NIGERIAN ONLINE JOURNAL OF EDUCATIONAL SCIENCES AND TECHNOLOGY
nojest.unilag.edu.ng
nojest@unilag.edu.ng

INFLUENCE OF INFORMATION AND COMMUNICATION TECHNOLOGY ON SCIENCE UNDERGRADUATE STUDENTS' ACADEMIC PERFORMANCE AND 21ST-CENTURY SKILLS ACQUISITION

OKUNUGA, RACHAEL O.
Department of Science Education, University of Lagos, Nigeria.
rokunuga@unilag.edu.ng

To cite this article:
Okunuga, R. O. (2025). Influence of information and communication technology on science undergraduate students' academic performance and 21st-century Skills Acquisition. Nigerian Online Journal of Educational Sciences and Technology (NOJEST),7 (1), 1-10

Nigerian Online Journal of Educational Sciences and Technology (NOJEST)

Volume 7, Number 1,2025

INFLUENCE OF INFORMATION AND COMMUNICATION TECHNOLOGY ON SCIENCE UNDERGRADUATE STUDENTS' ACADEMIC PERFORMANCE AND 21ST-CENTURY SKILLS ACQUISITION

OKUNUGA, RACHAEL O.

Article Infor

Article History

Received:
05 January 2025

Accepted:
March 07, 2025

Keywords
ICT, skills acquisition, digital age, academic performance, undergraduates

Abstract
Information and communication technology (ICT) has played a pivotal role in the activities of undergraduate students in universities across the globe in this digital age. The perception of chemistry undergraduates on the influence of information and communication technology on students' academic performance and acquisition of twenty-first-century skills was investigated in this study. Four research questions and four hypotheses guided the research. A descriptive survey design was adopted, and structured questionnaires were administered to 180 students randomly selected from one public university in Lagos State. The data collected were analysed using descriptive statistics, while the hypotheses were tested using the frequency cross-tabulation statistics and independent samples Mann-Whitney tests. The findings showed that most students who make use of ICT perceive a positive influence on their academic performance and acquisition of 21st-century skills. Further findings showed that both male and female perceptions of academic performance were significant and not gender sensitive. It was recommended that lecturers and students use ICT more in the classrooms for educational purposes.

Introduction

The world is changing rapidly in a lot of ways, especially in Information and Communication Technology (ICT) and, more importantly, with the evolution of artificial intelligence. ICT was defined as an umbrella term which includes the use of any special gadgets such as radio, phones, computers and satellite frameworks for different purposes. Eguavoen (2016) noted that other infrastructures such as wireless communications gadgets, videotapes, sound conferencing and even social media are used to facilitate teaching-learning without undermining the quality of instruction and learning outcomes. All these

technologies have great implications in education, our interactions in the workplace, in the community, and even at home.

In this 21st century, in particular, ICT has become fully integrated and mobilised into the educational system to aid and enhance the traditional system of instructional delivery, and to meet the demand for both student-centred learning and knowledge transfer. Ikwuka and Adigwe (2017) perceived ICT as an engine for growth and a tool for empowerment with profound implications for education, change, and socioeconomic development. The changing digitalised knowledge-based economy anticipates a shift and transition from teacher-centred instruction to the learner-centred mode of instruction. It is worth acquiring the new 21st-century knowledge, skills, and attitudes, such as communication, critical thinking, problem-solving, leadership, teamwork, and learning how to learn skills.

Alenezi (2020) found in a study that the more e-learning tools are used, the better the performance of the students and the greater the efficiency of the teachers in using the e-facilities. His findings showed that e-learning transformed education in Saudi Arabia at different levels, resulting in improvement of the learning experiences of the students. In the same vein, Erdogdu and Erdogdu (2015) showed that in Turkey, there was an improvement in the academic performance of students. Ben Youssef, Dahmani, and Ragni (2022) also found that the use of ICT has a positive effect on students' academic performance. However, Chiao and Chiu (2018) showed that there are many factors and interactions in the use of ICT and the academic performance of students. Ogujiofor, Okechukwu and Ogbuanya (2024) found that ICT has a positive effect on students' academic achievement in faith-based secondary schools in Anambra State, Nigeria.

ICT motivate students Learning and improve academic performance, but distraction is always a challenge to students in ICT usage. This is an issue of concern as it may lead to a negative impact on achievement except there is adequate monitoring to provide a form of checks and balances. This issue of distraction is not limited to secondary students alone, as observed by Awofala, Olabiyi, Awofala, Ojo, Okunuga, & Lawani (2020). A high level of distraction was observed among pre-service teachers of science, technology and mathematics (STM). Such distractions found prevalent include procrastination caused by the use of digital devices, emotional distraction and addiction to digital devices. The addiction to the use of digital devices, especially for social media instead of academic purposes, has become more common among undergraduate students. There are instances of misuse of search engines for assignments and class work, whereby students engage in a 'cut and paste' syndrome. This has led to restrictions on the use of digital devices in the classrooms and at times for academic purposes. Digital distraction is becoming more prevalent with the introduction of artificial intelligence.

The term 21st-century skills is generally accepted not to have a specific definition. They are described as the skills that are required for success in a complex and changing world (Lamry and Lubart, 2021). There are four types of 21st-century skills usually referred to as the 4Cs; these are critical thinking skills, collaboration skills, communication skills, and creativity skills. The teaching and assessment of the 4Cs, as stated by Thornhill-Miller, Camarda, Mercier, Burkhardt, Morisseau, et.al (2023), will require educational resources and a paradigm shift from the usual pedagogy used in teaching. They therefore advocated for the use of digital technologies in teaching and learning for the acquisition of these skills. However, Awofala, Ojo, Okunuga, Babajide, Olabiyi and Adenle (2019) opined that 21st-century skills are difficult to assess in students, since these skills are not taught in separate, stand-alone subjects. In their study, they found that STM students have low perception in critical thinking and reasoning, information literacy, self-direction and invention in education. The lack of effective methods of evaluation necessitates the use of the perception of the students as an alternative means of getting information on their acquisition of 21st-century skills.

Statement of the Problem

It has been established that science students get involved more in the use of ICT, and various research have shown that ICT is effective in improving academic performance of students, as well as, in encouraging acquisition of skills though distractions caused by the use of digital devices, which hampers academic performance of students have also been reported. Therefore, there is a necessity to get the perception of science undergraduates on the influence of ICT on academic performance and skills acquisition. It is also a general observation that 21st-century skills are not taught and evaluated directly in courses offered by science undergraduates. This lack of effective evaluation of the 21st-century skills acquisition among students necessitates the use of the perception of the students as an alternative means of getting information on their acquisition of 21st-century skills. Therefore, there is a need to get the perception of the science students in tertiary institutions on the effective use of ICT for their academic improvement and skills acquisition, hence this study.

Purpose of the Study

The study aimed at investigating the perception of university science students on the influence of ICT on their academic performance and acquisition of 21st-century skills. Specifically, the study 1. Assessed the level of ICT skills of science undergraduates.

2. Examined the extent science undergraduates use ICT for academic purposes.
3. Examined the perceptions of science undergraduates on the influence of ICT skills on academic performance
4. Assessed the perceptions of science undergraduates on the influence of ICT skills on the acquisition of 21st-century skills.

Research Questions

1. What is the level of ICT skills of science undergraduates?
2. To what extent do science undergraduates use ICT for academic purposes?
3. What are the perceptions of science undergraduates on the influence of ICT skills on academic performance?
4. What are the perceptions of science undergraduates on the influence of ICT skills on the acquisition of 21st-century skills?

Research Hypotheses

This research tested the following null hypothesis

H_{01}: There is no significant difference in the influence of ICT skills on the academic performance of science undergraduates by gender.

H_{02}: There is no significant difference in the perceptions of science undergraduates by gender on the influence of ICT skills on the acquisition of 21st-century skills.

H_{03}: There is no significant relationship between the extent of using ICT for academic purposes and whether ICT skills influence better academic performance.

H_{04}: There is no significant relationship between the extent of using ICT for academic purposes and perceptions of science undergraduates on the influence of ICT skills on the acquisition of 21st-century skills.

Methodology

This study employed a descriptive survey research design, utilizing structured questionnaires as the primary instrument for data collection. The target population comprised undergraduate students enrolled in science education programs at a university level. A total of 180 science education undergraduates were randomly selected from a public university located in southwestern Nigeria, forming the study sample. The data collection instrument consisted of closed-ended questionnaire items, which were distributed to the selected participants. Out of the 180 questionnaires administered, 153 were duly completed and returned, yielding a valid response rate of approximately 85%. Data analysis was conducted using descriptive statistical methods, specifically the computation of means and standard deviations. To test the research hypotheses, inferential statistical techniques were employed, including frequency cross-tabulations and the Mann-Whitney U test for independent samples.

Results

Table 1 below answered research questions 1-4

Table 1:

Descriptive statistics of the Level of Usage, perception of science undergraduates on the use and extent of use of ICT for academic purposes and on the influence of ICT on the acquisition of 21st-century skills

	N	Minimum	Maximum	Mean	Std. Deviation
Usage of ICT	153	1.00	3.00	2.0196	.29179
Extent of using ICT for academic purposes.	151	1.00	2.00	1.9536	.21096
ICT skills influence better academic performance.	153	1.00	4.00	3.3268	.49776
Perceptions of SU on the influence of ICT skills on the acquisition of 21st Century skills	153	1.00	4.00	3.3791	.50009

Research Question 1: What is the level of ICT Usage by science undergraduates?

Based on the results presented in Table 1, the mean score for ICT usage among science undergraduate students was 2.0196, with a standard deviation of 0.292. Given that the response scale ranges from 1 to 3, the midpoint (or average benchmark) is 2.00. Since the obtained mean slightly exceeds this midpoint, it can be inferred that the level of ICT usage among the respondents is marginally above average. Therefore, it is reasonable to conclude that science undergraduates demonstrate a moderately high level of ICT utilization in their academic activities.

Research Question 2: To what extent do science undergraduates use ICT for academic purposes?

ICT Usage for Academic Purposes

According to the descriptive statistics presented in Table 1, the mean score of 1.9536—on a scale ranging from 1 to 2—suggests that most science undergraduate students actively utilize ICT for their academic activities. This high level of engagement is consistent with expectations, as ICT tools are integral to the

study and practice of science at the undergraduate level. The near-maximum mean value indicates that ICT is a commonly adopted resource among these students, reinforcing its role as a critical component of science education.

Research Question 3: What are the perceptions of science undergraduates on the influence of ICT skills on academic performance?

Table 1 shows that science undergraduates were to respond to a four Likert scale questionnaire, ranging from Strongly Disagree to Strongly Agree, to determine their perceptions on the influence of ICT skills on academic performance. A mean higher than 2.5 indicates that most of the students agreed or strongly agreed with the statement that ICT skills influence students' academic performance. From Table 1, a high mean of 3.3268 with a standard deviation of 0.498 is obtained. Hence, it can be concluded that ICT skills influence students' academic performance.

Research Question 4: What are the perceptions of science undergraduates on the influence of ICT skills on the acquisition of 21st-century skills?
Here's a refined version of your paragraph with improved academic tone, clarity, and structure:

The final variable presented in Table 1 directly addresses the corresponding research question. A high mean score of 3.3791 was recorded on a four-point Likert scale, indicating that a majority of the science undergraduate respondents either agreed or strongly agreed that ICT skills significantly influence the acquisition of 21st-century skills. This finding underscores the perceived importance of ICT competence in fostering critical skills such as communication, collaboration, creativity, and problem-solving—skills that are essential for success in the modern academic and professional landscape.

Research Hypotheses

H_{01}: There is no significant difference in the influence of ICT skills on the academic performance of science undergraduates by gender.

The hypothesis was tested using the frequency cross-tabulation statistics and the Independent samples Mann-Whitney Tests.

Table 2: ICT skills influence better academic performance * Gender Cross-tabulation

		Gender		Total
		Male	Female	
SD	% within Gender	0.0%	0.0%	0.0%
D	% within Gender	0.0%	2.1%	1.3%
A	% within Gender	58.5%	67.0%	64.0%
SA	% within Gender	41.5%	30.9%	34.7%
Total	Count	53	97	150
	% within Gender	100.0%	100.0%	100.0%

Table 2 shows the frequency cross-tabulation of ICT skills, influencing better academic performance with gender classification. The table showed that about 98.7 % of the students agreed or strongly agreed that ICT skills influence better academic performance. Looking at the percentage gender differences on the

scales, there is a difference of 8.5% between males and females on those who agreed to the statement, with 67% of the females in agreement. However, there is a difference of 10.6% in those who strongly agreed within the gender, with males having 41.5%. When these are put together, that is, those in agreement with those who strongly agreed, we have females as 97.9% while all the males, that is, 100%, are in the category. The difference between male and female is just 2.1%, which may not be significant. This is tested using the independent sample Mann-Whitney U test, and the result is displayed in Table 3.

Table 3: Nonparametric Tests

	Null Hypothesis	Test	Sig	Decision
1	The distribution of ICT skills influences better academic performance is the same way across categories of Gender.	Independent-Samples Mann-Whitney U Test	.153	Retain the null hypothesis
2	The distribution of perceptions of science undergraduates on the influence of ICT skills on the acquisition of 21st-century skills is the same across categories of Gender	Independent-Samples Mann-Whitney U Test	.020	Reject the null hypothesis

The significance level is .05.

Table 3 shows that there is no significant difference in the influence of ICT skills on the academic performance of science undergraduates across the categories of gender, given a non-significant value of 0.153. Hence, the influence of ICT skills on the academic performance of science undergraduates is not gender biased. Therefore, the null hypothesis is accepted, that is, there is no significant difference in the influence of ICT skills on the academic performance of science undergraduates by gender.

Hypothesis 2

H_{02}: There is no significant difference in the perceptions of science undergraduates by gender on the influence of ICT skills on the acquisition of 21st-century skills.

Table 4: Perceptions of SU on the influence of ICT skills on acquisition of 21st Century skills * Gender Cross-tabulation

		Gender		Total
		Male	Female	
SD	% within Gender	0.0%	0.0%	0.0%
D	% within Gender	0.0%	1.0%	0.7%
A	% within Gender	49.1%	67.0%	60.7%
SA	% within Gender	50.9%	32.0%	38.6%
	Count	53	97	150
	% within Gender	100.0%	100.0%	100.0%

As it was reported in hypothesis 1, the results from Tables 3 and 4 were examined, and the following inferences were drawn. Table 4 shows that about 99.3% of the students have perceptions that either agreed or strongly agreed that ICT skills influence the acquisition of 21st-century skills. Looking at this percentage by gender, the perceptions of science undergraduates on the influence of ICT skills on the acquisition of

21st-century skills among those who agreed were examined. We observed that only 49.1% of the males agreed as against 67% of the females, which gives a wide difference of 17.9%. Similarly, among those who strongly agreed, 50.9% of the male students strongly agreed and only 32% of the female students did, which also resulted in a wide difference of 18.9% between the male and the female. These differences can be ascertained whether they are statistically significant or not. To do this, we carry out an independent sample Mann-Whitney U test, and the result is given in Table 3. We observed from Table 4 that there is a statistically significant difference between males and females in the perceptions of science undergraduates on the influence of ICT skills on the acquisition of 21st-century skills. The significant value of 0.020 at a 5% significance level indicates that the null hypothesis is rejected therefore, the alternative hypothesis is accepted. Hence, the perceptions of science undergraduates on the influence of ICT skills on the acquisition of 21st-century skills differ across genders.

Hypothesis 3

H_{03}: There is no significant relationship between the extent of using ICT for academic purposes and whether ICT skills influence better academic performance.

Table 5 describes the relationship between three variables, namely, the extent of using ICT for academic purposes by science undergraduates and whether ICT skills influence better academic performance, as well as the perceptions of science undergraduates on the influence of ICT skills on the acquisition of 21st-century skills.

Table 5: Non-parametric Correlations

Spearman's rho		extent of using ICT for academic purposes	ICT skills influence better academic performance	Perceptions of SU on the influence of ICT skills on the acquisition of 21st Century skills
extent of using ICT for academic purposes	Correlation Coefficient	1	.195*	.109
	Sig. (2-tailed)	.	.017	.183
	N	151	151	151

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

** Correlation is significant at the 0.01 level (2-tailed).

Table 5 shows the relationship between the extent of using ICT for academic purposes and whether ICT skills influence better academic performance, has a correlation coefficient of 0.195, which is significant at the 0.05 level, with a p-value of 0.017. Hence, there is a significant relationship between the extent of using ICT for academic purposes and whether ICT skills influence better academic performance. The null hypothesis is rejected, and the alternative is accepted. Therefore, it can be concluded that the extent of using ICT for academic purposes by science undergraduates is significantly related to ICT skills, influencing better academic performance.

Hypothesis 4

H_{04}: There is no significant relationship between the extent of using ICT for academic purposes and perceptions of science undergraduates on the influence of ICT skills on the acquisition of 21st-century skills. From Table 5, the relationship between the extent of using ICT for academic purposes and perceptions of science undergraduates on the influence of ICT skills on the acquisition of 21st-century skills has a non-significant p-value of 0.183 and a correlation coefficient of 0.109 at the 0.05 level. Hence, we accept the null hypothesis that there is no significant relationship between the extent of using ICT for academic purposes and perceptions of science undergraduates on the influence of ICT skills on the acquisition of 21st-century skills.

Discussion of Findings

Science undergraduates hold the perspective that the use of ICT enhances their academic performance as well as the acquisition of 21st-century skills. This is in line with various studies that reported improvement in the academic performance of students at various levels of education (Alenezi, 2020; Ogujiofor, Okechukwu and Ogbuanya, 2024). However, there are reports also of distractions as students make use of ICT tools for purposes other than academic, even during classes (Awofala, Olabiyi, Awofala, Ojo, Okunuga, & Lawani, 2020). The findings from this study also revealed that ICT enhances the acquisition of 21st-century skills. Okunuga, Ojo, and Okafor (2022) found that the use of virtual chemistry laboratory enhances the acquisition of practical skills among secondary chemistry students.

Findings on gender showed that the acquisition of 21st-century skills is not significantly gender sensitive. This aligns with the study of Bagheri and Ghanizadeh (2016) that reported that the acquisition of critical thinking skills, which is one of the major types of 21st-century skills, is not gender biased.

Conclusions

ICT has been found to improve the academic performance of science undergraduate students and also to enhance the acquisition of 21st-century skills. However, there is a need for the proper usage of ICT for academic purposes and skills acquisition because of the various distractions that are associated with its use.

Recommendations

The study recommended that ICT should be engaged by lecturers and students in the classrooms to make a meaningful impact on the academic work of the students. Also, 21st-century skills should be integrated into discipline-specific courses.

References

Alenezi, A. (2020). The role of e-learning materials in enhancing teaching and learning behaviors. *International Journal of Information and Education Technology*, 10*(1)*, 48-56 10.18178/ijiet.2020.10.1.1338

Atim, T. W. (2017). Impact of Information and Communication Technologies (ICT) on Student's Academic Performance in Post-Secondary Schools: Case Study of Federal College of Agriculture, Ishiagu, Ivo LGA, Ebonyi State-Nigeria. *European Journal of Computer Science and Information Technology, 5*(3), 41-48.

Awofala, A.O.A., Olabiyi, O.S., Awofala A. A., Ojo, O. T., Okunuga, R.O., & Lawani, A.O. (2020). Investigating Digital Distraction among Pre-service Science, Technology and Mathematics Teachers in Nigeria. *Digital Education Review*, 37, 32-48.

Awofala, A.O.A, Ojo, O. T., Okunuga, R.O., Babajide, V.F.T., Olabiyi, O.S., & Adenle, S.O. (2019). Investigating perception of the 21st century skills among Nigerian pre-service Science, Technology and Mathematics (STM) teachers. *International Online Journal of Educational Sciences* 11(5), 1-12.

Bagheri, F. & Ghanizadeh, A. (2016). Critical thinking and gender differences in academic self-regulation in higher education. *Journal of Applied Linguistics and Language Research, 3*(3), 133-145

Ben Youssef, A., Dahmani, M., Ragni, L. (2022). ICT Use, Digital Skills and Students' Academic Performance: Exploring the Digital Divide. *Information, 13*, 129. https:// doi.org/10.3390/info13030129

Chiao C. Chiu C. (2018). The mediating effect of ICT usage on the relationship between students' socioeconomic status and achievement. *Asia-Pac Educ Research* 27(2), 109-210.

Eguavoen E E.O. (2016). ICT utilization as correlates of academic performance among students with visual impairment in Lagos State, Nigeria. *European Scientific Journal*, 12(13), 205-224.

Erdogdu, F.; Erdogdu, E. (2015). The impact of access to ICT, student background and school/home environment on the academic success of students in Turkey: An international comparative analysis. *Comput. Educ. 82*, 26–49.

Ikwuka, O. I., Adigwe, J. E. H., (2017). Effect of ICT on secondary school students' academic performance in Christian religious studies in Oshimili North Local Government Area. *International Journal of Innovative Science, Engineering & Technology*, 4(5), 376-384.

Ishaq, K., Azan, N., Zin, M., Rosdi, F., Abid, A., & Ijaz, M. (2020). The impact of ICT on students' academic performance in public and private sector universities of Pakistan. *International Journal of Innovative Technology and Exploring Engineering*, 9(3), 1117- 1121.

Jérémy L., & Lubart T. 2021. Creativity and Its Relationships with 21st Century Skills in Job Performance. *Kindai Management Review* 9: 75–91.

Ogujiofor, C. N., Okechukwu, J. N., Ogbuanya, P. C., (2024). Impact of information and communication technology on academic achievement and character development of secondary school students in Anambra State, Nigeria. *International Journal of Research (IJR)*, 11(3), 1-17.

Okoro, C. O., & Ekpo, E. E. (2016). Effects of Information and Communication Technology (ICT) application on academic achievement of students in Christian religious studies in Cross River State. *International Journal of Interdisciplinary Research Method*, *3*(2), 14-24

Okunuga, R. O., Ojo, O. T. & Okafor, N. P. (2022). Impact of virtual chemistry lab software (VCLS) and gender on the acquisition of practical skills in acid-base titration among secondary school students. *Nigerian Online Journal of Educational Sciences and Technology (NOJEST)*, 4 (2), 22-30

Thornhill-Miller, B., Camarda, A., Mercier, M., Burkhardt, J., Morisseau, T., Bourgeois-Bougrine, S., Vinchon, F., El Hayek, S., Augereau-Landais, M., Mourey, F., Feybesse, C., Sundquist, D., and Lubart, T. (2023). Creativity, Critical Thinking, Communication, and Collaboration: Assessment, Certification, and Promotion of 21st Century Skills for the Future of Work and Education. *Journal of Intelligence* 11: 54. https://doi.org/10.3390/jintelligence11030054

Voogt, J., & Roblin, N. P. (2012). A comparative analysis of international frameworks for 21st century competences: Implications for national curriculum policies. Journal of Curriculum Studies, 44 (3), 299–321. doi:10.1080/00220272.2012.668938