and irrelevancy of course content and technical malfunction.

Recommendations
The conclusions revealed that more needs to be done to encourage and support teachers in the integration of technology in the teaching/learning process. Additional research on factors related to technology integration in the teaching/learning process is needed. This
recommendation for further study certainly includes research to determine whether
teachers are being adequately prepared by teacher education institutions to integrate
technology in the teaching/learning process.
To effectively harness the power of ICT and integrate properly the following important
conditions must be met:
1. There must be sufficient access to the Internet and other digital tools in the
classroom. The cost of using the Internet it too expensive as many students and
teachers have to go to the cafes to do their work
2. Knowledge, skills, and abilities to use the ICT in teaching and learning must be
improved.
3. Resources must be provided for both teachers and students.

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Appendix (Interview Guide)

Exploration
1. What activities indicate that you have been exploring the use of ICT in the classroom?
2. Are you planning to take courses/attend trainings to learn how to use ICT in the teaching/learning process?
3. Have you talked recently to your principal or fellow teachers about using ICT to enhance instruction?

Experimentation
1. What activities indicate that you have been experimenting the use of ICT in the classroom?
2. Does this statement describe you, “I am just beginning to use instructional exercises that require students to use ICT”.
3. If so, can you tell us some of the instructional exercises that require students to use ICT at school?

Adoption
1. What activities indicate that you have been adopting the use of ICT in the classroom?
2. Do you emphasize the use of ICT as a learning tool in the classroom or laboratory? If so, explain some of the usage.
3. Do you assign students to use the computer to do content related activities on a regular basis? If so, give some examples.

Integration
1. What activities indicate that you have been integrating the use of ICT in the classroom?
2. Do you encourage students to design their own technology-based learning activities? Give some examples.
3. Do you incorporate ICT in your teaching to such an extent that your students use ICT to collaborate with individuals at other classes, schools, states or countries, etc?