

Impact of Information and Communication Technology on Teaching and Learning of Science Subjects in Nigeria

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Abstract: *The assumption is that incorporating ICT into teaching and learning processes will aid teaching and learning processes. The aim is to ensure that teaching learning is reversed from highly teacher dominated to student instruction. Unfortunately, there is very limited, unequivocally compelling data to support this belief. As a result, the purpose of this study was to look into the impact of Information and Communication Technology in science subjects teaching and learning in secondary schools in Nigeria. To achieve this, the researchers designed and administered a structured questionnaire to teachers from the three senatorial districts of Ondo State, Nigeria. A multistage sampling technique; which involved simple random and purposive sampling methods was used to select the sample for the study. The study was directed by three research questions and three research hypotheses. The hypotheses were validated using the Pearson Product Moment correlation statistic at 0.05 significant level; using SPSS version 20 while the research questions formulated were assessed using frequency counts and percentages. The result of the study showed that if ICT are used for teaching and learning both teachers and students will perform efficiently.*

Key Word: *Teaching, Learning, ICT, student, Impact*

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I. Background:

For many industries around the world, including education, Information and Communication Technology (ICT) has become an essential source of innovation and efficiency improvement. In the education sector, the use of ICT both inside and outside the classroom has become a significant aspect of the teaching and learning processes for both students and teachers.

People have created numerous strategies for communicating their thoughts, wants, and wishes to others since ancient times. People used to congratulate one another in geographically limited clusters in which communication was properly achieved by vocal and written communications in early civilized times. Smoke signals, carrier pigeons, and other long-distance communication systems were tried as civilization spread across broader geographical areas. The usage of fire signals by Greeks in the eighth century B.C. for sending alerts, pleas for help, or announcements of particular occurrences was one of the earliest known optical linkages.

We are now living in an Information Age which is marked by the rapid adoption of new technologies (Holland, 2015). Information and Communication Technology (ICT) which is the forerunner of all the new technologies have influenced the way we live, communicate, socialize, learn or educate. As sciences include complex relationships of unfamiliar and abstract concepts, it is quite difficult to be taught and learned. Students often experience difficulty in understanding certain scientific concepts and try to learn them via memorization without understanding (Kilic & Salam, 2004). The application of ICT to the teaching abstract concepts can help understand such concepts better. Students can best improve their generic skills when they understand the concept of ICT and their teachers fully understand that ICT is most employers' expectations in this century (Adewumi M. *et al.*, 2017).

A survey in the Nigeria Education system has shown that learning becomes more interesting and lively through the use of multimedia equipment and wireless signals in classroom through active participation of learners in the learning process (PMID, 2013). It is especially important in the sciences as computers can present information virtually through well-prepared pictures, three-dimensional models, animations, interactive environments, etc (Wang Q., 2017).

The acts of Information and Communication Technology (ICT) include all automated means of teaching with the aid of computers and web-related resources. The age of automation and technology has added a vast array of instructional materials and media to conventional education. These new materials supplement the 'natural' contrivances of the educational profession and can substantially be instructional methods and

techniques. The need to integrate the use of ICTs into the teaching and learning of sciences has been the subject of a good deal of debate. In Nigeria, a relationship between ICT development and penetration and their use in the sciences is finally and gradually beginning to take hold. ICT is a broad phrase that refers to the act of creating, editing, storing, and transmitting data in various formats between humans and machines around the world, utilizing a variety of electronic technologies, to achieve a goal (be it recreational or otherwise) (Akanbi G.O, 2014). ICT has contributed a lot to change our everyday life such as letter to e-mail, market shopping to on-line shopping, classroom learning to e-learning and many others (Bosamia, 2018).

The study of science is very important in any educational system as no nation can ever develop without a solid background in science. Aniodoh (2012) defined science as a way of investigating a body of established knowledge. Educationists have become very concerned about the deteriorating standard of science education in our secondary schools and there is a tremendous loss of enthusiasm for the study of the sciences in Nigerian institutions of learning. This was backed up by the WAEC Chief Examiners Report (2014), which decried students' poor performance in senior secondary school certificate examinations in the sciences. Therefore, this calls for quick action and intervention for the proactive measure.

Science is knowledge gained via methodical and logical research in any branch of physical, chemical, or natural sciences, and is expressed as facts, principles, or hypotheses, to open up new fields of knowledge. It is the systematic pursuit and application of knowledge and understanding of the natural and social worlds using evidence-based methodologies. (Adewumi *et al.*, 2020) defined science as a subject that has an impact on our daily activities which can be seen as a tool that is important to both individuals and the nation as a whole to survive and to meet the global economic requirements.

Science as a subject in Nigeria secondary schools is categorized into three basic subjects; which are Biology, Chemistry and Physics. These subjects are very vital to the actualization of Nigeria as a nation and the emancipation of her great potentials.

Biology is the study of living beings, and it focuses on their structure, function, growth, evolution, and distribution. Biology is the study of a region's plant and animal life. Biology is referred to be a science of life, and it plays a critical part in the lives of all humans. It encompasses a wide range of disciplines, including zoology, botany, ecology, genetics, evolution, and sophisticated cell and molecular biology. Biology is incredibly significant in a student's life since it allows them to grasp the diversity of life forms and their interaction and exploitation through numerous biological disciplines. Chemistry is a discipline of science that studies the structure and properties of matter and substances, as well as human interaction. Chemistry is the feeling of attraction and affection between two people. Physics on the other hand is the branch of science that investigates matter's structure and interactions with the universe's fundamental ingredients. It uses quantum mechanics to study items as small as atoms and general relativity to study the entire universe.

Teachers are vital in the adoption and use of new technologies in the classroom. Their perceptions are an important aspect that influences their adoption of ICT in teaching and learning (Zhu, 2010) because teachers' educational beliefs are closely linked to their actual use of ICT in classrooms (Dwyer, Rin Tondeur, Valcke, & Van Braak, 2008). Olojuolawe & Amin, (2019) strengthen the usefulness of ICT by identified ICT as one of the constructs of employability skills that are needed to match Science students with the labour market. With this backdrop, this study aims to investigate the effects of integrating ICT into the teaching and learning of science subjects in Nigerian senior secondary schools.

Statement of the problem: The performance of students in science subjects at various levels of our education in the recent decade has been rapidly dropping; the trend shows there is speed downfall of performance in science subjects at all levels of academic institutions, particularly at the senior secondary school level. The high failure rate of students in science subjects continues to pose a great threat to stakeholders in the field of science education. Many researchers have attempted to proffer solutions to students' poor performance in science subjects at the senior secondary school level but no avail. This incessant downward trend in the performance of students in science subjects, if left unchecked may be heading towards a dangerous dimension as it may result in a shortage of science experts like doctors, engineers, and teachers.

Based on the identified research gaps and the problem description, it is thought that further research into the use of ICT in teaching and learning, as well as its impact on student performance, is required. In this regard, this study thoroughly examined the way and the extent to which Nigerian schools have adopted the use of ICT, as well as how the adoption of ICT has impacted students' performance. Therefore, this study sought to investigate if the use of ICT for teaching and learning science subjects would have a significant impact on students' performance in secondary school science in Nigeria.

Purpose of the study: Although most schools that have implemented ICT for teaching and learning have seen significant progress in terms of improving learning methods, teaching, research, and development. However, it is unclear what effect ICT applications have on students' performance and achievement. Numerous researches

have been conducted to investigate the relationship between ICT and students' performance; however, none of these studies have been able to pinpoint the exact impact of ICT on students' performance.

The purpose of this study, therefore, is to examine the impact of ICT's effective prospects and relevance of implementing a large-scale technological intervention in education and the aspect of sciences in Ondo state. For this purpose, this research work investigated the impact of ICT in the effective teaching and learning of sciences in Ondo state's senior secondary schools. It also:

- i. Examined whether schools with available ICT facilities performed better in science subjects in Senior Secondary School Examinations (SSCE)
- ii. Determined whether the supply of ICT equipment was necessary for effective learning of Science Subjects

Research Objectives

This research seeks to meet the following research objectives in this study:

- (a) To evaluate the extent to which the schools have adopted ICT
- (b) To determine the relationship between ICT adoption and the performance of students in the sciences
- (c) To find out the impact of ICT adoption on schools, in general, and on students' performance in the sciences, in particular

Research hypotheses

The following hypotheses guided the study:

HO₁: There is no significant impact of ICT facilities on teaching and learning of Science Subjects in Senior Secondary Schools

HO₂: There is no significant impact of ICT facilities on Science Students' academic outcomes in Senior Secondary Schools

HO₃: There is no significant gender difference in the usage of ICT facilities on academic outcomes of Ondo State senior secondary school science students.

II. Literature Review:

The advent of ICT has provided our society with a vast array of new opportunities which has changed the way people think and approach their chores. ICT has made both developed and developing countries of the world witnessed significant changes in almost all facets of human endeavour. In Africa for example, the use of ICTs in sectors such as banking, insurance, travel, health, education and others has witnessed a dramatic increase. The introduction of ICT into teaching and learning has brought a lot of innovation into the field of education. The application of ICT in education allows students and teachers to experience new ways of learning and teaching. It allows schools to ensure that students have access to curriculum materials while in the classroom and also ensure that students who are outside the classroom, such as home or hospitals, can learn. ICT tends to increase educational access. Learning may take place at any time and in any location when ICTs are involved. Teaching and learning are no longer solely dependent on printed materials or physical contacts between students and teachers, thanks to ICT. The use of ICT is growing increasingly popular as a result of several unprecedented happenings in our life.

There is a general idea that Information and Communication Technologies (ICTs) which can assist empower both instructors and students by shifting teaching and learning processes from primarily teacher-dominated to student-centered (Castro and Aleman 2011); and that this transition will lead to greater student learning gains by providing an opportunity for learners to enhance their creativity, problem-solving abilities, informational reasoning skills, communication skills, and other higher-order thinking capabilities.

Information and communication are the ultimate powers of technology. ICT is critical for social life, business, and the economy, as well as for educational growth, to fulfill the demands of today's information society (Aduwa Ogiegbaen & Iyamu, 2005). Its use by the teacher to teach the students is highly advantageous in that it enables them to exhibit an understanding of the opportunities and implications of using technology in the classroom; design, implement and manage learning and teaching in an open and flexible learning environment (UNESCO, 2014). According to Balasubramanian et al. (2009), employing ICT in education improves both the quality and quantity of education, while Adeosun (2010) believes that ICT improves greater innovation, creativity, cognitive thinking, as well as educational productivity and efficiency. It allows for individualized, flexible, and asynchronous learning, as well as a shift in learning from instructor to student, and so catalyzes classroom, educational institute, community, and system reforms (Youssef & Dahmani, 2008). In another study conducted by Adegbite (2017) on the analysis of the impact of ICT on the performance of students in Secondary Schools in Oyo State; Nigeria, it was found that the adoption of ICT in teaching students of secondary schools in Oyo state had a significant impact on the performance of students, as the entire statistic outcomes used for analysis in the study suggested positive significant effect on the impact of ICT in teaching the students. In a study on the effects of computer simulation package on Ekiti State senior secondary school science students' attitude in some science concepts conducted by Alake, Olojo & Abe (2018), it was found that

the developed simulation package had positive effects on students' attitude towards the learning of science concepts. The study also revealed that gender did not have any significant influence on both the experimental and control groups and consequently, it was recommended that teachers of science subjects in secondary schools should be trained on how to use the developed package. Similarly, Alake & Olojo (2020) found that the use of the Computer Simulation Package (CSP) improved the performance of students in some scientific concepts. Consequently, the researchers recommended that the usage of the designed package be incorporated into the school curriculum.

Despite the importance of ICT to the teaching and learning of the sciences, it has been observed that most science teachers have not integrated it into its usage in Nigerian secondary schools. This lack of integration of ICT into science teaching and learning is discouraging, resulting in low student morale and enthusiasm for science. This is because teachers embrace linguistic and theoretical techniques of teaching and understanding science, making it difficult to convey some scientific topics to students. If this problem is not addressed promptly, it may lead to a lack of interest in science on the part of students, resulting in poor performance in the disciplines and, as a result, the majority of students expressing interest in non-scientific subjects/courses. As a result, the researchers believe it is important to look into the use of ICT in the teaching and learning of sciences, as well as investigate the impact it has on students' performance. In this regard, this study thoroughly examined the way and amount to which Nigerian schools have adopted the use of ICT in the teaching and learning of sciences, as well as how the adoption of ICT has impacted students' performance.

III. Methodology:

This study employed the descriptive research design of survey type which investigated the impact of ICT on the academic outcomes of science students.

Descriptive survey research investigates certain facts concerning an existing phenomenon. Azuka (2013) described descriptive research as the study which reports things exactly the way they are systematical, to explain existence or non – existence on the present state of a phenomenon that is being investigated. This method is found to be appropriate for this study because the study intends to elicit responses from the respondents on their level of usage of ICT facilities for the teaching and learning of science subjects as well as the impact the usage has on the academic outcomes of students. The study also intended to investigate the disposition of science students in Ondo state senior secondary schools to ICT-driven lessons. Besides, the study intended to use the Pearson Product Moment statistic to test the research hypotheses generated.

The population of the study comprised all the science teachers in senior secondary schools in Ondo state. A multistage sampling approach was employed to select the subjects for the study. In the first instance, a random sampling method was used to select fifteen schools used for the study (five schools were selected from each of the three senatorial districts that make up the state). Thereafter, a purposive sampling approach was adopted to select science teachers from each of the schools already selected for the study. Finally, a random sampling procedure was used to select one hundred and fifty (150) teachers that were used for the study (ten teachers were chosen from each of the schools).

Research Instrument: The researchers constructed a well-structured questionnaire based on some perceived attributes of ICT usage for teaching and learning purposes; for data collection. The instrument was made up of two parts A and B. Section A consists of items aimed at eliciting information on the respondents' personal information; such as Name of School, Sex, State, Age – range, Highest Academic Qualification and year of Experience. Section B is made up of items arranged in a five-point Likert scale format of Strongly Agree (4), Agree (3), Disagree (2), Strongly Disagree (1) and Undecided (0) aimed at eliciting responses from the respondents on some perceived attributes of ICT usage for teaching and learning.

The validity of the instrument was ascertained by the use of both face and content validity approaches. These were determined by test and measurement experts from the Department of Science Education of the University of Education, Science and Technology, Ikere – Ekiti. The investigators also ensured that the instrument had construct validity and also reliable. This was achieved by using the Cronbach Alpha formula. The estimate was 0.85; an index that was considered to be high and significant enough for the study of this kind.

Data Analysis: The data gathered were analyzed using both descriptive and inferential statistics. Descriptively, the data were analyzed using frequency counts and percentages; while the Pearson Product Moment correlation analysis was used to test the hypotheses formulated at 0.05 significant level; using SPSS version 20

IV. Results:

There is no significant impact of ICT facilities on teaching and learning of Science Subjects in Senior Secondary Schools.

Table 1: Significant Impact of ICT Facilities on Teachinga Learning of Science Subjects

| | Construct | ICT Facilities | Teaching and Learning |
|-----------------------|-----------------------------------|----------------|-----------------------|
| ICT Facilities | Pearson Correlation | 1 | .094 |
| | Sig. (2-tailed) | | .254 |
| | Sum of Squares and Cross-products | 78.027 | 9.181 |
| | Covariance | .527 | .062 |
| | N | 149 | 149 |
| Teaching and Learning | Pearson Correlation | .094 | 1 |
| | Sig. (2-tailed) | .254 | |
| | Sum of Squares and Cross-products | 9.181 | 121.973 |
| | Covariance | .062 | .824 |
| | N | 149 | 149 |

Table 1 showed the correlation between ICT facilities and teaching and learning of science subjects in secondary schools. The table revealed that the calculated Pearson correlation significant value (0.094) which was less than the table value of 3.84 (at the 95% level of confidence) obtained for the responses on the impact of ICT facilities on teaching and learning of science subjects in secondary schools. However, the covariance for ICT facilities and teaching and learning was (0.527) and (0.824) respectively. This means that the hypothesis of no significant impact should not be upheld. This indicated that ICT facilities have a significant impact on the teaching and learning of science subjects in Nigerian secondary schools. This implied that ICT usage has a significant impact on the teaching and learning of science subjects in secondary schools.

Table 2: There is no significant impact of ICT facilities on Science Students’ academic Outcomes in Senior Secondary Schools

** . Correlation is significant at the 0.05 level (2-tailed).

Table 2: Significant Impact of ICT Facilities on Science Students’ Academic Outcomes

| | Construct | ICT Facilities | Academic Outcomes |
|-------------------|-----------------------------------|----------------|-------------------|
| Ict Facilities | Pearson Correlation | 1 | .555** |
| | Sig. (2-tailed) | | .000 |
| | Sum of Squares and Cross-products | 75.812 | 34.295 |
| | Covariance | .512 | .235 |
| | N | 149 | 149 |
| Academic Outcomes | Pearson Correlation | .555** | 1 |
| | Sig. (2-tailed) | .000 | |
| | Sum of Squares and Cross-products | 34.295 | 50.107 |
| | Covariance | .235 | .339 |
| | N | 149 | 149 |

Table 2 showed the correlation between ICT facilities and academic outcomes in secondary schools. From the table, it could be seen that the Pearson correlation value is (0.556) while the table value at the 95% level of confidence is (3.84). The covariance for ICT facilities and students’ academic outcomes is (0.512) and (0.339) respectively. Since the Pearson correlation calculated value is less than the table value, the hypothesis of no significant difference impact should not be upheld. This implied that ICT has a significant impact on students’ academic outcomes in science subjects in senior secondary schools.

Table 3: There is no significant gender difference in the usage of ICT facilities on academic outcomes of Ondo State senior secondary school science students

Table 3: Significant Gender Difference in the Usage of ICT Facilities on Academic Outcomes

| | Construct | Gender | Academic Outcomes |
|--------|-----------------------------------|--------|-------------------|
| Gender | Pearson Correlation | 1 | .190* |
| | Sig. (2-tailed) | | .020 |
| | Sum of Squares and Cross-products | 35.839 | 9.899 |
| | Covariance | .242 | .067 |

| | | | |
|--------------------------|-----------------------------------|-------|--------|
| | N | 149 | 149 |
| Academic Outcomes | Pearson Correlation | .190* | 1 |
| | Sig. (2-tailed) | .020 | |
| | Sum of Squares and Cross-products | 9.899 | 75.812 |
| | Covariance | .067 | .512 |
| | N | 149 | 149 |

*. Correlation is significant at the 0.05 level (2-tailed).

Table 6 revealed the correlation between gender differences in the usage of ICT facilities and students' academic outcomes in secondary schools. From the table, it could be seen that the Pearson correlation value is (0.190) while the table value at the 95% level of confidence is (3.84). The covariance for gender difference in the usage of ICT facilities and students' academic outcomes is (0.242) and (0.512) respectively. Since the Pearson correlation calculated value is less than the table value, the hypothesis of no significant difference impact should not be upheld. This implied that gender difference in the usage of ICT facilities has a significant impact on students' academic outcomes in science subjects in senior secondary schools.

V. Discussion of Findings:

The result of the study showed that Ondo State senior secondary science teachers believed that ICT facilities helped them teach better and also made their students learn more. The study also showed that female students could compete favourably with their male counterparts when ICT facilities are involved in teaching and learning processes. This means that students' performance is not a function of gender in an ICT-driven lesson. The study equally revealed that using ICT facilities for teaching and learning in Nigerian secondary schools would lead to a major positive impact on student's performance in the sciences. Also, the result showed that Ondo state science students were positively disposed to ICT-driven lessons. This means ICT usage for teaching and learning of sciences will ultimately lead to a better attitude and interest in ICT-driven lessons on the part of students.

The results of this study are in agreement with those of UNESCO (2014), Adebite(2017) and Balasubramanian et al. (2009) that found that employing ICT for teaching and learning improved both the quality and quantity of education. Besides, the results of the study also support those of Adeosun (2010) and Aishah and Zeema (2017) that believed that ICT improves greater innovation, creativity, cognitive thinking, as well as educational productivity and efficiency. The result is also in agreement with those of Alake, Olojo & Abe (2018) and Alake & Olojo (2020) who found that the developed simulation package had positive effects on students' attitude towards the learning of science concepts and also that gender did not have any significant influence on students' performance when ICT facilities were involved.

VI. Conclusion:

The findings of the study showed that Ondo state science teachers use ICT facilities for teaching and learning. The study also revealed that using ICT facilities for teaching and learning in Nigerian secondary schools leads to a major positive impact on student's performance in the sciences. Besides, the result showed that Ondo state science students were positively disposed to ICT-driven lessons and that female students could compete favourably with their male counterparts when ICT facilities are involved in the teaching and learning process.

VII. Recommendations:

Governments at various levels should provide ICT facilities to all senior secondary schools in Ondo State. Teachers in other subject areas in the state should be encouraged to adopt ICT usage in their teaching and learning processes. Secondary school students in the state should be introduced to basic ICT skills such as Ms Excel, Windows with file Management, and Photoshop, discussion forums and blogs and simple application of SPSS in computer courses.

ICT facilities should be fully integrated into the teaching and learning process at all levels of education in the state.

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