
MATHEMATICS LECTURERS' PEDAGOGICAL SKILLS IN THE APPLICATION OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN INSTRUCTION IN TERTIARY INSTITUTIONS

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Abstract

This study assessed mathematics lectures' pedagogical skills in the application of Information and Communication Technology (ICT) in mathematics instruction in tertiary institutions in Cross River State. Two research questions and one null hypothesis guided the study. A descriptive survey research design was used for the study. Twenty-six mathematics education lecturers participated in the study. Questionnaire for Mathematics Lecturers' Pedagogical Skills in the application ICT (QMLPSICT) was administered to mathematics lecturers and their responses analysed. Mean and standard deviation were used to answer research questions while the null hypothesis was tested using t-test statistics. The results indicated that mathematics lectures pedagogical skills are applied in low extent in mathematics instruction. Institutional types do not have any significant influence on the extent mathematics lecturers apply pedagogical ICT skills in mathematics instruction. This revealed that mathematics lecturers required the needed pedagogical ICT skills for instructions. Recommendations were made to help facilitate the application of ICT in mathematics instruction at all levels especially in tertiary institutions. The following suggestions were made for further studies; that the present study was conducted in tertiary institutions; similar study should be carried out in secondary schools.

Keywords: Application, Mathematics Instruction, Mathematics Lecturers, Pedagogical ICT skills, Tertiary Institution.

Introduction

Lecturers' subject matter knowledge is crucial in mathematics instruction, it's also crucial to evaluate their teaching methods and standards in order to monitor the teaching and learning process. This is why it is crucial to continue evaluating how ICT is used in education. When the teaching and learning process in tertiary institutions in Nigeria is critically evaluated, it can be seen that the problem is leveraging ICT to embrace teaching and learning rather than covering subject (Olaofe, 2005). Danner and Pessu (2013) argued that ICT is seen as a catalyst for change in teaching methods, learning strategies, and information availability. Oluwarobi (2012) defined Information and communication technology (ICT) as a type of electronic technology that is typically used to access knowledge as well as retrieve, store, process, and package information. According to the

author, ICT is used to refer to a broad range of technological applications, including the use of microcomputers, optical discs, the creation of telecommunication networks, television, and the internet, among others, and as a necessary tool for problem-solving and improving effective teaching and learning.

Information and communication technologies may be excellent auxiliary tools for improving and reforming education. It's dynamic, interactive, and interesting material has affected both the amount and quality of teaching and learning, and it can really offer opportunity for personalised training (Egomo, Enyi & Tah, 2012). When implemented properly, various ICTs help increase educational quality by making teaching and learning an engaging active process that is connected to real life, enhancing the relevance of education to the increasingly digital workplace, and extending access to education (Ezenwafor, 2011). At the tertiary levels, Onasanya, Shehu, Oduwaiye and Shehu (2010) reported that ICT has been cited as having advantages for lecturers in the areas of teaching that include: increasing the amount of time students spend learning; enhancing the speed of data and information availability; providing rapid feedback; assisting less qualified professors; and increasing lecturers' efficiency and effectiveness..

Government, institutions, organizations, and individuals are increasingly concerned about the need to integrate ICT into Nigeria's educational system by installing physical ICT infrastructures in a few chosen universities in Nigeria and requiring that all College of Education lecturers be computer literate, the National Universities Commission (NUC) and the National Commission for Colleges of Education (NCCE) have made a commendable achievement in this direction (Afufu, 2015). To facilitate the actualization of the primary tasks of the higher institutions, this is done to ensure that ICT is properly integrated into tertiary education. However, despite this commendable investment in ICT usage in education made by the Federal government and other agencies, the educational system in Nigeria still falls behind in this area of technology (Owolabi, Oyewole & Oke, 2013). This may have been caused by factors such as poor management of ICT facilities, lack of appropriate ICT skills by lecturers among others.

Regardless of the quantity and caliber of technical tools utilized in the classrooms, lecturers are the key to how the technological tools are used. Lecturers are the heart and soul of any educational system, thus they should be ready to offer their students technology-supported learning opportunities (Afufu, 2015). This is possible if lecturers consider using technology and understanding how it supports student learning to be essential skills for success. In other words, lecturers need to be ready to arm students with the benefits that technology has to offer. Lecturers in academic institutions and lecture halls should be proficient in technology, have access to resources, and be able to effectively teach the required subject material while combining technical concepts and skills (United Nations Educational, Scientific and Cultural Organization [UNESCO] 2008).

Jones (2004) opined that regardless of how educational systems organise and predict teaching and learning, effective teaching and learning ultimately depends greatly on the motivation and skill of teachers. Thus, lecturers play a crucial role in the efficient use of ICT in tertiary teaching and learning. Even in environments and content that are rich in ICT, lecturers play a crucial role in the learning process since ICT technologies cannot function effectively on their own without the assistance of skilled and knowledgeable users. As a result, it is crucial for all lecturers at tertiary institutions to possess the

knowledge and abilities to incorporate ICT into their regular teaching methods in order to optimize their capacity to contribute to the development of students' digital skills.

ICT skill is concerned with the capacity to: understand when to apply or acquire a specific skill in utilizing an ICT resource; understand the purposes for using ICT and its impact on both users and content; and have a critical and self-assured attitude toward living with the technology (UNESCO, 2004). ICT skill is the ability to carry out a task that calls for the application of ICT successfully and efficiently utilizing the relevant knowledge, skills, attitudes, and abilities that have evolved over time and in response to the needs (Oluwaronbi, 2012). The use of ICT in educational settings requires a variety of skills, knowledge and attitudes from teachers in order to increase the effectiveness of the teaching and learning process.

In Nigeria, there are three categories of ICT skills: pedagogical, subject-oriented, and personal (Diri, 2013; Afufu, 2015). These authors define pedagogical skill as the capacity to organize, prepare, teach, evaluate, and assess lessons where a variety of appropriate learning outcomes could be recognized to be supported by ICTs. It includes, among other things, general educational tools, purposes, values, and goals that are involved in all aspects of teaching and learning, classroom management, lesson plan development and implementation, and student evaluation. Pedagogical skills are processes and practices or methods of teaching and learning (Koehler & Mishra, 2009). It refers to the skills, knowledge, expertise, and attitudes lecturers have about the nature of instruction and the proper use of ICTs in instruction.

Studies have shown that lecturers' proficiency with ICT applications has an impact on how much ICT they integrate into their teaching and students' learning (Abolade & Yusuf 2005; Akudolu 2008; Diri, 2013; Tayo & Adedayo, 2013). Yusuf (2005) confirms that when new courses or media are brought into the educational system, teachers' skills are of special concern. It is also thought that a variety of additional factors, such as the institution's kind, influence the level of ICT proficiency among lecturers in Nigeria's higher education institutions (that is Universities and Colleges of Education). This is why Onasanya, Shehu, Oduwaiye and Shehu, (2010) ascertained that colleges of education lecturers' degree of skill acquisition in the usage of ICT facilities and equipment is concerning; the authors also stated that lecturers at universities had greater ICT skill levels than lecturers at colleges of education. Similarly, Ololube (2006) reported that ICT utilization skills vary with lecturers and that professionally qualified lecturers seem to be more dominant with high ICT skill rates than their non-professional counterparts. This suggests that there disparity in the level of ICT skills that lecturers possess which has called for continual investigations.

However, the degree to which mathematics lecturers use pedagogical ICT skills in teaching mathematics in tertiary institutions (that is Universities and Colleges of Education) in Cross River State is not yet known. This might have prevented the goals of the Nigerian government's national ICT policy from being realized in Cross River State's tertiary mathematics education. Consequently, the purpose of this study is to evaluate how much ICT pedagogy is used by mathematics teachers in tertiary institutions (Universities and Colleges of Education); the influence of institutional type (Universities and Colleges of Education) on how mathematics lecturers in Cross River State use pedagogical ICT skills in their lessons.

In order to meet the goals of the nation's ICT policy and to enable Nigerian lecturers to be part of the community of experts in ICT supported teaching, the Federal Government of Nigeria and a number of agencies, including the National Universities Commission (NUC) and the National Commission for Colleges of Education (NCCE), among others, have invested in ICT usage in education. This is founded on the fact that information and communication technology (ICT) is currently employed in mathematics education and other educational programs as tools, tutors, and tutees.

Despite these laudable efforts, in Cross River State the pedagogical ICT skills of lecturers in the application of ICT in instruction are still not satisfactory. Evidence abound that the level of ICT application during instruction varies among lecturers in the tertiary institutions due to some factors such as pedagogical ICT skills, institutional type and gender among others. This discrepancy in finding has made research in this area inconclusive and it has also made it paramount to continually seek for strategies that could enhance the application of pedagogical ICT skills in instructions since pedagogical ICT skills among lecturers have been viewed in literatures as a prerequisite in the application of ICT in instructions. Therefore, the problem of this study is: what is the pedagogical ICT skills level of mathematics lecturers in the application of ICT in mathematics instructions in tertiary institutions in Cross River State? The purpose of this study is to evaluate the pedagogical skills of mathematics lecturers in the use of information and communication technology (ICT) in tertiary institutions.

Research questions

The following research questions were addressed

1. To what extent do mathematics lecturers apply pedagogical ICT skill in mathematics instructions in tertiary institutions in Cross River State?
2. What is the influence of institutional type on the extent mathematics lecturers apply pedagogical ICT skills in mathematics instruction in Cross River State?

Hypothesis

1. Institutional type (Universities and Colleges of Education) do not have any significant influence on the extent mathematics lecturers apply pedagogical ICT skills in mathematics instruction.

Materials and methods

Design of the study

The research design used in this study is a descriptive survey. According to Nworgu (2015), the design is one in which a group of individuals or objects is investigated by gathering and examining data from only a small number of individuals or objects thought to be representative of the entire group. According to Nworgu, descriptive survey studies try to gather information about and describe in a systematic way the traits, traits, or facts about a certain community. The researcher intended to gather and analyze data on the group of mathematics education lecturers in tertiary institutions in Cross River State in order to determine the extent of their pedagogical skills in the use of ICT in mathematics instruction. As a result, this design is appropriate for the study.

Participants

The population of the study is made up of all the twenty-six (26) mathematics education lecturers in the five (5) tertiary institutions in Cross River state. (Personnel Department of the various Tertiary Institutions in Cross River State). All the twenty-six (26) mathematics education lecturers of the five (5) tertiary institutions in Cross River state was used in this study. Therefore, no sampling process was carried out as the entire population constitutes the sample for the study. This is because the population is manageable.

Instruments for data collection

Questionnaire for Mathematics Lecturers' Pedagogical Skills in the application ICT (QMLPSICT) is divided into two sections; section A and B. Section A contains demographic information of the respondents (lecturers) such as institutional type. Section B comprises of a 10 item instrument structured on pedagogical skills. It was designed on a four point liker scale of very high extent (VHE), high extent (HE), low extent (LE) and very low extent (VLE) to determine the extent mathematics lecturers apply pedagogical ICT skills in mathematics instruction in the tertiary institutions. It was adopted from Afufu (2015). The researcher administered the questionnaires to mathematics education lecturers in all the tertiary institutions in the area of study. The responses collected from the respondents were subjected to further analysis.

Method of data analysis

The research questions were answered using mean and standard deviations. The mean value of 2.50 was used as a benchmark for decision, mean value below 2.50 were regarded as Low Extent (LE) while 2.50 and above were regarded as High Extent (HE). The hypothesis was tested using t – test statistic at 0.05 level of significance.

Results

Table 1: Mean and Standard Deviation of Respondents on the Extent Mathematics Lecturers Apply Pedagogical ICT Skill in Mathematics Instruction in Tertiary Institutions in Cross River State.

S/ N	Item Statement	N = 26		
		Mean ($\bar{x}$)	SD	Decision
1	Evaluating mathematics topics using specific mathematics software	2.27	0.96	LE
2	Developing mathematics websites	1.73	0.77	LE
3	Preparing ICT-based learning materials in mathematics	2.12	0.86	LE
4	Preparing schemes of work and lesson notes in mathematics using ICT	2.35	0.84	LE
5	Solving common ICT problems relating to instruction in mathematics	2.19	0.74	LE
6	Writing mathematics programmes	2.04	0.91	LE
7	Monitoring ICT teaching and learning mathematics	2.00	0.98	LE
8	Integrating ICT in mathematics	2.46	0.90	LE

9	Using ICT for teaching and learning mathematics	2.27	0.96	LE
10	Developing hardware components	1.77	0.95	LE
Grand Mean		2.11	0.54	LE

LE = Low Extent. HE = High Extent

Table 1 shows the mean and standard deviations of respondents on the extent mathematics lecturers apply pedagogical ICT skill in mathematics instruction in tertiary institutions in Cross River State. The result obtained show that items 11-20 had mean ratings of 2.27, 1.73, 2.12, 2.35, 2.19, 2.04, 2.00, 2.46, 2.27 and 1.77 with standard deviations of 0.96, 0.77, 0.86, 0.84, 0.74, 0.91, 0.98, 0.90, 0.96 and 0.95 respectively. These mean values are within the range of 1.50 – 2.49 which are below the bench mark value of 2.50 this implies low extent. This means that mathematics lecturers apply the following pedagogical ICT skills in mathematics instruction to a low extent. These include: evaluating mathematics topics using specific mathematics software, developing mathematics websites, preparing ICT-based learning materials in mathematics, preparing schemes of work and lesson notes in mathematics using ICT, solving common ICT problems relating to instruction in mathematics, writing mathematics programmes, monitoring ICT teaching and learning mathematics, integrating ICT in mathematics, using ICT for teaching and learning mathematics and developing hardware components. The grand mean rating of 2.11 with a standard deviation of 0.54 showed that mathematics lecturers apply pedagogical ICT skills in mathematics instruction to a low extent.

Table 2: Mean and Standard Deviation of Respondents on the Extent Mathematics Lecturers Apply Pedagogical ICT Skill in Mathematics Instruction in Cross River State Based on Institutional Type

S/N	Items	University (N = 8)			College of Education (N=18)		
		$\bar{x}$	SD	Dec.	$\bar{x}$	SD	Dec.
11	Evaluating mathematics topics using specific mathematics software	2.38	0.91	LE	2.22	1.00	LE
12	Developing mathematics websites	1.63	0.74	LE	1.78	0.80	LE
13	Preparing ICT-based learning materials in mathematics	2.00	0.92	LE	2.17	0.85	LE
14	Preparing schemes of work and lesson notes in mathematics using ICT	2.00	0.75	LE	2.50	0.85	HE
15	Solving common ICT problems relating to instruction in mathematics	2.00	0.92	LE	2.28	0.66	LE
16	Writing mathematics programmes	1.88	0.83	LE	2.11	0.96	LE
17	Monitoring ICT teaching and learning mathematics	1.88	0.83	LE	2.06	1.05	LE
18	Integrating ICT in mathematics	2.38	0.91	LE	2.50	0.92	HE
19	Using ICT for teaching and learning mathematics	2.38	1.06	LE	2.22	0.94	LE
20	Developing hardware components	1.25	0.46	LE	2.00	1.02	LE
Grand Mean		1.97	0.48	LE	2.18	0.56	LE

Table 2 shows the mean and standard deviations of respondents on the extent mathematics lecturers apply pedagogical ICT skill in mathematics instruction in tertiary institutions in Cross River State based on institutional type. The result obtained show that the university mathematics lecturers apply items 11-20 to a low extent. On the other hand, the colleges of education mathematics lecturers use items 14 and 18 to a high extent and apply items 11-13, 15-17, 19 and 20 to a low extent. However, the grand mean of 1.97 with a standard deviation of 0.48 for university mathematics lecturers and the cluster mean 2.18 with standard deviation of 0.56 for college of education mathematics lecturers show that mathematics lecturers in tertiary institutions in Cross River State apply pedagogical ICT skills in mathematics instruction to a low extent. Therefore, institutional type has no influence on the extent mathematics lecturers apply pedagogical ICT skill in mathematics instruction in tertiary institutions in Cross River State.

Table 3: *t-test Analysis of the Extent Institutional Type Influence Mathematics Lecturers Application of Pedagogical ICT Skills in Mathematics Instruction*

S/N	Items	Institution	$\bar{x}$	SD	t-cal	df	Sig.	Dec.
11	Evaluating mathematics topics using specific mathematics software	UNI	2.38	0.91	0.36	24	0.72	NS
		COE	2.22	1.00				
12	Developing mathematics websites	UNI	1.63	0.74	-0.45	24	0.65	NS
		COE	1.78	0.80				
13	Preparing ICT-based learning materials in mathematics	UNI	2.00	0.92	-0.44	24	0.65	NS
		COE	2.17	0.85				
14	Preparing schemes of work and lesson notes in mathematics using ICT	UNI	2.00	0.75	-1.42	24	0.17	NS
		COE	2.50	0.85				
15	Solving common ICT problems relating to instruction in mathematics	UNI	2.00	0.92	-0.87	24	0.39	NS
		COE	2.28	0.66				
16	Writing mathematics programmes	UNI	1.88	0.83	-0.69	24	0.55	NS
		COE	2.11	0.96				
17	Monitoring ICT teaching and learning mathematics	UNI	1.88	0.83	-0.43	24	0.67	NS
		COE	2.06	1.05				
18	Integrating ICT in mathematics	UNI	2.38	0.91	-0.32	24	0.75	NS
		COE	2.50	0.92				
19	Using ICT for teaching and learning mathematics	UNI	2.38	1.06	0.36	24	0.72	NS
		COE	2.22	0.94				
20	Developing hardware components	UNI	1.25	0.46	-1.96	24	0.06	NS
		COE	2.00	1.02				
Grand Mean		UNI	1.97	0.48	-0.90	24	0.37	NS
		COE	2.18	0.56				

UNI = Universities. COE = Colleges of Education

The result in Table 3 showed the t-test analysis of the extent institutional type influence mathematics lecturers' application of pedagogical ICT Skills in mathematics instruction. The result shows that there was no significant difference on items 11-20

because all the probability values are greater than 0.05 set as level of significance. The grand t-value of -0.90 with a degree of freedom of 24 and a probability value of 0.37 was obtained. Since the probability value of 0.37 is greater than 0.05, this means that the result is not significant. Therefore, the null hypothesis which stated that Institutional type do not have any significant influence on the extent mathematics lecturers apply pedagogical ICT skills in mathematics instruction is not rejected. Inference drawn therefore is that mathematics lecturers from both universities and colleges of education did not differ in their opinion on the extent of the application of pedagogical ICT skill in mathematics instruction in Cross River State. Hence, Institutional type (Universities and Colleges of education) do not have any significant influence on the extent mathematics lecturers apply pedagogical ICT skills in mathematics instruction.

Discussion

The findings indicate that mathematics lecturers in tertiary institutions in Cross River State apply pedagogical ICT skills in mathematics instruction to a low extent. These include: evaluating mathematics topics using specific mathematics software, developing mathematics websites, preparing ICT-based learning materials in mathematics, preparing schemes of work and lesson notes in mathematics using ICT, solving common ICT problems relating to instruction in mathematics, writing mathematics programmes, monitoring ICT teaching and learning mathematics, integrating ICT in mathematics, using ICT for teaching and learning mathematics and developing hardware components. This implies that mathematics lecturers have a low level of pedagogical ICT skill. This agrees with the findings of Diri (2013) who reported that mathematics teachers are not adequately competent in their pedagogical ICT skill. This finding of this study is not consistent with the expectations in UNESCO (2008) which advocate teachers' instructional practices and the knowledge of the curriculum. It requires that lecturers should be able to develop applications within their disciplines to make effective use of ICTs to support and extend teaching and learning. The finding also disagrees with Jegede, Dibu-Ojerinde and Ilori (2007) they observed that as teachers' perceived computers to be useful in their pedagogical enterprise, the interests become aroused which in turn help their computer skills.

The study also investigated the influence of institutional type on the extent mathematics lecturers apply pedagogical ICT skill in mathematics instruction in tertiary institutions. From the findings, it shows that institutional type (university and college of education) has no influence on the extent mathematics lecturers apply pedagogical ICT skill in mathematics instruction in tertiary institutions. This implies that mathematics lecturers from both universities and colleges of education apply pedagogical ICT skills to the same extent in mathematics instruction. Universities and colleges of education apply pedagogical ICT skills are applied in low extent in mathematics instruction in both the universities and colleges of education. This implies that mathematics lecturers from both universities and colleges of education have the same levels of pedagogical ICT skills. These findings disagree with the views of Onasanya, Shehu, Oduwaiye and Shehu (2010) that university lecturers possessed more ICT skills and skills than lecturers in the college of education. However, the level of skills of mathematics lecturers in the application of ICT in mathematics instructions in both the Universities and Colleges of education is

worrisome. This means that in-service training, workshops and seminars should be organized to improve the ICT pedagogical skill of lecturers.

Conclusion

The findings of this study gave rise to the following conclusions; that Mathematics lecturers in tertiary institutions in Cross River State apply pedagogical ICT skills in mathematics instruction to a low extent and institutional type (Universities and Colleges of education) do not have any significant influence ($p > 0.05$) on the extent mathematics lecturers apply pedagogical ICT skills in mathematics instruction in Cross River State.

Educational implications

The results of this study suggest that there is a pressing need to enhance mathematics lecturers' skills to apply ICT in mathematics instruction. This is clear from the study's findings, which showed that lecturers' mean scores were regarded as having low levels of pedagogical ICT skill proficiency. The majority of these ICT tools are used by math lecturers, but they aren't employed wisely in math lessons since mathematics lecturers aren't yet proficient in using ICT in lessons.

The study also showed that the institutional type (universities and colleges of education) had no discernible impact on how much mathematics teachers in Cross River State use pedagogical ICT skills in their classroom. This suggests that in order to develop their skills in the application of ICT in mathematics instruction, mathematics lecturers in universities and colleges of education should be exposed to ICT in-service training, workshops, and seminars.

Recommendations

The study conclusions have led to the following recommendations:

- More practical opportunities should be facilitated for lecturers in Cross River State to demonstrate their pedagogical ICT skills before employment, upgrading or promotion.
- Lecturers preparation courses should include elements of pedagogical ICT skills which will promote the integration of ICT in mathematics education.

Suggestions for further studies

1. The present study was conducted in tertiary institutions; similar study should be carried out in secondary schools.
2. The present study was conducted investigating pedagogical ICT skills. Therefore, a similar study should be conducted in personal ICT skills, subject-oriented ICT skills among others.
3. Other forms of statistical analysis should also be used to find out the pedagogical ICT skills of lecturers

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