PERCEIVED INFORMATION AND COMMUNICATION TECHNOLOGY COMPETENCY OF SCIENCE TEACHERS IN BENUE STATE, NIGERIA

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Abstract

This study examined perceived ICT competency of science teachers at Primary and Secondary Schools in Benue State using descriptive survey design. The study was guided by four research questions and three hypotheses. The population of the study comprised 2,918 science teachers in public primary and secondary schools (992 secondary schools and 1926 primary schools). Of this number, multi- stage sampling technique was used to sample 352 respondent (202 science teachers from primary schools and 150 from secondary schools). The instrument used for data collection was ICT Competency Questionnaire (ICTCQ). The instrument was trial tested on 30 respondents and the reliability yielded a coefficient of 0.83 through Cronbach alfa. Data collected were analysed using mean and standard deviation to answer the research questions. Hypotheses were tested using t-test at 0.05 level of significance. The findings revealed that: science teachers in public primary and secondary schools have low competency in ICT operations and utilization. There was a significant difference between the mean perceived ICT competency level of primary and secondary school science teachers in Benue State. The study also found that there was a significant difference between the mean perceived ICT competency level of male and female science teachers in primary and secondary school. It was therefore recommended among others that ministry of education should work in conjunction with NGOs to enhance ICT competency and utilisation among science teachers through regular organization of seminars, conferences and workshop that are ICT inclined. Both male and female teachers should be intentional at getting acquainted with the present demands of ICT competency in school by equipping themselves with the basic knowledge of ICT to improve their competences.

Introduction

The advent of information and communication technology ICT have transformed the way and manner activities are conducted in various facets of human endeavour, including educational practices. With regards to instructional processes, particularly in science and technological subject areas, ICT seem to be gaining dominance in its applications. ICT simply refer to information and communication technology. This is the term used to refer to information handling tools ranging from video conferencing through multimedia, delivery to websites which are used to produce, store, distribute and exchange information (Ode, Eriba & Abah, 2020). Information and Communication Technology (ICT) has been conceived differently by

authors. Ode and Udu (2022) defined ICT as a set of activities which is facilitated by electronic means the processing, transmission and display of information. Marcelle (2016) described ICT as a complex varied set of goods, applications and services used for producing, distributing, processing, transforming information (including) telecoms, TV and radio broadcasting, hardware and software, computer services and electronic media. Olorunsola and Aboyade (2017) viewed ICT as a cluster of associated technologies defined by their functional usage in information access and communication of which one embodiment is the internet.

In a competitive global world that is driven by Information and Communication Technology (ICT), the manipulation and application of various ICT gadgets remains a very important disposition needed by science and technology teachers. Moreover, application of ICT in the educational sector is believed to have revolutionized the methods of teaching and learning in all subjects' areas. Science is not an exception. Science is being taught at all levels of educational system. Science is made up of Biology, Chemistry, Physics and Mathematics, Basic Science and Technology, Physical and Health Education, Agricultural Science. This implies ICT is involved in the study of Computer Science and ICT (Information and Communications Technology Basic Science, Elementary Biology, Anatomy, Earth/Solar System, Ecology, Genetics, Chemistry and Physics as a single science subject at the secondary school levels. It offers training in scientific skills required for human survival, sustainable development and societal transformation.

Science is the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence. The abstract nature of scientific concepts makes ICT indispensable to effective teaching of science subjects to concretize learning experiences. Information and Communication Technology has strong impact in education. It therefore provides enormous tools for enhancing teaching and learning. ICT has also brought about new opportunities like interaction between students and teachers. Furthermore, ICT has useful effects on teaching and learning of science if it is used under the right conditions, including suitable resources and instructors. Information and communication technology offer the potential to meet the learning needs of individual students, promote equal opportunity, offer learning material and also promote interdependence of learning among learners (Mahmood & Bukhari, 2021). Information and communication technology have grown rapidly in various fields of study especially in science. Therefore, it offers broad experiences comprising everything related to process, tool, manipulation and management of information. It has created a channel in which people communicate with one another across the globe. It has also widely opened the doors of knowledge for information seekers and shortened the ever-wide gap that existed between the information source and users (Mbaeze, Elochukwu & Anudu, 2017).

The utilization of ICT in the education sector has reduced the cost of accessing educational materials. It has also made it easy for teachers and students to learn from anywhere and anytime, speeds up the transfer and dissemination of information between teachers

and students as well as replacing some old methods of sourcing for information such as borrowing of books in the libraries (Karehka, 2016). It is envisaged that ICT has contributed in the development of science education. It is in recognition of the importance of ICT in education that governments and non-governmental organizations in the developing countries are now investing on educational technologies with a view to bridging the digital gap and enhance teaching and learning in the new contemporary society.

In order to ascertain the importance of ICT in Science education, the National Policy on Information and Communication Technology in Education in Nigeria (2019) spelt out that, the Nigerian government has introduced computer education and competency into primary and secondary schools in 1997 with general objectives of the ICT competency programme. This includes: bring about ICT competency in each state of Nigeria; develop ICT facilities as a tool for teaching in all subjects areas and to familiarize teachers and students with ICT competency in technology; enable the present generation of school children at the primary and secondary school level to appreciate the potentials of the ICT and to be able to utilize it in various aspects of life and later occupations; and to expose teachers and students to the latest scientific knowledge and skills. However, these can only be achieved when science teachers are fully equipped with ICT (Information and Communications Technology) competency (Adomi & Kpangban, 2021).

Competency is a person's ability in performing a given task as well as a result of training and practice. Competency as viewed by Ode and Udu (2022), is the ability of teachers to develop learning innovations through information technology both in planning, implementing, and evaluating learning, both in the aspects of pedagogical competency. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) (2014) defines competency as a set of attributes covering knowledge, skills and attitudes for given occupation or function to the standards expected in employment. The notion of competence with regards to the use of ICT in education is broader than the technical skills needed to use ICT. The type of ICT competence needed by teachers is a collection of knowledge, skills and attitudes that are inextricably bound up with the context and pedagogy. ICT competency describes what a teacher should be able to do with technology in professional practice. The major ICT competencies required by teachers include competency in making personal use of ICT; mastery of a range of educational paradigms that make use of ICT; competency in making use of ICT as minds tools; competency in using ICT as tool for teaching, competency in mastering a range of assessment patterns which involves use of ICT and competency in understanding the policy dimensions of the use of ICT for teaching and learning. ICT perceived competency is the ability required by science teachers for effective instruction to primary and secondary school students in Benue State.

It is believed, that the level of ICT competency among teachers in Nigerian schools, such as the primary and secondary schools under study, is determined by a number of factors including gender. In a study on gender awareness in ICT with focus on education conducted by Jean and Johan (2018), male

teachers responded more to the questionnaire items than female teachers which shows that female teachers may not have had either the prerequisite ICT skills, with the computer hardware, necessary to respond to the questionnaire item. Similarly, regarding to gender gaps, some studies show that both male and female teachers hold positive attitudes towards ICT with males having stronger positive attitudes than their female teachers (Photos and Kyriacos, 2020).

Gender is considered as a variable that has so much effect on science teachers in the teaching process. Gender, according to Nnamani and Oyibe (2016) is a psychological experience of being a male or female. It has to do with personality and central components of self-concept. Unlike sex, which is concerned with, only the distinction between male and female based on biological characteristics, gender encompasses other personality attributes as roles, orientation and identity based on individual's conceptualization of self. For instance, Singh (2014) opines that gender refers to a socio-cultural construct that connotes the differentiated roles and responsibilities of men and women in a particular society. This definition implies that gender determines the role, which one plays in relation to general political, cultural, social and economic system of the society. ICT-related gender knowledge concern not only students, but also teachers as well. According to Goswami and Dutta (2016), there are cases where gender differences cannot be discerned in the knowledge of ICT which includes computers, email services and electronic data management systems. The authors add that gender acts as an influencing factor in technology adoption as men are more

technologically skilful compared to women in public primary and public secondary institutions of learning.

Gender is seen as a socially ascribed attribute of female and male. Gender has become a contemporary variable for science educators as well as researchers in many disciplines owing to its effect on science teaching interest, learning and performance. Ode and Udu (2022) have revealed that, gender is relevant issue in the learning of science and technology, since the social expectations that prescribe how males and females think, act and feel differs. These authors further stated that, gender differences in science achievement have been a major concern in science education and science educators seek to provide avenues for achieving gender parity for sustainable development.

School level is another factor that may influence the ICT competency of teachers' resources in public primary and secondary school in Nigeria. According to Suskie (2013), level is the position or rank of someone or something when compared to others in the society, organization and group. With regard to school level (primary and secondary schools), Tahira and Sadia (2015) affirm that teachers in primary schools are more ICT competent than teachers in secondary schools. The reasons according to them are that teachers in primary schools have students whose parents belong to high socio-economic status that primary schools are being taught by competent teachers in the society in contrast with their secondary counterparts who are not so opportune.

Studies have been conducted on the assessment of ICT competency of teachers for teaching and learning in primary and

secondary schools. However, based on literature evidence, the findings of these studies are inconsistent. While some (Nnnaim, Morandi & Amuei, 2018; Thakur, 2020) found low level of ICT literacy by primary and secondary school teachers, Singh (2014); Onu and Ezhim, (2019) found that teachers were highly competent in the utilization of ICT. Furthermore, Ode and Udu (2022) found no significant difference between male and female teachers' competency in the use of ICT facilities for teaching. The inconsistent nature of these findings suggests that research on in-service chemistry teachers' ICT competency is still inconclusive. It is in view of this that this study investigated ICT competency of science teachers in primary and secondary schools in Benue State, Nigeria.

Statement of the Problem

ICT utilisation is very instrumental to effective teaching and learning of science. Literature is replete with the fact that the attainment of goals of science education through a successful delivery of school science curriculum relies on a teacher attribute that boarder on the level of ICT competency of science teachers particularly in contemporary classrooms. Even the success and efforts of the government and non-governmental organisation towards enhancing scientific literacy and technological literacy of citizens is premised on ICT competency of teachers particularly that ICT tools have become indispensable in the 21st Century teaching and learning. ICT Competency of science teachers can influence considering the numerous features and tools that can be deployed to reduce the level of abstraction in science concepts and make learning meaningful.

However, based on literature evidence studies on ICT perceived competency of science teachers in Benue state across school locations, levels and gender are scarce. Against this backdrop, the problem of this study was: What is the perceived ICT competency of science teachers in primary and secondary schools in Benue State?

Purpose of the Study

The purpose of this study was to assess the ICT competency level of science teachers at Primary and Secondary Schools in Benue State, Nigeria. Specifically, the study sought:

1. perceived ICT competency level of science teachers in Benue state

2. difference between the mean perceived ICT competency level of primary and secondary school science teachers.

3. difference between the mean perceived ICT competency of male and female science teachers in primary school.

4. difference between the mean perceived ICT competency of male and female science in secondary schools.

Research Questions

The following research questions raised guided the study

1. What is the perceived ICT competency level of science teachers in Benue state?

2. What is the difference between the mean perceived ICT competency level of primary and secondary school science teachers?

3. What is the difference between the perceived ICT competency of male and female science teachers in primary school?

4. What is the difference between the perceived ICT competency of male and female science teachers in secondary schools?

Hypotheses

The following null hypotheses formulated were tested at the 0.05 level of significance

Ho1: There is no significant difference between the mean perceived ICT competency level of primary and secondary school science teachers.

Ho2: There is no significant difference between the mean perceived ICT competency of male and female science teachers in primary school.

Ho3: There is no significant difference between the mean perceived ICT competency of male and female science in secondary schools.

Methodology

This study used descriptive survey research design. The population of this study comprised 2,918 science teachers in public primary and secondary schools (992 from secondary and1926 from primary schools). Out of the 992 secondary school science teachers, 568 are males while 424 are females; Furthermore, out of the 1,926 science teachers in primary school, 974 are males and 952 are females; (Benue State Teaching Service Board Makurdi, Benue State Universal Basic Education Board, 2022). The research involved a sample of 352 respondents, consisting of 202 science teachers from public primary schools (135 male and 67 female) and 150 science teachers from public secondary schools (96 male and 54 female). The respondents were drawn from a total of 129

public primary and secondary schools using multi-stage sampling technique.

The study used Science Teachers ICT Competency Questionnaire (ICTCQ) developed by the researchers for data collection. The instrument ICTCQ contained two sections, A and B. Section A sought to obtain the demographic information of the respondents, while section B contained 30 items on assessing the level of ICT perceived competency regarding ICT operations and utilization among the respondents. The items have four response options in a Likert scale with the following: Very Highly Competent = 4, Highly Competent = 3 Moderately Competent = 2, Lowly Competent = 1 and in reverse order for negative items. In order to ensure the validity of the instrument, the research instrument was given for face validation to three experts for face validity the instruments were assessed in terms of clarity of wordings and ambiguity the instrument was assessed in terms of what the instrument supposed to measure. Two experts were from the Department of Science Education and one from measurement and evaluation, Faculty of Education all from Benue State University, Makurdi for scrutiny to ensure that the items are capable of measuring the variables of the study and they are appropriate, clear, unambiguous and relevant to the purpose of the study. Their comments and suggestions regarding wordings, specifications and ICT content coverage guided the researchers in improving the quality of the instrument.

To establish the reliability of the instrument was trial tested on 30 respondents who were not part of the main study but have the same characteristics in one of the Local Government

Areas of Benue State to establish the reliability coefficient of the instrument using Cronbach alpha and the value yielded 0.83. The choice of Cronbach alpha was because the items were not dichotomous in nature; that is, they do not have right or wrong responses (Emaikwu, 2016).

The researchers went around each of the sampled schools with the help of two research assistants and administered the instrument to respondents physically to ensure high rate of return of the instrument. Data collected from respondents were analysed using mean scores and standard deviation to answer research questions while t-test was used to test all the null hypotheses at 0.05 level of significance. The choice of independent t-test for this study is because the study was set to assess the differences in mean that may exist in the ICT competency of science teachers across gender and school levels.

Results
Research Question Two

What is the ICT perceived competency level of science teachers in Benue state?

Table 1: Mean and Standard Deviation on the Perceived ICT Competency Level of Science Teachers in Benue State.

Variable	N	$\bar{\mathrm{X}}$	SD	Remark
ICT Operational Competency	352	1.55	0.83	Low Operational competency
ICT Utilization Competency	352	0.72	0.53	Not competent in ICT utilization
Grand mean and SD		1.14	0.68	

Result in Table 1 shows the mean, standard deviations on the ICT perceived operational and utilization competency level of science teachers in Benue State. Result showed that science teachers had a mean ICT perceived operational competency of 1.55 with a corresponding standard deviation of 0.83 which implies that science teachers perceived they have low ICT operational competency. The table also revealed that science teachers' perceived ICT utilization had a mean value of 0.72 with a corresponding standard deviation value of 0.53. The overall grand mean for all respondents was found to be 1.14, accompanied by a standard deviation of 0.68. The result depicts that science teachers are incompetent in ICT perceived utilization in public primary and secondary schools in Benue State.

Research Question Two

What is the difference between the mean perceived ICT competency level of primary and secondary school science teachers?

Table 2: Mean and Standard Deviation on the Difference between the Perceived ICT Competency Level of Primary and Secondary School Science Teachers

Variable	Public School	N	$\overline{X}$	SD	Mean difference.
ICT Competency Level	Primary School science Teachers	202	.41	.492	
					1.60
	Secondary School science Teachers	150	2.01	.675	

Result in table 2 shows the mean, standard deviations and difference between the mean ICT perceived competency level of primary and secondary school science teachers in Benue State. Result showed that primary school science teachers have mean ICT perceived competency of 0.14 and SD value of .492 while secondary school science teachers had a mean ICT perceived competency of 2.01 and SD value of .675. There is a mean difference of 1.60 in favour of secondary school science teachers. This means that secondary school science teachers had higher mean ICT perceived competency level as compared to primary school science teachers.

Research Question Three

What is the mean difference between the perceived ICT competency of male and female science teachers in primary school?

Table 3: Mean and Standard Deviation on the Difference between the Perceived ICT Competency of Male and Female Science Teachers in Primary School.

Variable	Gender	N	$\overline{X}$	SD	Mean difference.
ICT Competency Level	Male Science Teachers in Primary School	135	2.77	.424	
					0.77
	Female Science Teachers in Primary School	67	2.00	.000	

Table 3 shows the mean, standard deviations and difference between the mean perceived ICT competency level of male and female science teachers in primary schools in Benue State. Male science teachers in primary schools had a mean perceived ICT competency of 2.77 and SD value of .424. While female science teachers in primary schools had a mean perceived ICT competency of 2.00 and SD value of .000. There is a mean difference of 0.77 in favour of male science teachers in primary schools. This implies that male science teachers in primary schools had higher mean ICT perceived competency level as compare to female science teachers in primary schools.

Research Question Four

What is the mean difference between the perceived ICT competency of male and female science teachers in secondary schools?

Table 4: Mean and Standard Deviation on the Difference between the Perceived ICT Competency of Male and Female Science Teachers in Secondary School.

Variable	Gender	N	$\bar{X}$	SD	Mean Difference.
ICT Competency Level	Male Science Teachers in Secondary School	96	3.00	.000	
	Female Science Teachers in Secondary School	54	2.00	.577	1.00

Table 4 shows the mean, standard deviations and difference between the mean perceived ICT competency level of male and female science teachers in secondary schools in Benue State. Male science teachers in secondary schools had a mean perceived ICT competency of 3.00 and SD value of .000. While female science teachers in secondary schools had a mean perceived ICT competency of 2.00 and SD value of .577. There is a mean difference of 1.00 in favour of male science teachers in secondary schools.

This indicates that male science teachers in secondary schools had higher mean perceived ICT competency level as compare to female science teachers in secondary schools.

Hypothesis One

There is no significant difference between the mean perceived ICT competency level of primary and secondary school science teachers.

Table 5: t-Test on the Difference Between the Mean Perceived ICT Competency Level of Primary and Secondary School Science Teachers

Variable	School Level	N	$\bar{X}$	SD	df	t	p	Remark
ICT Competency Level	Public Primary Schools	202	.41	.492				
					350	25.828	.000	Significant
	Public Secondary Schools	150	2.01	.675				

Table 5, t = 25.828, P= 0.000 < 0.05. Since the P value is less than the alpha value, the null hypothesis which states that there is no significant difference between the mean ICT perceived competency level of primary and secondary school science teachers is rejected. This means that there is a significant difference between the mean ICT perceived competency

level of primary and secondary school science teachers in Benue State.

Hypothesis Two

There is no significant difference between the mean perceived ICT competency of male and female science teachers in primary school.

Table 6: t-Test on the Difference Between the Mean Perceived ICT Competency of Male and Female Science Teachers in Primary School

Variable	Gender	N	X̄	SD	df	t	p	Remark
ICT Competency Level	Male Science Teachers in Primary Schools	135	1.59	.494				
					350	11.461	.000	Significant
	Female Science Teachers in primary schools	67	1.00	.000				

Table 13, t = 11.461, P= 0.000 < 0.05. Since the P value is less than the alpha value, the null hypothesis which states that there is no significant difference between the perceived ICT competency level of male and female science teachers in primary schools is rejected. This means that there is a significant difference between the perceived ICT competency level of male and female science teachers in primary schools.

Hypothesis Three

There is no significant difference between the mean perceived ICT competency of male and female science teachers in secondary schools.

Table 7: t-Test on the Mean Difference Between the Mean Perceived ICT Competency Level of Male and Female Science Teachers in Secondary School

Variable	School Level	N	X̄	SD	df	t	p	Remark
ICT Competency Level	Male Science Teachers in secondary school	96	3.00	.000				
					350	7.550	.000	Significant
	Female Science Teachers in secondary school	54	2.00	.577				

Table 7, t = 7.550, P= 0.000 < 0.05. Since the P value is less than the alpha value, the null hypothesis which states that there is no significant difference between the perceived mean ICT competency level of male and female science teachers in secondary schools is rejected. This means that there is a significant difference between the mean perceived ICT competency level of male and female science teachers in secondary schools.

Discussion of Findings
It was found that the perceived ICT competency level of science teachers in Benue State was

significantly low. This was evident in science teachers' mean response value of 1.14 which indicates that their skills in operating and utilizing ICT devices and services in teaching and learning processes were poor. This finding aligns with that of (Maisamari et al, 2018) who fond poor utilization of ICT in teaching and learning activities among teachers and learners in both public and private schools. Similarly, the finding corroborates that of Richard and Augustine (2016) who found that many teachers were not computer literate due to a lack of exposure to ICT training. It also agrees with Ezeugbor (2018) who reported low ICT competence among lecturers, hindering their ability to fully on leverage ICT for better teaching. These findings collectively underscore the urgent need to enhance ICT content in teacher education programs and address the broader challenges hindering effective ICT integration in teaching and learning in primary and secondary schools.

It was revealed that the science teachers in primary schools were not ICT competent but those in secondary schools were moderately competent. This finding agrees with Fulan, Zhang, Beilei, Bai, Zhou and Lin (2016); who found that public secondary schools have and use ICT resources more than their counterparts in primary schools in their operations.

Furthermore, a significant difference was found between the perceived mean ICT competence of male and female science teachers in primary and secondary schools. This finding disagrees with that of Ode and Udu (2022) who found no significant difference between male and female teachers' competency in the use of ICT facilities for teaching. It however agrees with that of Qianjun (2018) who found that there is a

significant difference between primary and lower secondary schools' teachers in manipulating computer and using curriculum software. The implication of these findings is that more training is needed for science teachers to improve their competences in ICT operations and utilisations for effective science teaching and learning at primary and secondary school levels in Benue State.

Conclusion

These findings suggest that there is low level of ICT competences among science teachers and there are variations in ICT competency levels among science teachers in different school levels across gender.

Recommendations

Based on the findings of the study, the following recommendations were advanced

1. Teacher training institutions should enrich their curriculum with ICT courses to improve competencies needed by the 21st century science teachers

2. Ministry of education and NGOs should regularly organize workshops, seminars and trainings for science teachers to enhance their ICT competences.

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