ICT Competence and Science Teachers' Instructional Effectiveness in Northern Cross River State, Nigeria

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Abstract: **The purpose of this study was to examine the influence of Information and Communication Technology (ICT) competence on science teachers' classroom instructional effectiveness using teachers in secondary schools in Northern Cross River State, Nigeria. To achieve research objectives, three hypotheses were formulated to guide the study. A random sample of 193 science teachers was selected using the multistage sampling technique from a total of 371 science teachers in public and private secondary schools in the area. Two well validated rating scales, the ICT Competence Inventory (ICI) with a reliability co-efficient of 0.91 and the Classroom Instructional Effectiveness Scale (CIES) with a Cronbach co-efficient of 0.84, were used to obtained data. The data were subjected to t-test analysis using the SPSS version 23.0. The results of the study revealed that the level of ICT competence among the science teachers was significantly below the expected minimum competency level. Majority of the teachers were not competent in ICT. Male science teachers were significantly higher in their mean ICT competence than their female counterparts while science teachers, who are ICT competent, were significantly more effective in their classroom instructional effectiveness than those who were not ICT competent. It was recommended amongst others that school proprietors, government and non-governmental organizations should initiate practical and realistic programmes towards the training of science teachers on ICT while special preference should be given to the female science teachers during such trainings as this will ultimately enhance their instructional effectiveness.**

Keywords**: Information, Communication, Technology, Competence, Instruction, Effectiveness.**

I. INTRODUCTION

Education is a platform for transmitting ideas, beliefs, values and skills. Be it formal or informal education, there is the existence of the teacher and the learners. The place of the teacher in education cannot be underestimated, neither can the role of the teacher be ignored. Therefore, the teacher is an important factor in the teaching-learning environment. Hence no education can rise above the quality of the teacher (Federal Republic of Nigeria, 2004; Chamyal, 2021).

The effectiveness of the teacher in delivery the needed instruction is manifested in the progress of the students in attaining the learned objectives evidenced by the performance. After all research evidences have shown positive correlation between teaching effectiveness and academic performance (Oviawe, 2016; Akiri & Ugborugbo, 2017, Akram, 2019).

The 21st century teacher is faced with the challenges of being ahead of the learners. With the innovation and sophistication in technology, the need to cope up with technological advancement; the use, acquisition of skills needed, the need for transmission of content occasioned by the new normal, and the challenges of the digital revolution in the information and communication age has placed the necessary burden on the 21st century teacher to expand the frontiers of competence beyond the specialized subject area. Therefore, for the teacher to do his work diligently and assure good results, he must be versatile with the new technologies that would help him to be effective.

Teacher effectiveness is a *sine qua non* to school effectiveness. The provision of school facilities, structure, curriculum and good textbooks does not guarantee effective learning if the teacher is not effective in content delivery. Teacher effectiveness have been variously conceived; however, researchers have not come to consensus on its actual meaning (Kim, Jorg & Klassen, 2019). The most common measures of teacher effectiveness have been on the use of students' evaluation of teaching, classroom observation, and students' academic achievements (Kane, Kerr & Pianta, 2014).

Students evaluations of teaching effectiveness aims at using the students to report on what they perceive of the capacity of the teacher in the classroom activity. Classroom observation requires a well- trained observer to rate the teacher in the classroom during lessons, using standard rating instrument based on some key variables. However, the students' performance dimension of measuring teacher effectiveness which either uses the actual test scores arising from the examination of students after the instruction or in some instance uses the students' performance self- efficacy. The performance self-efficacy measures the students' perception of their capability to perform academically (Shell & Husman, 2001).

Teacher effectiveness is variously associated with many indicators (e.g. Hattie, 2009, Chang, 2009; Brown 2012, Garcia, et al, 2011, John et al 2008, Briones, 2018). For instance, Briones (2018), showed that teachers' competency on the use of ICT in teaching physics was significantly and positively related to their effectiveness (associated with students' performance). The study, carried out in the Philippines using K-12 curriculum, showed that the teachers'

use of Information and Communication Technology (ICT) helped improved students' understanding of science ideas, increased students' motivation in learning science ideas, stimulated their interest to scientific ideas, facilitated their teaching and learning process of science and in all provided the teacher with the opportunity to be innovative in the delivery of the lessons. Also, Akpan (2014) in his study of ICT competence and lecturer's job efficacy in universities in Cross River State, Nigeria showed that lecturers with high ICT competence were more effective in classroom instructions than those with moderate and low ICT competence levels. The study equally did not show that ICT competence differed between male and female lecturers in the study. However, Soffer and Raban (2003) and Ramayah, Jantan and Aatagi (2003) showed in related stu ndies significant gender difference in ICT competence among teachers. Therefore, ICT competence which may be mediated by several variables was a likely factor for teacher effectiveness.

But studies have shown that ICT competence among teachers in Nigeria have been low (Yusuf, 2005, Olulube, 2006, Akpan, 2008; Opie, Igiri & Ojating, 2008, Badu & Sakiyo, 2013). The teaching of science requires scientific aptitude, competencies and skills needed of an effective science teacher to deliver instruction in the 21st century. Researchers have concluded that ICT competence is one of the most important factors needed to perform various tasks in education especially in the process of searching for new information, teaching and learning in the classroom environment (Asubioju & Ajaiyi, 2017). The Nigerian teacher cannot be different from others across the world neither can he escape from the technological effect of globalization. The impact is too offensive and oppressive.

The Nigerian science teacher, faced with a mirage of problems ranging from poor motivation, lack of facilities, poor classrooms and laboratory equipment to personality issues and above all the challenges of ICT to deliver effective instruction. Amidst these, several questions needed to be answered about how effective are science teachers in this part of the world, given advancement in ICT? How competent are science teachers in the use of ICT for classroom instructions? Is there gender difference in science teachers' ICT competence? Are science teachers who are competent in the use of ICT more likely effective in classroom instruction than their counterparts who are not ICT competent? Although studies, carried out elsewhere, have shown that competence in ICT could impact positively on job effectiveness and that ICT competence is moderated by internal and external variables, with inconclusive decisions. It's important to note that none of these works was carried out using science teachers in the discharge of their instructional duty especially in Northern Cross River State, Nigeria. Hence the need to further investigate the influence of ICT competence on science teachers' instructional effectiveness.

Purpose of the study

The aim of this study was to

i. Examine the level of ICT competence among science teachers for effective classroom instructions in secondary schools in Northern Cross River State.
ii. Examine gender difference in science teachers' ICT competence amongst secondary school teachers in Northern Cross River State.
iii. Examine the influence of the level of ICT competence of science teachers' instructional effectiveness in secondary schools in Northern Cross River State.

Hypotheses

The following well hypotheses were used to guide the study;

1. Science teachers' in Northern Cross River State are not significantly competent in ICT for effective use classroom instruction.
2. Gender differences does not significantly influence science teachers' ICT competence amongst secondary schools in Northern Cross River State.
3. Science teachers' level of ICT competence does not significantly influence their instructional effectiveness amongst secondary schools in Northern Cross River State.

II. METHODOLOGY

The survey research design was used in this study. The population for this study consisted of three hundred and seventy- one (371) science teachers distributed in 113 public and private secondary schools in the Zone. The study adopted a multistage sampling technique consisting of stratified and simple random sampling techniques to select 193 science teachers across in Northern Cross River State, Nigeria.

Two instruments were used to gather data. The first was the ICT Competence Inventory (ICI) with ten (10) items defined on five -point rating scale. Where 0 = No knowledge, 1 = Poor knowledge, 2 = Fair knowledge, 3 = Good knowledge, 4 = Very good knowledge and 5 = Excellent knowledge. Teachers rated their competence on the computer skills, they have acquired using the ICI scale. The ICI had a Cronbach co-efficient of 0.91. The second instrument was the Classroom Instructional Effectiveness Scale (CIES), also made up of ten (10) items. The maximum score for each item was 5 points. Trained Research Assistants and Head of Subjects were used to assess the teachers using the CIES. The CIES had a Cronbach co-efficient of 0.84. Data obtained from the study were analysed using SPSS version 23.0.

III. RESULTS

H_{O1}: Science teachers in Northern Cross River are not significantly competent in ICT for the effective classroom instruction.

To test this hypothesis, the one sample t-test was used with the test value of 25 points. It was expected that out of the ten (10) terms (with a maximum of 5 points per term), any science teacher with a score of less than 25 points was not ICT competent while those with 25 points and above were ICT competent. The results are presented on Table 1.

Table 1: One sample t-test of the level of competence among science teachers (test value=25).

Variables	N	Mean	SD	df	t	P-value
ICT competence	193	17.75	6	192	-16.78*	0

*Significant, p <.05, M.D = -7.25, critical t = -1.960.

From Table 1, the result of the analysis showed the mean ICT competency level of 17.75 amongst the science teachers, with a mean difference (MD) of -7.25 from the hypothesised test value of 25 points. Hence, the average science teachers in the study is ICT incompetent. That is, the mean ICT competence level was far below the acceptable average (M.D = -7.5) of the research conception of the minimum competency level.

The t-test analysis of this mean (mean = 17. 75) against the hypothesized test value of 25 points showed a t-value of -16.78 ($p<.05$). This value was less than the critical t-value of -1.96 ($\alpha = .05$, df = 193). Hence, the null hypothesis was rejected. To this end, the study concluded that science teachers in Northern Cross River were significantly ICT incompetent to use ICT for classroom instructions.

$H0_2$. Gender difference does not significantly influence science teachers' ICT competence amongst secondary schools in Northern Cross River State.

The data for testing this hypothesis were analysed using the independent t-test. The result of the test is on Table 2.

Table 2: Results of independent t-test of the influence of gender difference on the mean ICT competence of science teachers.

S/N	Gender	N	Mean	SD	df	t	P-value
1	male	147	18.37	6.26	191	2.616*	0.01
2	female	46	15.76	4.61			

*Significant, P<.05, critical t = 1.96.

The result of the analysis on Table 2 showed a calculated t-value of 2.616 ($p<.05$), which was higher than the critical t-value of 1.96 ($\alpha= .05$, df = 191). Hence the test was significant. Its concluded that gender difference significantly influences teachers' mean ICT competence in Northern Cross River State, Nigeria. From the Table 2, the mean ICT competence level of male science teachers (mean=18.37; SD=6.26) was significantly higher than those of their female counterparts (mean =15.75; SD=4.61). Therefore, male science teachers differ significantly from female science teachers in their level of ICT competence.

Ho_3 – Science teachers' level of ICT competence does not significantly influence their instructional effectiveness amongst secondary schools in Northern Cross River State.

In this hypothesis, ICT competence was categorised into two levels. All science teachers whose score on the ICI scale was less than 25 points were adjudged ICT incompetent while those with 25 points and above were ICT competent. These two groups were then compared on the basis of their instructional effectiveness in analysing the data. The result of the independent t-test analysis is presented on Table 3.

Table 3: Results of independent t-test of the influence of level of ICT competence on science teachers' instructional effectiveness.

S/N	Level of ICT	N	Mean	SD	df	t	P-value
1	ICT competent	28	32.64	6.3	191	7.492	0
2	ICT incompetent	165	25.17	4.6			

Significant, P<.0.5, critical t=1.960.

Table 3 show the result of the test of hypothesis three. From the table, data evidence showed a calculated t-value of 7.492 ($p<0.5$) which was higher than the critical t-value of 1.96 ($\alpha = 0.5$, df = 191). Hence, the null hypothesis was rejected.

The results indicated that ICT competent science teachers (mean= 32.64 SD = 6.30) in the study have a significant mean difference in their instructional effectiveness than their counterparts who were ICT incompetent (mean =25.17; SD=4.60). Hence, the level of ICT competence significantly influences science teachers' instructional effectiveness among secondary schools in Northern Cross River State.

IV. DISCUSSION OF FINDINGS

One of the findings of this study showed that science teachers were not significantly competent in ICT for use in instructional delivery. In other words, teachers in the study area were significantly incompetent in the use of ICT necessary for effective classroom instructional delivery. This fact underuses the scenario in most third world countries. Nigeria is not an exception to this. ICT is a relatively new innovation in classrooms in most developing countries and the use of ICT by teachers for classroom instruction in Nigeria too is rather seen as such. The rate of poverty among teachers, low level of motivation, lack of facilities, reluctance to accept innovation, the challenge needed to engage in the training and above all, the ICT phobia may have accounted for this finding. The study area is vastly rural with few schools in the urban and semi urban centres where electricity and ICT training centres exist. With this scenario, it takes teachers who really know the importance and impact of ICT on their profession to acquire the skills.

This finding is in agreement with the works of Yusuf (2005), Badu and Sakiyo (2013) and Ololube (2006) who showed that teachers' ICT competence in Nigeria is low and of course below expectation. This is not surprising because in

Nigeria, only good, standard and model secondary schools have access to computers and even where there exist, the problem of electricity to power the computers is a major challenge. In the midst of these, the teachers only struggle to become ICT literate. The challenge of ICT competence is another phase in its entirety. Being ICT literate is one thing and being competent to apply it for classroom instruction is another.

Furthermore, another finding of this study showed that gender difference significantly influences science teachers' ICT competence in the secondary schools studied. The male science teachers had a significantly higher mean ICT competence than their female counterparts. Studies such as Soffar and Raban (2003);Azeta and van der Merwe((2018), Ramayah, Jantan and Aafagi (2003) have shown significant influence of gender on the level of teachers' ICT competence. Given the Nigeria scenario, which favours male gender, the male teacher's ability to explore and exploit their environment faster than their female counter-parts pre-disposes them to accept this new technology faster. Wajeman (2006) in Fomsi and Orduah (2017) viewed western technology as having patriarchal values and that the very language of technology is masculine. The very skills of technology being embedded in the culture of masculinity that are more favourable to males than their female counter parts. This, together with the environmental factors, predisposes the male teachers on a higher advantage to their female counterparts.

Also, another finding of this study was that science teachers' level of ICT competence significantly influences their classroom instructional effectiveness. ICT competent science teachers were significantly more effective than ICT incompetent science teachers in their classroom instruction. Teacher effectiveness is a function of various indicators and is highly associated with the level of competence in content. The evolution of ICT and access to ICT predisposes teachers to access pedagogical content from across the world. Such access, usage and application of ICT facilities defines the 21st century teacher. Opie, Igiri and Ojating (2008) had stated that the challenge before the 21st century teacher is to be one step ahead of the learners in delivering classroom instruction. Again, Asubioju and Ajaiyi (2017) had stated clearly that ICT competence is one of the most important factors needed to perform various tasks in education. Classroom instruction is no exception to this. Finally, Briones (2018) showed that physics teachers' competency in the use of ICT in teaching Physics was significantly and positively related to their effectiveness. The outcome of this study just corroborated these earlier works.

V. CONCLUSION

Arising from the findings of this study it is concluded that the level of ICT competence among science teachers in Northern Cross River State is below the acceptable minimum competency level. Majority of the science teachers are not ICT competent to use it for effective classroom instructions. Male science teachers are significantly more competent in ICT than their female counterparts and that science teachers, who are ICT competent are more effective in classroom instruction than their counterparts who are ICT incompetent. In other words, ICT competence significantly influences science teachers' effective classroom instruction.

VI. RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

Government, proprietors and non-governmental organizations should encourage the training and re-training of science teachers on ICT and the use of ICT facilities for instructional deliveries. There should be a deliberate and comprehensive programme to train science teachers on Computers and other ICT facilities.

Acquisition of ICT skills is a sine qua non for teachers' instructional effectiveness in the 21st century, hence this should be one of the bases for recruitment of new science teachers. Government and School proprietors should encourage the use of ICT by teachers through equipping schools with ICT facilities, provide necessary environment and leverage on ICT workshops to train those that are not ICT literate.

Furthermore, the training of science teachers on ICT should accord preference and priority to the female science teachers; and finally, the use of ICT packages /applications that enhances classroom instructional effectiveness should be upper- most in such trainings. Doing all of these would enhance science teachers' teaching effectiveness.

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