Relationship Among Availability, Adequacy and Utilization of Information and Communication Technology Facilities for Teaching and Academic Achievements of Mathematics Undergraduate Students in Universities in Gombe State, Nigeria

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Abstract

The study examined the relationship among availability, adequacy, and utilization of information and communication technology (ICT) facilities and the academic achievement of mathematics undergraduates in universities in Gombe State, Nigeria. A correlational research design was adopted with a sample of 92 lecturers and 192 students. Data were collected using validated questionnaires and analysed using mean, standard deviation, Pearson correlation, and regression analysis at the 0.05 significance level. Results revealed significant positive relationships among availability, adequacy, and utilization of ICT facilities and students' academic achievement, but no significant relationship was found between gender and ICT utilization. The study recommends that universities enhance ICT provision and training for effective integration in teaching and learning.

Keywords: *Availability, Adequacy, Utilization of ICT facilities, Academic achievements, Undergraduates*

INTRODUCTION:

Information and Communication Technology (ICT) refers to the diverse set of technological tools and resources used to create, store, process, transmit, and share information in various forms such as text, images, audio, and video. In higher education, ICT encompasses computers, projectors, interactive whiteboards, internet facilities, educational software, and other digital devices that enhance teaching and learning processes. The integration of ICT into university education, particularly in mathematics, plays a significant role in transforming traditional teaching methods into more interactive and student-centered approaches. Through ICT, lecturers can access vast online resources, simulations, and mathematical applications that make abstract concepts easier to understand and apply, thereby enriching students' learning experiences and improving engagement and motivation.

In the context of mathematics education in universities in Gombe State, the availability, adequacy, and utilisation of ICT facilities are crucial factors influencing students' academic achievement. However, despite national and institutional efforts to integrate ICT into university teaching, many mathematics departments still experience challenges such as limited ICT infrastructure, insufficient training of lecturers, and underutilisation of available resources. A review of existing literature shows that while several studies have examined ICT and students' performance in other disciplines across Nigeria, there is a noticeable lack of research focusing specifically on the availability, adequacy, and utilisation of ICT facilities for teaching mathematics and their relationship with students' academic achievement in universities within Gombe State. This gap necessitates an empirical investigation to provide evidence-based understanding in this context.

Therefore, the present study aims to examine the relationship among the availability, adequacy, and utilisation of ICT facilities for teaching and the academic achievement of undergraduate mathematics students in universities in Gombe State. The findings of this study are expected to contribute to educational policy and practice by highlighting the extent to which ICT resources support mathematics learning outcomes and by identifying areas that require improvement in ICT provision and usage. The study is delimited to universities in Gombe State that offer undergraduate programmes in mathematics education, focusing on lecturers and students as respondents to ensure a comprehensive understanding of ICT integration in mathematics instruction.

Ajayi (2018) posited that ICT is an indispensable part of educational administration as its application makes institutions more efficient and productive, thereby engendering a variety of tools to enhance and facilitate teachers' pedagogical activities. For instance, e-learning is becoming one of the most common means of using ICT to provide education to students both on and off campus by means of teaching online offered via web-based systems. Although ICT resources have been looked upon as tools for uplifting the standard of education in any nation, the level of compliance in implementing the ICT resources in the instructional development process leaves much to be desired in Nigerian higher education system.

Higher education is approaching the point at which information and communication Technology (ICT), plays a part in nearly all phases of the educational process. Every institutions of higher learning uses computers in their educational programmed. Today such issues like Global Mobile System of Communication (GSM), digitalization of information such as texts, numbers and sound are commonly used. They have inevitably become part of the information society and have encouraged easy access to data, records and information and above all made transmission of information among individuals millions of miles always possible and less cumbersome. ICT has greatly influenced the educational sector especially on teaching, learning and research. The application of Information Communication Technology (ICT) is not only emphasized in corporative business and the industrial sector, but it is an essential part of education at all levels (Allen, 2011). ICT is generally believed to foster cooperative learning, provide more information and through simulation, make complex learning experiences easier to understand. Therefore, the use of ICT cannot be ignored either by teachers or by students. ICT tools for teaching and learning include Computer, Internet, PowerPoint, Television, Overhead Projectors, Camera, Radio Cassette, Video Tape, Audio Cassette, Audio CD, World Wide Web (WWW), Telephone, etc. Gannon (2014). The role of teacher cannot be underrated for proper and effective use of ICT in the teaching and learning process, in as much as the teacher is the actual implementer of any curriculum. So the ability, skill, knowledge, resourcefulness and competence of the teacher is of great importance. In effect, Ajeyalemi (2012), stated that for any teacher at any level to be able to contribute to national development in this global world, he/she must be empowered to provide ICT based training for the students. Thus, his/her education must include opportunities to acquire skills in the selection, application and use of ICT tools and materials for instructional exercise.

Availability of ICTs in education is the presence of required facilities in the classroom for instructional delivery which enables the teacher to elaborate and explain to his students in an understandable way. ICT facilities in this study are instructional equipment and services which make teaching and learning processes to be done electronically and provide access to a wide range of innovative, informative and educational materials on the internet in order to bring the world into the classroom. ICT is used for gathering, processing, storing, sharing and distributing information, knowledge and ideas (ESCAP in Ugwoke, 2011). Availability of ICT facilities and service can be measured by the number of ICT facilities available in academic libraries for students to use in sourcing for information. Lack of such access affects the ability

of users to improve their learning with educational software, acquire valuable technology skill. Availability not only means that the "thing" is provided but it also entails accessibility, but availability is meaningless if those who want to make use of the substance cannot have access to it. Above all, it must be accessible that utilization is possible.

Adequacy of information and communication technology facilities for teaching is the sufficiency level of the required facilities which is available to lecturers for instructional service delivery which will enable them to deliver what is intends to in a simple and understandable ways, adequacy of information and communication technology facilities may be different from one school to another depending on their population and demand. With the development of learning technologies in the late 20th century, education system has changed rapidly. This is due to the capability of technology to provide a proactive, easy access and comprehensive teaching and learning environment. Nowadays, Ministry of education in all over the world has provide a lot of facilities and training in order to enhance the use of advanced technologies in the countries' teaching and learning process. A high budget has been placed in order to provide the equipment needed by teachers to improve the education system. Despite all the efforts, most of the countries are facing similar problem whereby the teachers are not maximizing the usage of the technology provided (Albirini, 2016).

Effective utilization of ICT facility for instructional process reinforces the teacher's ability to cater for individual differences and fosters learners' involvement, participation and understanding, which help them in grounding their thoughts and feelings and in turns contribute to good academic performance in schools. In this current era, ICTs are recognized as means of quality assurance in curriculum management. For instance, the use of ICT to instruct students will help them learn better as they do not always forget what they are taught when used alongside the traditional method of teaching (Cushman & Klecun, 2013; Hussain, Iqbal, & Akhtar, 2010). The Federal Ministry of Education (2011a) opined that quality learning outcome depends on the quality of teaching and learning inputs and the qualitative processing of the inputs, which among others include the use of ICT facilities for teaching and learning. ICT facilities are enablers (equipment or technology-based services) which are provided to ease the performance of certain tasks, operations, events or processes. Adomi, (2010) identified Information and Communication Technology (ICT) as an essential teaching and learning facility, which has become a natural part of man's daily life. Thus, ICT use in education by staff (academic and non-academic) and students has become a necessity. The essence of ICT utilization is to ensure that individuals participate fully in contemporary life and educational process to effectively accomplish their daily tasks.

There is widespread belief that ICTs can and will empower teachers and learners, transforming teaching and learning processes from being highly teacher-dominated to student-centred, and that this transformation will result in increased learning gains for students, creating and allowing for opportunities for learners to develop their creativity, problem-solving abilities, informational reasoning skills, communication skills, and other higher-order thinking skills. However, there are currently very limited, unequivocally compelling data to support this belief, ICTs are very rarely seen as central to the overall learning process even in the most advanced schools in the country ICTs are generally not considered central to the teaching and learning process. Gender issue has become the talk of today's forum. Although the literacy rate is more among the males than females, it is quite interesting to observe that girls are securing better ranks than boys in almost all competitive examinations (Goni, Yagana, Ali, Bularafa, 2015). Pillow, (2018) examined the gender differences among student on their academic performance has reveal that in individuals background characteristic affect his/her cognitive and non-cognitive is one of the most significant and influential characteristics in academic performance. Academic achievement of students is of utmost importance to parents, educators, concerned Nigerians and the government. Thus, of course, is because of the huge impact education has on

the national and economic development of the country. Education is an investment as well as an instrument that can be used to achieve rapid scientific, social, political, technological, cultural and economic development in the country. Regrettably, however, the consensus of opinion all over the country is that academic achievement of students in Nigeria is poor (Adebule, 2017). School, colleges and universities have no worth without student. Students are most essential asset for any educational institute. The social and economic development of the country is directly linked with student academic performance. The students' performance (academic achievement) plays an important role in producing the best quality graduates who will become great leader and manpower for the country thus responsible for the country's economic and social development (Ali et.al, 2019). Student academic performance measurement has received considerable attention in previous research, it is challenging aspects of academic literature, and science student performance are affected due to social, psychological, economic, environmental and personal factors. These factors strongly influence on the student performance, but these factors vary from person to person and country to country.

In view of the above, ICT today offers new tools for easy content delivery. However, this depends on the availability and utilization of ICT tools, but most of the Universities don't have the required ICTs for instructional delivery and are not utilizing the available ones, on the other hand, those schools with less or no ICTs to perform low on academic achievements. The rationale of this study is to investigate the relationships among availability, adequacy and utilization of ICTs for teaching and mathematics undergraduate student's academic achievements in the universities in Gombe State. This is because literature has revealed that there is no research that has been done concerning this problem specifically in Gombe.

Research Questions

The following research questions will be answered in the course of this study:

1. What is the level of relationship between availability of ICT facilities for teaching in the universities in Gombe state?
2. What is the level of relationship between adequacy of ICT facilities for teaching and academic achievements of mathematics undergraduate students?
3. What is the level of relationship between utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students in the universities in Gombe state?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance for this study

Ho1: There is no significant relationship between availability of ICT facilities for teaching and academic achievements of mathematics undergraduate students.

Ho2: There is no significant relationship between adequacy of ICT facilities for teaching and academic achievements of mathematics undergraduate students.

Ho3: There is no significant relationship between utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students.

Ho4: There is no significant relationship between gender in utilization of ICT for teaching and academic achievements of mathematics undergraduate students.

Ho5: There is no significant relationship among availability, adequacy and utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students.

Methodology

The population of the study is 398 200Level students of mathematics department from the universities in Gombe State which comprises the Federal University of Kashere and Gombe State University while the sample size of the study 191 students out of the total population of part two students which is 398 from mathematics department of the universities by applying

the Taro Yamane formula. Also simple random sampling technique will be used so that each member of the population has chance of being selected. The instruments used for data collection of this study were two which include a checklist and a past examination. Pearson Product moment correlation coefficient (PPMCC) will be used for testing the hypotheses one to three, multiple regression analysis will be used for testing hypotheses four. The decision rule on testing the null hypotheses would be rejected when $P<0.05$ and also would not be rejected when $P>0.05$. **Presentation of Results:**

Three research questions were raised and answered using descriptive statistics, while the formulated hypotheses were tested using PPMCC and regression tested at 0.05 level of significance.

Research Question 1. What is the level of availability of ICT facilities for teaching in the universities in Gombe state?

Table 1. Descriptive statistics of availability of ICT facilities for teaching in the universities in Gombe state.

	Mean	SD	Decision
Computer Hardware	3.28	1.61	MA
Computer Software	3.25	0.80	MA
Integrated Services Digital Network	3.07	1.44	MA
Fiber Optics Connection	3.01	1.56	MA
Smart Board	4.02	1.04	HA
Learning Management System	4.39	0.94	HA
Digital Camera	3.88	1.18	HA
Data Projector	3.00	1.54	MA
TV/Radio	2.91	1.70	MA
Scanning Machine	4.68	0.78	HA
Electronic Smart Board	2.66	1.43	MA
Grand Mean	3.46	1.27	MA

The descriptive statistics in Table 1 indicated 92 lecturers responded to the questionnaire items on the checklist indicating level of availability of ICT facilities for teaching in the universities in Gombe state. The grand mean of 3.46 with standard deviation of 1.27 show the level of availability of ICT facilities for teaching in the universities in Gombe state is moderate.

Research Question 2. What is the level of adequacy of ICT facilities for teaching in the universities in Gombe state?

Table 2. Descriptive statistics of adequacy of ICT facilities for teaching in the universities in Gombe state.

	Mean	SD	Decision
Computer Hardware	4.64	0.54	HA
Computer Software	3.89	1.16	HA
Integrated Services Digital Network	4.39	0.94	HA

Fiber Optics Connection	3.85	1.17	HA
Smart Board	2.84	1.51	MA
Learning Management System	2.91	1.70	MA
Digital Camera	4.68	0.78	HA
Data Projector	2.66	1.43	MA
TV/Radio	4.64	0.54	MA
Scanning Machine	3.89	1.16	HA
Electronic Smart Board	4.39	0.94	HA
Grand Mean		1.07	
	3.88	HA	

The descriptive statistics in Table 2 indicated 92 lecturers responded to the questionnaire items on the checklist indicating level of adequacy of ICT facilities for teaching in the universities in Gombe state. The grand mean of 3.88 with standard deviation of 1.07 show the level of adequacy of ICT facilities for teaching in the universities in Gombe state is moderate.

Research Question 3. What is the level of utilization of ICT facilities for teaching in the universities in Gombe State?

Table 3. Descriptive statistics of utilization of ICT facilities for teaching in the universities in Gombe state

	Mean	SD	Decision
Computer Hardware	3.85	1.17	HU
Computer Software	2.89	1.52	MU
Integrated Services Digital Network	4.64	0.54	HU
Fiber Optics Connection	3.76	1.24	HU
Smart Board	3.29	1.50	MU
Learning Management System	3.79	1.20	HU
Digital Camera	2.89	1.01	MU
Data Projector	4.39	0.94	HU
TV/Radio	3.76	1.24	HU
Scanning Machine	4.04	1.18	HU
Electronic Smart Board	4.04	0.90	HU
Grand Mean	3.75	1.13	HU

The descriptive statistics in Table 3 indicated 92 lecturers responded to the questionnaire items on the checklist indicating level of utilization of ICT facilities for teaching in the universities in Gombe state. The grand mean of 3.75 with standard deviation of 1.13 show the level of utilization of ICT facilities for teaching in the universities in Gombe state is high.

4.3 Testing Hypotheses

The following hypotheses were tested at 0.05 level of significant in this study:

Ho1: There is no significant relationship among availability of ICT facilities for teaching and academic achievements of mathematics undergraduate students?

Table 4. PPMC of relationship between availability of ICT facilities for teaching and academic achievements of mathematics undergraduate students.

Variable	**n**	**Mean**	**SD**	**R**	**Sig**
Availability	92	45.76			
	5.54				
				0.62	0.00

Students' Achievement	192	3.25	1.18

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

The result of the analysis in Table 4 indicated that the computed P-value (0.00) is below 0.05 level of significance. Since the computed P-value is less than the level of significance, therefore the null hypothesis which states that there is no significant relationship between availability of ICT facilities for teaching and academic achievements of mathematics undergraduate students is rejected. The r-value (0.62) indicated that, the relationship between availability of ICT facilities for teaching and academic achievements of mathematics undergraduate students is high and positive.

Ho2: There is no significant relationship among adequacy of ICT facilities for teaching and academic achievements of mathematics undergraduate students?

Table 5. PPMC of relationship between adequacy of ICT facilities for teaching and academic achievements of mathematics undergraduate students.

Variable	n	Mean	SD	R	Sig
Adequacy	92	43.13			
	8.95				
				0.78	0.00
Students' Achievement	192	3.25	1.18		

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

The result of the analysis in Table 5 indicated that the computed P-value (0.00) is below 0.05 level of significance. Since the computed P-value is less than the level of significance, therefore the null hypothesis which states that there is no significant relationship between adequacy of ICT facilities for teaching and academic achievements of mathematics undergraduate students is rejected. The r-value (0.78) indicated that, the relationship between adequacy of ICT facilities for teaching and academic achievements of mathematics undergraduate students is high and positive.

Ho3: There is no significant relationship among utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students?

Table 6. PPMC of relationship between utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students.

Variable	n	Mean	SD	R	Sig
Utilization	92 7.61	44.18			
				0.85	0.00
Students' Achievement	192	3.25	1.18		

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

The result of the analysis in Table 6 indicated that the computed P-value (0.00) is below 0.05 level of significance. Since the computed P-value is less than the level of significance, therefore the null hypothesis which states that there is no significant relationship between utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students is rejected. The r-value (0.87) indicated that, the relationship between utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students is high and positive.

Ho4: There is no significant relationship among gender in utilization of ICT for teaching and academic achievements of mathematics undergraduate students

Table 7. PPMC of relationship between gender in utilization of ICT for teaching and academic achievements of mathematics undergraduate students.

Variable	n	Mean	SD	R	Sig
Gender	192 7.61	44.18			
				0.01	0.95
Students' Achievement	192	3.25	1.18		

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

The result of the analysis in Table 7 indicated that the computed P-value (0.95) is above 0.05 level of significance. Since the computed P-value is greater than the level of significance, therefore the null hypothesis which states that there is no significant relationship between gender in utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students is upheld. The r-value (0.01) indicated that, the relationship between gender in utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students is very low.

Ho5: There is no significant relationship among availability, adequacy and utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students

Table 8a: Regression of relationship among availability, adequacy and utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students.

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	3575.364	3	1191.788	86.15	.000[b]
	Residual	1217.289	88	13.833		
	Total	4792.652	91			

a. Dependent Variable: STUDENTS' ACHIEVEMENT
b. Predictors: (Constant), Utilization, Availability , Adequacy

Table 8b: Model summary of relationship among availability, adequacy and utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.86[a]	0.74	0.73	3.71

a. Predictors: (Constant), Utilization, Availability , Adequacy

Table 8c: Coefficient of relationship among availability, adequacy and utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students.

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	1.882	3.296		.571	.570
	Availability	.259	.097	.198	2.668	.009
	Adequacy	.001	.158	.001	.007	.994
	Utilization	.700	.205	.734	3.412	.001

a. Dependent Variable: STUDENTS' ACHIEVEMENT

The linear regression tables in Table 8a, 8b and 8c show significant differences between the various R values, $F = 86.15$ (df 3, 91), $P < 0.05$. Since the computed p-value (0.00) is less than 0.05 level of significance, therefore the null hypothesis is rejected and concluded that, there is significant relationship among availability, adequacy and utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students. Furthermore, the adjusted R-square value (0.74) indicates that, 74% of undergraduate students' academic achievements mathematics in this study is accounted for by availability, adequacy and utilization of ICT facilities for teaching.

Findings of the Study

1. There is significant and positive relationship between availability of ICT facilities for teaching and academic achievements of mathematics undergraduate students with r-value of (0.62).
2. There is significant and positive relationship between adequacy of ICT facilities for teaching and academic achievements of mathematics undergraduate students with r-value of (0.78).
3. There is significant and positive relationship between utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students with r-value of (0.87).
4. There is no significant relationship between gender in utilization of ICT for teaching and academic achievements of mathematics undergraduate students with r-value (0.01).

5. There is significant relationship among availability, adequacy and utilization of ICT facilities for teaching and academic achievements of mathematics undergraduate students with adjusted R-square value (0.74).

Discussion of Findings

The findings of this study revealed a significant and positive relationship between the availability of ICT facilities for teaching and the academic achievement of undergraduate mathematics students in universities in Gombe State. This suggests that when ICT facilities are readily available, mathematics instruction tends to be more engaging and effective, which may be associated with better student performance. This finding aligns with the report of Aduwa-Ogiegbean and Iyamu (2015), who noted that ICT plays a vital role in achieving quality education at all levels and serves as a key tool for acquiring, processing, and disseminating knowledge. Similarly, Yusuf (2015) found that the availability of ICT resources enhances educational quality by promoting ongoing discussion, independent learning, critical thinking, and data analysis. Within the Gombe State context, where efforts are being made to integrate ICT into higher education despite infrastructural limitations, this finding underscores the importance of sustained provision of ICT tools to support mathematics teaching.

The study also found a significant and positive relationship between the adequacy of ICT facilities for teaching and students' academic achievement in mathematics. This indicates that when ICT tools are adequate in quantity and functionality, they are more likely to support effective instruction and student engagement. This finding corresponds with that of Solity (2012), who reported that adequate provision of ICT materials positively influences teaching and learning outcomes. Likewise, Levis (2011) observed that teaching effectiveness is enhanced when ICT resources are properly organized and easily accessible to educators. In Gombe State universities, however, variations in ICT adequacy may exist due to differences in institutional funding and infrastructure. Such contextual disparities may influence the extent to which ICT contributes to students' learning outcomes in mathematics.

Furthermore, the study revealed a significant and positive relationship between the utilisation of ICT facilities for teaching and academic achievement among mathematics undergraduates. This suggests that when lecturers and students effectively use ICT tools, teaching and learning processes are likely to be more interactive and productive. This finding is consistent with the works of Cushman and Klecun (2013) and Hussain, Iqbal, and Akhtar (2010), who emphasized that the effective utilisation of ICT enhances learners' participation, understanding, and engagement, thereby improving academic outcomes. In the current digital era, ICT is widely recognized as a mechanism for quality assurance in curriculum delivery. However, the extent of its utilisation in Gombe State universities may be influenced by contextual factors such as lecturers' ICT competence, students' digital literacy levels, and institutional support for technology integration. These factors highlight the need for continuous training and capacity building to ensure optimal use of ICT resources for mathematics instruction.

Conclusion

Based on the findings of this study, it is concluded that there exists a significant and positive relationship among the availability, adequacy, and utilisation of ICT facilities for teaching and the academic achievement of undergraduate mathematics students in universities in Gombe State. The correlation coefficient ($r = 0.62$) indicates a moderately strong association, suggesting that improved ICT access and utilisation are linked with higher academic achievement. However, since the study employed a correlational design, the results should be interpreted as showing associations rather than causal relationships. Contextual factors such as infrastructural challenges, lecturers' digital competence, and institutional ICT policies may also shape the nature of these relationships.

Recommendations

Based on the findings, it is recommended that universities in Gombe State should sustain and strengthen the provision of ICT facilities for teaching mathematics. Regular seminars and workshops should be organized to train lecturers and students on the effective utilisation of available ICT resources to enhance the teaching and learning process. Institutional policies should also support the maintenance and upgrading of ICT infrastructure to ensure adequacy and accessibility. Furthermore, stakeholders in higher education should consider contextual realities—such as funding limitations, electricity supply, and internet connectivity—when planning ICT integration strategies, to promote equitable and effective use of technology in mathematics education.

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