

SOCIO-ECONOMIC DETERMINANTS OF INSTITUTIONAL MIGRATION TO IoT-ENABLED SYSTEMS IN PUBLIC UNIVERSITIES

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Abstract

This study investigated the socio-economic determinants of institutional migration to Internet of Things (IoT)-enabled systems in public universities in Ogun State, Nigeria. Despite the transformative potential of IoT in enhancing educational delivery through interactive learning, real-time communication, and operational efficiency, the migration of Nigerian universities toward IoT-integrated systems remains limited. The problem addressed by this study stems from uncertainty regarding the extent to which socio-economic determinants such as affordability and digital literacy influence both the adoption and subsequent usability of IoT devices during this institutional migration process. The study was guided by three research questions examining how affordability impacts IoT adoption, how affordability impacts IoT usability, and how digital literacy impacts IoT adoption within the context of institutional migration to IoT-enabled systems. Utilizing a descriptive survey research design, data were collected from 520 lecturers across public universities in Ogun State through a structured questionnaire administered via Google Forms. Means and standard deviations were employed for data analysis. Findings revealed that affordability significantly affects the adoption (grand mean=2.67) and usability (grand mean=3.00) of IoT devices during institutional migration. Additionally, digital literacy was found to impact IoT adoption to a high extent (grand mean=2.85). The study concluded that socio-economic determinants significantly influence institutional migration to IoT-enabled systems in public universities. Recommendations include implementing advanced in-training programs for lecturers, ensuring structured integration of IoT devices into university systems, improving government infrastructural support, and strengthening institutional policies to sustain and expand effective

IoT utilization during this technological transition, thereby fully realizing its potential to enhance teaching, learning, and overall university operations.

Keywords: Education, Internet of Things, Digital Literacy, Institutional Migration, Technology Adoption

Introduction

Education is a deliberate endeavour aimed at attaining specific objectives, including the transfer of knowledge, the development of skills, and the cultivation of character (Odoh, Agbanimu and Ukeh, 2025). It is seen as the cornerstone of development because it forms the basis of literacy, skill acquisition, technological advancement, knowledge acquisition, and ability to harness the natural resources of the environment (Okoro, 2024). Antai and Anam (2019), asserted that education nurtures citizens and helps to upgrade the general standard of living in a society. The education sector in any country is very important because education supplies the skilled manpower needed for the achievement of national economic goals and objectives. In the view of Adeogun (2020), education is a major instrument for tackling unemployment, poverty and ignorance. It is on this basis that the Federal Republic of Nigeria (FRN, 2013) outlined in her National Policy on Education (NPE), the cardinal aims of education which include among others;

- the development of the intellectual capacity of individuals to understand and appreciate their environment; and
- the acquisition of both physical and intellectual skills which will enable individuals develop into useful members of the community.

These skills are acquired in formal education settings from primary, secondary, and tertiary institutions such as universities, polytechnics, and colleges of education. In this study, the focus will be on university education. University education is the form of education students receive after secondary school. Udalla (2017), noted that the importance of university education lies in its position as the agent for preparing individuals for useful living in society.

One of the broad goals of university education is to prepare people for useful living in society. This has made it imperative that it should, among others; supply trained manpower in the applied sciences, technology and commerce at sub-professional levels; inspire its students with the desire for self-improvement and achievement of excellence; raise a generation of people who can think for themselves, respect the views and feelings of others; and respect the dignity of labour (Onwa, 2023). The Federal Republic of Nigeria (FRN), (2013), in her National Policy on Education, stipulates that tertiary education is education given after post-basic education in institutions, and its goals shall be to:

- *contribute to national development through high-level manpower training;*
- *provide accessible and affordable quality learning opportunities in formal and informal education in response to the needs and interests of all Nigerians;*
- *provide high quality career-counselling and lifelong learning programmes that prepare students with the knowledge and skills for self-reliance and the world of work;*

- *reduce skills shortages through the production of skilled manpower relevant to the needs of the labour market;*
- *forge and cement national unity; and*
- *promote national and international understanding and interaction. (pg 26)*

Being that teachers are the prime movers in the development of optimum conditions for learning, teachers utilize various means, such as the use of computers to achieve desired learning outcomes. According to Babalola (2023), teachers possess many qualities that are vital for effective learning within the classroom in universities. Babalola further noted that a teacher must plan ahead to set up a worthwhile learning situation and should constantly strive to develop an appropriate environment for learning. Such appropriate environments for learning no doubt include the adoption of technological devices in the university system. It must be emphasized that technological devices such as CCTV cameras, computers, laptops, tablets or smartphones, closed-circuit television (CCTV), internet, projectors, intercoms, printers, scanners, television, biometric and recognition technology have proven very useful in teaching and learning (Onyema, Ani, Nnaji, Abdullahi, Alsayed and Noorulhasan, 2019).

With the growth in the university systems in size and scope of activities, emerging technologies have provided a mechanism for teaching and learning to keep abreast of increasing demands for current and documented information (Tayo & Abass, 2021). Grades assigned to students must be recorded in some fashion, and these records must be easily and readily accessible to appropriate individuals. Currently, several educational institutions and boards in Nigeria are using some emerging technology devices and equipment to process examination results (Rex, 2023). Umeh and Ogbuabor (2024), posited that such emerging technology tools relevant in universities, among others include the Internet of Things (IoT). Institutional migration, refers to the systematic transition of universities from traditional operational and pedagogical frameworks to technology-integrated environments powered by IoT devices. This migration represents a fundamental shift in how institutions function, moving from conventional methods of teaching, learning, administration, and communication to smart, interconnected systems that leverage the capabilities of IoT technologies (Kreische, Ullrich, & Ziemann, 2025). The concept of migration is particularly apt because it implies a deliberate, structured movement from one state to another in this case, from non-IoT-integrated to IoT-enabled institutional ecosystems.

The Internet of Things (IoT) is a network of connected computing devices, mechanical and digital machinery, items, animals, or people that may exchange data across a network without requiring applications-to-applications or applications-to-computer interaction. It refers to the ever-growing network of physical objects that feature an IP address for internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices and systems (Triper, 2023). According to Rex (2023), the Internet of Things extends internet connectivity beyond traditional devices like desktop and laptop computers, smartphones, and tablets to a diverse range of devices and everyday things that utilize embedded technology to communicate and interact with the external environment, all via the Internet. Internet of Things (IoT) is a connection of a wide variety of devices with the internet, ranging from equipment with sensors (Kreische, Ullrich, & Ziemann, 2025). It is an interrelated embedded system that brings proximity of two technologies which are

wireless connectivity and smart sensor. These joined embedded technological systems are based on small microcontroller computers where the human intermediary is not needed. Instead of connecting and interacting with people, these systems have a mechanism of detecting objects which is advanced technologically and uses different sensors (Grindvoll, Vermesan, Crosbie, Bahr, Dawood, & Revel, 2022).

IoT opens up opportunities for learning because it enables learners to access, extend, transform, and share ideas and information in multi-modal communication styles and formats. It helps the learner to share learning resources and spaces, promote learner-centered and collaborative learning principles, and enhance critical thinking, creative thinking, and problem-solving skills (Iwenna, 2022). Sendoo (2023) posited that IoT devices can improve teaching methods in lecture halls and labs to more rapidly and effectively boost student interest. Kene (2022) noted that IoT systems make education more interactive, communal, and widely accessible. Additionally, they make interactive learning possible, ensure the safety of educational facilities, boost productivity, offer real-time learning experiences, and allow for close supervision. Udoka (2023) stated that to build a sophisticated environment within universities, campuses must integrate IoT technology. This is because, in reality, some of the most advantageous uses of IoT in education are the improvement of energy efficiency, exceptional communication between students and lecturers, and reduced operational costs. Idike (2023) revealed that IoT becomes more significant and capable of providing more insights when it is integrated into traditional teaching techniques. This implies that IoT converts traditional schooling into a digital paradigm; essentially, it enables the institutional migration toward smart education ecosystems.

Despite the efficacy of IoT in Education, the migration toward IoT-enabled systems in most Nigerian universities seems to be impeded as a result of socio-economic determinants. In line with this, Mgbede (2024) stated that the integration of technologies in educational institutions is still in an embryonic stage, due to socio-economic variables that call for serious attention. Sando (2024) posited that socio-economic factors significantly influence the adoption of Internet of Things (IoT) devices, creating a "digital divide" between those with advantaged socio-economic status and those without, thereby affecting the pace and success of institutional migration.

Socio-economic determinants are the social and economic conditions, like income, education, and occupation, that influence a person's or community's opportunities, resources, and quality of life, significantly impacting health, housing, food security, and overall well-being. These interconnected factors determine an individual's social standing and affect access to quality of living and life outcomes, often creating systemic disparities (Nebo, 2020). Stephanie and Deborah (2021) defined socio-economic status as an expression that is used to differentiate between people's relative status in the community regarding income, political power, educational background, and occupational status. Saifi and Mehmood (2021) submitted that socio-economic factors are a combined measure of an individual or group's income and social position relative to others based on income, education, and occupation. These socio-economic determinants, according to Rex (2023), among others, include affordability and digital literacy.

It is unfortunate that despite the promising potential of Internet of Things devices in education, there is uncertainty regarding the pace and success of institutional migration to

IoT-enabled systems in public universities in Ogun State. Research has shown that lecturers and students often face challenges in accessing educational technologies, which may limit their engagement with Internet of Things devices that enhance learning experiences. Additionally, issues such as affordability and digital literacy could further impede lecturers' and students' ability to effectively utilize Internet of Things devices during this technological transition. This suggests that a gap may exist between the potential benefits of Internet of Things devices and the actual progress of institutional migration toward IoT-enabled systems in public universities in Ogun State, Nigeria. Therefore, this study aims to bridge this gap by investigating the socio-economic determinants of institutional migration to IoT-enabled systems in public universities in Ogun State.

The objectives of this study include; to determine

1. affordability impact on the adoption of Internet of Things devices during institutional migration to IoT-enabled systems in public universities in Ogun State
2. affordability impact on the usability of Internet of Things devices during institutional migration to IoT-enabled systems in public universities in Ogun State
3. digital literacy impact on the adoption of Internet of Things devices during institutional migration to IoT-enabled systems in public universities in Ogun State

Based on the research objectives above, the researcher has coined the following questions to help steer the study:

1. To what extent does affordability impact the adoption of Internet of Things devices during institutional migration to IoT-enabled systems in public universities in Ogun State?
2. To what extent does affordability impact the usability of Internet of Things devices during institutional migration to IoT-enabled systems in public universities in Ogun State?
3. To what extent does digital literacy impact the adoption of Internet of Things devices during institutional migration to IoT-enabled systems in public universities in Ogun State?

Materials and Methods

The research design used for this study is the descriptive survey. According to Babbie (2020), the survey research method is possibly the most frequently utilized way of data gathering among scholars. Today, surveys are often used in all aspects of life. According to Bryman (2021), a survey is defined as a structured method for collecting data from a sample of respondents through standardized questionnaires, which underscores its essential role in systematic data gathering for empirical research. If the survey is properly organized and conducted, it can yield reliable and valid data. Because surveys are valuable in gauging public opinion, attitudes, and orientations that are prevalent among a sizable population at a given time, the method was deemed appropriate for this study, which involved the opinion of lecturers in public universities in Ogun State regarding the institutional migration to IoT-enabled systems.

Every step of this study's methodology was presented for checks for any form of unethical measure. All participating schools were properly informed of the study's purpose without withholding any information. The possibility that students and lecturers participating in the study will miss any lecture on the school timetable schedule was considered. However, the make-up plan for such a loss following the distribution of the questionnaire was also discussed. Lecturers' permission to serve as research assistants was sought, and it was clearly stated that students' confidentiality would be protected and they would remain anonymous. Students who need a consent letter from their parents due to restrictions or access to the computer laboratory or any internet-enabled device were also served by the school administration. Aside from the preceding, no respondents were biologically and psychologically harmed or assaulted during the research.

The sample size for this study is 560 participants. This was arrived at using the purposive stratified sampling method, given the relatively large size of the population. The purposive stratified sampling method involves dividing a population into key subgroups (strata) with the researcher's intentional selection of participants, aiming to capture variation and depth rather than statistical generalizability, ensuring rich data from specific segments like age, department, faculty, and gender (Daniels, 2023). This approach is particularly justified in the current study because it ensures representation of diverse perspectives within key segments and provides high-quality, relevant data from knowledgeable participants in each category. This study utilized the purposive stratified sampling method, meaning data were collected from a sample group of the target population. Thus, 560 lecturers in public universities in Ogun State participated in the study.

The researcher employed a structured questionnaire as the instrument for data collection in this study. Bryman (2021) defines a questionnaire as a structured instrument that systematically presents respondents with a uniform set of questions, ensuring consistency in data collection. The questionnaire was designed in Google Form format to facilitate convenient distribution and response collection from the lecturers who are spread across the state. It consisted of two sections: Section A, gathering demographic data (e.g., age, gender, and background characteristics), and Section B, capturing psychographic responses. In Section B, respondents indicated their level of agreement with statements relevant to the study's objectives on a 4-point Likert scale ranging from Very High Extent, High Extent, Low Extent, and Very Low Extent. This method offered an efficient approach for systematically gathering structured data from a large and geographically dispersed population.

Primary and secondary sources of data were used in this study. For primary data collection, a structured questionnaire was developed and distributed to respondents in a Google Form format, ensuring accessibility for lecturers. The link to the questionnaire was shared via the WhatsApp groups of each public university, allowing lecturers to complete it at their convenience. This method was chosen to facilitate efficient data collection without requiring in-person administration.

Data collected using the questionnaire were analyzed using means and standard deviations. This statistical method was selected for its effectiveness in summarizing and interpreting data, allowing for clear insights into the respondents' responses. All analyses were done using the Statistical Package for Social Sciences (SPSS) version 25.

Results and discussions

Research Question 1: To what extent does affordability impact the adoption of Internet of Things devices during institutional migration to IoT-enabled systems in public universities in Ogun State?

Table 1: Mean Responses and Standard Deviation of the Respondents on the Extent Affordability Impacts the Adoption of Internet of Things Devices During Institutional Migration to IoT-Enabled Systems in Public Universities in Ogun State
N=520

S/N	Affordability impacts the adoption of Internet of Things devices during institutional migration by;	VHE	HE	LE	VLE	$\bar{X}$	SD	DEC
1.	institutions inability to make basic applications accessible	149	140	145	86	2.68	1.06	HE
2.	institutions inability to offset platform fees	165	175	176	4	2.96	0.83	HE
3.	institutions inability to make operational savings	135	160	145	80	2.67	1.02	HE
4.	institutions inability to use wireless sensor network for collecting,	129	146	147	78	2.59	1.06	HE
5.	institutions inability to use wireless sensor network for disseminating information	149	164	159	48	2.80	0.96	HE
6.	institutions inability to use QR code to track files	153	148	124	95	2.69	1.08	HE
7.	not using Roboters to deliver books to users within the library	128	133	143	116	2.52	1.09	HE
8	not hosting service over the internet using cloud computing	115	144	133	128	2.47	1.09	LE
	GRAND MEAN					2.67	1.02	HE

From Table 1 above, the results of data analysis for research question 1 indicated that items (1,2,3,4,5,6,7) had mean responses that were higher than the cut-off point as indicated in the decision rule. The standard deviation for the items raised is small, indicating that the respondents' responses for the items raised are homogenous and closely clustered around the Mean. The value of the grand mean was also high at 2.67. Going by the decision rule for interpreting the respondents' mean score, the answer to research question 1 is that affordability to a high extent impacts the adoption of Internet of Things devices during institutional migration to IoT-enabled systems in public universities in Ogun State.

This finding aligns with the work of Batu (2022), who asserted that the cost of IoT devices, required infrastructure, and maintenance can be prohibitive for institutions, excluding them from the benefits of a connected world. Similarly, Nie (2023) found that universities lacking necessary financial and technical resources face impediments in adopting IoT technology. The high mean scores on items related to platform fees (2.96) and wireless sensor networks for disseminating information (2.80) particularly underscore the financial barriers that public universities encounter during their migration to IoT-enabled systems.

These findings suggest that without adequate financial resources, the pace and success of institutional migration to IoT-enabled systems will remain constrained.

Research Question 2: To what extent does affordability impact the usability of Internet of Things devices during institutional migration to IoT-enabled systems in public universities in Ogun State?

Table 2: Mean Responses and Standard Deviation of the Respondents on the Extent Affordability Impacts the Usability of Internet of Things Devices During Institutional Migration to IoT-Enabled Systems in Public Universities in Ogun State

N=520

S/N	Extent affordability impacts usability of Internet of Things devices during institutional migration include inability to;	VHE	HE	LE	VLE	$\bar{X}$	SD	DEC
9.	purchase wireless Sensor Network	148	144	125	103	2.65	1.09	HE
10.	acquire QR Codes	209	218	52	41	3.14	0.89	HE
11.	use Roboters	211	249	29	31	3.23	0.80	HE
12.	use Capria Technologies	232	255	31	2	3.38	0.62	HE
13.	use Pressure Pad Sensor	236	248	34	2	3.38	0.63	HE
14.	install Noise Information Storage	154	169	98	99	2.73	1.08	HE
15.	get RFID (Radio-Frequency Identification)	140	150	112	118	2.60	1.11	HE
16.	use NFC (Near-Field Communication)	151	174	104	91	2.74	1.06	HE
17.	get Comprehensive Access to Printed Materials (CAPM) System	202	235	68	15	3.20	0.77	HE
GRAND MEAN						3.00	0.89	HE

The results of data analysis in Table 2 indicated that items (9, 10, 11, 12, 13, 14, 15, 16, 17) had high mean responses. The standard deviation for the items raised is small, indicating that the respondents' responses for the items raised are homogenous and closely clustered around the Mean. The grand mean (3.00) was also high. Going by the decision rule for interpreting the respondents' mean score, the answer to research question 2 is that affordability, to a great extent, impacts the usability of Internet of Things devices during institutional migration to IoT-enabled systems in public universities in Ogun State.

This finding is particularly significant given the very high mean scores for specific IoT devices such as Capria Technologies (3.38), Pressure Pad Sensors (3.38), and robots (3.23). These high scores indicate that lecturers perceive the inability to acquire and use these specific IoT devices as major barriers to successful institutional migration. The findings corroborate Ukamaka and Kakiri's (2021) observation that budget constraints and rising prices of ICT-enabled devices hinder effective IoT utilization. Araujo (2024) also emphasized that IoT implementation requires significant investment in computing resources to ensure

reliability, availability, and scalability. The high grand mean of 3.00 suggests that affordability constraints not only affect initial adoption but also significantly impact the ongoing usability of IoT devices during the migration process, potentially slowing or stalling the institutional transition to fully IoT-enabled systems.

Research Question 3: To what extent does **digital literacy** impact the adoption of Internet of Things devices during institutional migration to IoT-enabled systems in public universities in Ogun State?

Table 3: Mean Responses and Standard Deviation of the Respondents on the Extent Digital Literacy Impacts the Adoption of Internet of Things Devices During Institutional Migration to IoT-Enabled Systems in Public Universities in Ogun State
N=520

S/N	Extent to which digital literacy impacts the adoption of Internet of Things devices during institutional migration include;	VHE	HE	LE	VL E	$\bar{X}$	SD	DEC
18.	clamor for IoT devices by staff members	187	196	134	3	3.09	0.80	HE
19.	demand for IoT devices	203	229	48	40	3.14	0.88	HE
20.	awareness of the need for IoT devices	144	164	118	94	2.69	1.06	HE
21.	institutional researchers on IoT	170	169	174	7	2.97	0.85	HE
22.	conducting online lectures	130	138	138	114	2.55	1.09	HE
23.	advising institutional heads about IoT	165	174	180	1	2.97	0.82	HE
24.	engaging the government about IoT devices	130	134	148	108	2.55	1.08	HE
GRAND MEAN						2.85	0.94	HE

Table 3 above presents the results of data analyses for research question 3. Items (18-24) had mean responses that were higher than the cut-off point as indicated in the decision rule. The standard deviation for the items raised is small, indicating that the respondents' responses for the items raised are homogenous and closely clustered around the Mean. The grand mean (2.85) was also high. Going by the decision rule for interpreting the respondents' mean score, the answer to research question 3 is that digital literacy to a high extent impacts the adoption of Internet of Things devices during institutional migration to IoT-enabled systems in public universities in Ogun State.

This finding strongly supports Ukamaka and Kakiri's (2021) assertion that IoT requires tech-inclined users to effectively utilize its resources and services, and that without proper training, the entire purpose of migrating to IoT-enabled systems may be futile. The particularly high mean scores for "demand for IoT devices" (3.14) and "clamor for IoT devices by staff members" (3.09) suggest that digital literacy manifests not only as technical competence but also as awareness and advocacy for technological integration. This aligns with Asen's (2023) conceptualization of digital literacy as encompassing understanding of the digital landscape and the ability to navigate, participate in, and thrive in today's digital world.

The findings indicate that institutions with higher levels of digital literacy among staff are better positioned to successfully migrate to IoT-enabled systems, as digitally literate staff members are more likely to demand, advocate for, and effectively utilize IoT devices in their professional practice.

Conclusion

IoT systems make education more interactive, communal, and widely accessible. Most scholars are of the view that to build a sophisticated environment within universities, campuses must integrate IoT devices. This is because, in reality, some of the most advantageous uses of IoT in education are the improvement of energy efficiency, exceptional communication between students and lecturers, and reduced operational costs. More so, with the growth in the university systems in size and scope of activities, emerging technologies such as IoT have provided a mechanism for teaching and learning to keep abreast of increasing demands for current and documented information. The migration to IoT-enabled systems represents a fundamental transformation in how universities operate, teach, and facilitate learning.

It is a source of worry that, despite the efficacy of IoT in Education, the institutional migration to IoT-enabled systems in most Nigerian universities seems to be impeded as a result of socio-economic determinants. This is shown in the analysis of this study, which revealed that socio-economic determinants such as affordability, to a high extent, impact the adoption and usability of Internet of Things devices during institutional migration to IoT-enabled systems in public universities in Ogun State. The study also found that digital literacy, to a high extent, impacts the adoption of Internet of Things devices during this migration process.

Based on these findings, it can be concluded that socio-economic determinants such as affordability and digital literacy have an impact to a great extent on the institutional migration to IoT-enabled systems in public universities in Ogun State. Affordability constraints manifest in institutions' inability to acquire essential IoT infrastructure, from basic applications to advanced technologies like wireless sensor networks, robots, and specialized sensors. Digital literacy influences migration through staff awareness, demand, and advocacy for IoT integration, as well as their capacity to conduct research and advise institutional leadership on technological matters.

These insights highlight the need for targeted interventions such as advanced in-training programs, structured integration of IoT devices into the university system, government-improved infrastructural support, and stronger institutional policies to sustain and expand the effective migration to IoT-enabled systems in public universities in Ogun State. With these measures in place, IoT can more fully realize its potential to enhance teaching and learning experiences and transform the entire university environment through successful institutional migration.

Recommendations

1. There is a need for governmental support for the migration to IoT-enabled systems in public universities in Ogun State. This will ameliorate the impact of socio-economic determinants on this institutional migration process. Government funding and

subsidies can help address affordability constraints that currently impede adoption and usability of IoT devices.

2. There is a need for university management in Ogun State to place emphasis on and champion the migration to IoT-enabled systems in their institutions. Leadership commitment is essential for driving technological transition and creating an institutional culture that embraces IoT integration.
3. There is a need for periodic workshops and training programs on IoT in all public universities in Ogun State to enhance digital literacy among staff and students, thereby facilitating smoother institutional migration.

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