

ICT Engagement and Learning Outcomes Among Lagos State University College of Medicine, Medical Students

Richard Olalekan Arogunjo, Babcock University, Nigeria
Oluwatoyin Atinuke Omotayo, Bells University of Technology, Nigeria
Rukayat Folashade Atoyebi, Lagos Film School, Nigeria

The Paris Conference on Education 2026
Official Conference Proceedings

Abstract

The Fourth Industrial Revolution has positioned information and communication technology (ICT) as a central driver of knowledge acquisition in higher education. Grounded in self-determination theory (SDT), this study examines ICT engagement, knowledge acquisition methods, and the effect of ICT engagement on learning outcomes among undergraduates at Lagos State University College of Medicine (LASUCOM) in Nigeria. A cross-sectional online survey using convenience sampling was administered to 509 undergraduates, collecting self-reported data on ICT engagement and perceived learning outcomes, which were analyzed using descriptive statistics in SPSS version 26. The findings revealed high ICT engagement: 94.1% actively used digital devices for academic work, and 89.2% reported confidence in ICT use, consistent with SDT's competence and autonomy dimensions of SDT. Lecture notes, educational websites, and digital databases dominated knowledge acquisition; however, printed textbooks remained relevant, reflecting a hybrid-learning orientation. Over 93% of participants reported perceiving that ICT tools enhance their content comprehension, extend learning beyond the classroom, and foster critical thinking; however, these perceptions were not validated against objective learning outcome measures. The cross-sectional, single-institution design and reliance on self-reported perceptions limit causal inference and generalizability. Institutional strategies should move beyond infrastructure provision to cultivate digital literacy, support self-regulated learning, and redesign curricula that leverage both traditional and digital resources in the 4IR context.

Keywords: information and communication technology (ICT), ICT engagement, knowledge acquisition, undergraduates, 4th industrial revolution (4IR), higher education

iafor

The International Academic Forum
www.iafor.org

Introduction

Information and communication technology (ICT) is crucial for driving the fourth industrial revolution, which is characterized by the merging of digital, physical, and biological systems. ICT facilitates access to information, communication, collaboration, learning, and innovation across various fields and industries. ICT engagement refers to the frequency and extent of individuals use of ICT tools and resources for various activities, including education, work, entertainment, and social interaction. Engaging with ICT can positively impact knowledge acquisition, which involves obtaining, creating, sharing, and applying knowledge in diverse contexts. This knowledge acquisition process can improve cognitive, emotional, and behavioural outcomes, such as academic achievement, motivation, self-confidence, and career advancement.

University students use digital tools to learn more in today's digital world, especially in academics. Studies (D'Mello, 2021; Hew & Cheung, 2014; Kunina-Habenicht & Goldhammer, 2020) show that digital technology helps students engage by offering active learning, teamwork, feedback, and motivation.

In the 21st century, it is important to know how to use information and communication technology (ICT) well in learning and everyday life. ICT skills are not just about knowing how to use computers and software. They also involve cognitive and social knowledge (Jackman et al., 2021). It is important to encourage mental and motivational factors that help people use ICT independently of others. These factors are called ICT engagement, which was studied in the PISA 2015 (Kunina-Habenicht & Goldhammer, 2020).

The educational application of information and communication technology (ICT) has been extensively examined and debated in both academic and professional literature. ICT can facilitate knowledge acquisition by improving access to information, enabling communication and collaboration, and supporting the development of digital skills and competencies. However, ICT also presents challenges and risks, such as the digital divide, cyberbullying, privacy concerns, and ethical dilemmas.

Students' reliance on technology is evident in various aspects of their educational journey. From utilizing web resources for research to preparing for classes, and employing devices to capture and archive class sessions for future reference, technology has seamlessly integrated into the fabric of their academic pursuits (Alsayed et al., 2021). This shift empowers students to take charge of their learning and fosters independent inquiry and digital literacy, thereby altering the dynamics of teaching and learning in higher education institutions (Akour & Alenezi, 2022; Akram et al., 2022).

This study aimed to assess the level of ICT engagement among undergraduate students at Lagos State University College of Medicine (LASUCOM), identify the primary methods and sources through which they acquire knowledge, and examine the effect of ICT engagement on their knowledge acquisition. As a subset of Lagos State University, LASUCOM is one of the largest and most esteemed public universities in Nigeria, with an enrolment exceeding 3,000. LASUCOM offers a diverse range of academic programs that integrate ICT components, including online courses, e-learning platforms, digital libraries and laboratories.

Despite widespread ICT availability, few studies have applied the PISA 2015 ICT engagement framework to examine knowledge acquisition in Nigerian medical education contexts, where

infrastructure constraints, pedagogical traditions, and student populations may differ from the high-income settings in which the framework was developed. Understanding ICT engagement in this context is essential for evidence-based digital learning policy in Nigeria. Previous research has predominantly focused on the barriers, challenges, and benefits associated with ICT adoption and integration in higher education. However, these studies have not specifically examined the dimensions and outcomes of ICT engagement concerning knowledge acquisition. This exploratory study provides an initial descriptive baseline of ICT engagement and perceived knowledge acquisition at LASUCOM using the SDT-informed ICT engagement framework. While the findings are context-specific and do not test causal hypotheses, they offer preliminary evidence to guide future research and may contribute to digital learning policy discussions at LASUCOM and similar institutions, pending replication and validation with objective outcome measures. This study addresses the following questions:

1. What is the level of ICT engagement among undergraduate students at the Lagos State University College of Medicine?
2. What are the major ways by which undergraduate students of the Lagos State University College of Medicine acquire knowledge relating to their studies?
3. Which knowledge sources do undergraduate students at the Lagos State University College of Medicine report using most frequently and perceiving as most helpful for their studies?
4. How do LASUCOM undergraduate students perceive the effects of ICT engagement on their knowledge acquisition?

Given the exploratory nature of this baseline assessment, formal hypotheses were not specified. However, SDT suggests that students reporting higher perceived ICT competence and autonomy will report greater ICT engagement and more positive perceptions of learning outcomes. Future research should test these predictions using inferential analyses.

Literature Review

The onset of COVID-19 in 2020 and the subsequent global lockdown markedly accelerated the adoption and utilization of digital technology by institutions and individuals for educational and personal purposes (Bagheri-Nesami et al., 2021). Globally, educational institutions have rapidly transitioned to online teaching and learning, with studies documenting this shift in diverse national contexts, including Georgia (Basilaia & Kvavadze, 2020), China (Bao, 2020), and Nigeria (Onyema et al., 2020). Academics have faced significant pedagogical adjustments during sudden campus closures (Czerniewicz et al., 2019; Mishra et al., 2020). Students also reported varied experiences, with engagement levels and learning outcomes shaped by access to devices, connectivity, and institutional support (Wargadinata et al., 2020). The integration of Information and Communication Technology (ICT), encompassing educational technology and digital content, has the potential to enhance educational quality, expand learning opportunities, facilitate effective instruction, and foster student knowledge acquisition (Baradaran Abdollahy et al., 2020). The pervasive influence of ICT has precipitated substantial transformations in various facets of both individual and collective life, ultimately leading to the advent of e-learning (Pokhrel & Chhetri, 2021).

In contemporary higher education, technology has become an indispensable and integral component of modern learning and pedagogy (Haleem et al., 2022). This shift toward technology-enabled education holds significant potential to enhance the learning experiences of undergraduate students. It equips them with a diverse array of tools and resources that facilitate seamless information access, foster collaboration, and create invaluable networking

opportunities (Alshammari & Alanazi 2023). The growing uptake of e-learning platforms such as Moodle and communication tools such as WhatsApp reflects students' pragmatic choices about where to learn and how to engage with course content (Mpungose, 2020). Alongside formal platforms, social media has emerged as a significant supplementary space for academic engagement in higher education, extending participation beyond Facebook to platforms such as Instagram, Pinterest, and text-based tools (Manca, 2020). These trends are not limited to high-income settings; e-learning adoption among university students in developing countries, including Vietnam and Nigeria, demonstrates that digital engagement in higher education is a global phenomenon (Ho et al., 2021). Students' digital competence, which spans technical, informational, and communicative dimensions, varies across disciplines, highlighting the need for targeted institutional support (Burgos-Videla et al., 2021). Engagement with digital resources such as online databases, search engines, and electronic records similarly enhances information accessibility, helping students stay informed about developments in their fields (Alsayed et al., 2021).

ICT engagement encompasses four dimensions: interest in ICT, perceived ICT competence, autonomy in ICT use, and ICT as a topic of social interaction. Interest in ICT refers to an enduring inclination to engage in ICT-related topics, tasks, or activities. Perceived ICT competence is a subjective evaluation of an individual's ability to utilize ICT. Perceived autonomy in ICT use pertains to the sense of volition and choice in employing ICT. ICT as a topic in social interaction denotes the extent to which individuals discuss ICT-related issues with others (Kunina-Habenicht & Goldhammer, 2020). ICT engagement is anticipated to influence both the frequency and quality of ICT use for various purposes, such as entertainment, learning, and communication. Furthermore, ICT engagement may impact academic achievement and other educational outcomes, as well as career choices and lifelong learning opportunities (Kunina-Habenicht & Goldhammer, 2020).

Kunina-Habenicht and Goldhammer (2020) tested this four-dimensional structure using PISA 2015 data from Germany and Switzerland. The scales accounted for the greatest variance in ICT use for entertainment, and girls scored lower than boys on all subscales except for ICT interest.

D'Mello's (2021) OECD study provides valuable insights into effective methodologies for assessing student engagement with digital technologies. It also proposes strategies for designing these technologies to enhance engagement at the onset of learning or during periods of disengagement from the learning process. This chapter emphasizes that digital technologies can facilitate student engagement by offering opportunities for active learning, collaboration and feedback. Hew and Cheung (2014) investigated the influence of internal variables, such as goals, on student motivation in massive open online courses (MOOCs). Their findings indicate that students enroll in MOOCs to acquire knowledge or skills in a specific domain, obtain certification, connect with others interested in the topic, and advance their educational or career goals.

Fraillon et al. (2020) employ the term "engagement" to encompass both behavioural and emotional engagement, as delineated in Timotheou et al.'s (2023) framework on digital technology engagement. Behavioural engagement refers to the manner and frequency with which students utilize ICT, whereas emotional engagement refers to students' attitudes and feelings toward ICT. According to Fraillon et al. (2020), understanding the concept of engagement is crucial for comprehending students' interactions with ICT in educational settings.

Fraillon et al. (2020) delineate students' engagement with information and communication technology (ICT) through two primary perspectives: general ICT utilization and ICT application for academic purposes. The former involves the frequency with which students use ICT tools for activities such as creating or modifying informational content, engaging in social interactions, sharing information, and participating in recreational activities. In contrast, the latter pertains to the use of ICT within the academic domain, encompassing tasks such as completing assignments, conducting research, sourcing information, taking notes, composing projects and research papers, and delivering presentations. Consequently, Fraillon et al. (2020) suggest that a deeper understanding of student engagement can enable educators to design more effective learning experiences that incorporate ICT use, thereby enhancing learning outcomes and academic achievements.

Timotheou et al. (2023) elucidated the transformative impact of digital technology on education, emphasizing the imperative for educational institutions to augment their digital capabilities to foster meaningful ICT engagement among students. The research highlights that the recent COVID-19 pandemic accelerated the integration of digital technology in educational settings, thereby exposing disparities in digital readiness among higher-education institutions and underscoring the complexity of digital integration, which affects student performance and other dimensions of the educational environment.

While prior research (Fraillon et al., 2020; Kunina-Habenicht & Goldhammer, 2020) has validated ICT engagement constructs in high-income countries, their applicability and manifestation in resource-constrained, rapidly digitizing contexts such as Nigerian medical education remain underexplored. This study addresses this gap by documenting ICT engagement patterns and perceived learning effects at LASUCOM, providing preliminary evidence on whether SDT-based engagement dimensions are relevant in this setting and suggesting potential areas for further investigation and intervention development.

Theoretical Framework

This study is grounded in Self-Determination Theory (SDT), developed by Ryan and Deci (2020). As further elaborated by Chiu (2022), SDT explains human motivation, well-being, and personality through the lens of three fundamental needs: autonomy, competence, and relatedness. Autonomy pertains to control over one's behaviors and goals; competence involves the experience of effectiveness and challenge; and relatedness focuses on interpersonal connections. The fulfillment of these needs is associated with enhanced well-being, psychological flourishing, and an elevated quality of life. Ryan and Deci (2020) contested the prevailing notion that external rewards are the primary motivators of behavior. Instead, they posited that individuals are inherently driven to engage in activities that are intrinsically interesting, satisfying, and meaningful, and that intrinsic motivation fosters greater well-being and personal growth.

SDT, which is effectively applied in educational contexts, distinguishes autonomous motivation (driven by volition and choice) from controlled motivation (driven by external pressures). Autonomously motivated individuals tend to show greater interest, vitality, and confidence, which enhances their performance and well-being (Ryan & Deci, 2020).

Self-Determination Theory (SDT) is utilized in the educational domain to understand students' engagement with information and communication technology (ICT) for knowledge acquisition in the context of the Fourth Industrial Revolution. This era is characterized by the convergence

of the physical, digital, and biological domains through technologies such as artificial intelligence, biotechnology, robotics, and nanotechnology. These advancements present novel challenges and opportunities for education, necessitating that students develop new skills, competencies, and mindsets to succeed in an increasingly dynamic environment.

According to SDT, students' engagement with ICT and their acquisition of knowledge depend on how well the learning environment meets these three psychological needs. Students who feel autonomous choose ICT activities that match their interests; those who feel competent take on more challenging tasks and persist through difficulties; and those who feel connected to others collaborate and seek support more readily. Educators can build on this by designing learning environments that support all three needs of the students.

The significance of Self-Determination Theory (SDT) in relation to undergraduates' engagement with Information and Communication Technology (ICT) and their knowledge acquisition during the Fourth Industrial Revolution is rooted in its capacity to elucidate how students' motivation can be enhanced by fulfilling their basic psychological needs. A study introduced a comprehensive theoretical model that integrates SDT, self-efficacy, and the technology acceptance model to elucidate the acceptance of technology-enhanced learning during the COVID-19 pandemic among university students. The findings indicated that the determinants of SDT significantly predicted the constructs of the technology acceptance model, with perceived competence emerging as the most influential factor (Rosli & Saleh, 2022). SDT offers a theoretical framework for understanding how students' motivation can be augmented by satisfying their basic psychological needs. Research on self-determination and student engagement in higher education further confirms that competence beliefs and relatedness are significant predictors of academic engagement (Assefa et al., 2025).

Methodology

This study used a survey design with quantitative data to provide a holistic understanding of the research problems. Quantitative data were collected via an online questionnaire (Google Form) to assess the level of ICT engagement and knowledge acquisition among undergraduate students at the Lagos State University College of Medicine. The study population comprised undergraduate students across all levels within the Faculty of Clinical Sciences at Lagos State University College of Medicine. Participants were recruited via online convenience sampling through class communication channels and WhatsApp. Although efforts were made to reach diverse groups, the non-random, self-selected sample may not be representative of all LASUCOM undergraduates, limiting generalizability. The inclusion criteria encompassed undergraduate students enrolled at LASUCOM for a minimum of one academic year. Conversely, the exclusion criteria included undergraduate students who were unwilling or unable to participate in the study.

Data were collected using an online questionnaire comprising closed-ended questions utilizing Likert scales and multiple-choice questions. The questionnaire was structured into four sections: demographic information, the ICT Engagement Scale, the Knowledge Acquisition Scale, and open-ended questions. Prior to its administration to the main sample, the questionnaire was validated by experts and pilot-tested with a small group of students. The questionnaire was distributed by the respective class heads of communication (HOC) and social media platforms, specifically WhatsApp, with an attached consent letter. The data collection period was approximately three weeks long. Descriptive statistics were used to summarize the participants' characteristics and their responses. The data were comprehensively analyzed

using SPSS version 26, and the results were presented in descriptive tabular form, including frequency, percentage, and bar charts.

Results and Discussion

A total of 509 online questionnaires were completed and submitted by participants who were undergraduate students at the Lagos State University College of Medicine, Nigeria.

Demographic Characteristics of Respondents

Table 1 presents the distribution of respondents according to demographic variables.

Table 1

Demographic Variables of Respondents

Demography		Frequency	Percentage
Faculty	Clinical Science	422	83.0
	Basic Medical Sciences	87	17.1
Gender	Male	239	47.0
	Female	270	53.0
Age	15–20 years old	354	69.5
	21–25 years old	149	29.3
	26–30 years old	5	1.0
	31 years and above	1	.2
Level of Study	200 Level	220	43.2
	300 Level	54	10.6
	400 Level	234	46.0
	500 Level	1	.2
	600 Level	0	.0
		509	100.0

The data presented in Table 1 indicate that a significant proportion of respondents, specifically 83.0%, were students from the Faculty of Clinical Sciences, compared to 17.1% from the Faculty of Basic Medical Sciences. Gender-based analysis revealed a higher representation of female respondents (53.0%) than male respondents (47.0%) in the sample. Age distribution analysis showed that the majority (69.5%) of respondents were aged between 15 and 20 years, followed by those in the 21–25 age bracket, comprising 29.3% of the sample. Regarding the level of study, the largest group of respondents (46.0%) was in their fourth year, followed closely by second-year students (43.2%).

Level of ICT Engagement Among Undergraduate Students at Lagos State University College of Medicine

The data presented in Table 2 illustrate the extent of ICT engagement among undergraduate students at the Lagos State University College of Medicine.

Table 2*Level of ICT Engagement*

S/N	ICT engagement	SA	A	NS	D	SD
1	I actively use digital devices (e.g., smartphones, laptops, tablets) for my academic activities	339 (66.6%)	140 (27.5%)	25 (4.9%)	3 (0.6%)	2 (0.4%)
2	I frequently access online platforms (e.g., learning management systems, educational websites) for my coursework	232 (45.6%)	208 (40.9%)	60 (11.8%)	6 (1.2%)	3 (0.6%)
3	I regularly engage with online educational resources (e.g., e-books, videos, online tutorials) to supplement my learning	231 (45.4%)	213 (41.8%)	56 (11.0%)	12 (1.2%)	3 (0.6%)
4	I participate in online discussions and forums related to my academic studies	155 (30.5%)	218 (42.8%)	115 (22.6%)	19 (3.7%)	1 (0.2%)
5	I feel confident in using various ICT tools and technologies to support my learning	267 (52.5%)	187 (36.7%)	46 (9.0%)	9 (1.8%)	1 (0.1%)

Table 2 indicates that a substantial majority of respondents (479, or 94.1%) reported actively engaging with digital devices such as smartphones, laptops, and tablets for academic purposes. Approximately 454 (89.2%) undergraduates expressed confidence in utilizing various ICT tools and technologies to facilitate their learning. Furthermore, no fewer than 373 (73.3%) of the students stated that they participated in online discussions and forums pertinent to their academic studies. These findings suggest that most undergraduate students at the Lagos State University College of Medicine are extensively involved in using ICT in their daily academic activities.

Major Ways Undergraduate Students Acquire Knowledge Related to Their Studies

Figure 1 presents an analysis of the methods by which undergraduate students acquire knowledge.

Figure 1
Methods of Knowledge Acquisition

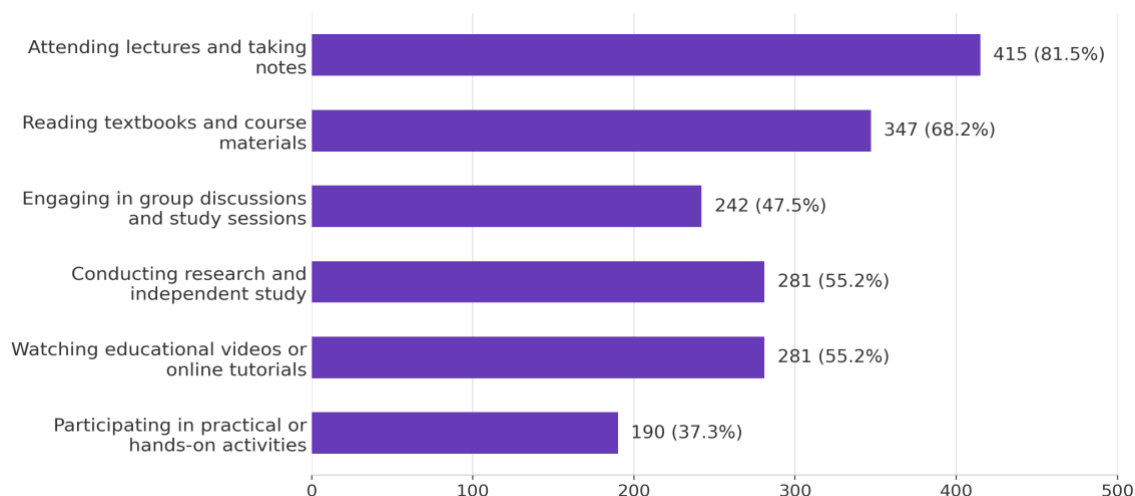


Figure 1 illustrates the primary methods and extent of knowledge acquisition among undergraduate students at Lagos State University College of Medicine. Most respondents (415, 81.5%) reported acquiring knowledge by attending lectures and taking notes. This was followed by 347 (68.1%) respondents who indicated reading textbooks and course materials, while 281 (55.3%) reported engaging in research and independent study and watching educational videos or online tutorials. These findings suggest that undergraduates typically acquire academic knowledge through various means, encompassing both ICT- and non-ICT-related methods.

Knowledge Sources Most Frequently Used and Perceived as Most Helpful by Undergraduates

Figure 2
Sources of Knowledge Acquisition

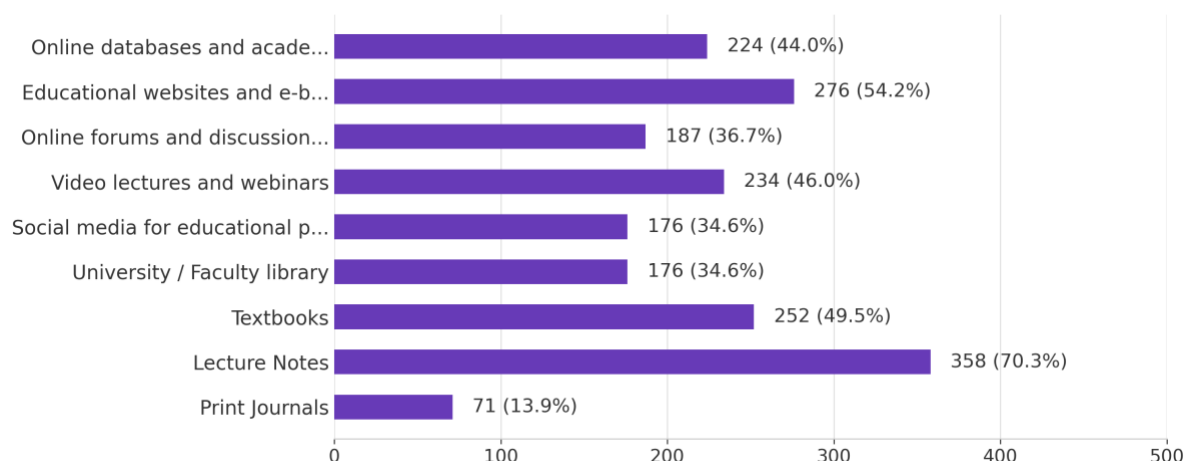


Figure 2 illustrates that most undergraduate students (358, or 70.3%) identified lecture notes as the most beneficial resource for knowledge acquisition. This was followed by educational websites and e-books, with 276 (54.2%) respondents indicating their usefulness. Notably, in this digital era, a significant proportion of students continue to find value in traditional sources, such as print textbooks (49.6%). Video lectures and webinars (45.9%) and online databases

and academic journals (44.0%) are increasingly popular among Nigerian university students. The data also suggest a decline in the use of university and faculty libraries, with only 34.6% of students utilizing these resources for their assignments.

Perceived Effects of ICT Engagement on Knowledge Acquisition Among Undergraduate Students

The data presented in Table 3 illustrate the impact of ICT engagement on knowledge acquisition among undergraduate students at the Lagos State University College of Medicine, Nigeria.

Table 3
Effects of ICT Engagement on Knowledge Acquisition

S/N	Effect of ICT engagement	SA	A	NS	D	SD
1	ICT tools and resources enhanced my understanding of the course content.	292 (57.4%)	183 (36.0%)	30 (5.9%)	4 (0.8%)	1 (0.2%)
2	Access to digital resources expands knowledge beyond that covered in the classroom.	291 (57.2%)	180 (35.4%)	33 (6.5%)	5 (1.0%)	-
3	Engaging with online learning materials helps me develop critical thinking and problem-solving skills.	254 (49.9%)	208 (40.9%)	40 (7.9%)	5 (1.0%)	2 (0.4%)
4	Collaborative online activities (e.g., group projects and online discussions) facilitate knowledge acquisition and retention.	208 (40.9%)	224 (44.0%)	69 (13.6%)	7 (1.4%)	3 (0.3%)
5	Online assessments and quizzes provide me with opportunities to assess and reinforce my learning	235 (46.2%)	218 (42.8%)	51 (10.0%)	4 (0.8%)	1 (0.1%)

Table 3 indicates that 93.3% of respondents believed that ICT tools enhanced their comprehension of course content. This reflects student perceptions; objective measures of comprehension were not collected. Furthermore, 92.5% of the respondents agreed that access to digital resources extended their knowledge beyond traditional classroom instruction. A significant proportion of respondents (90.8%) believed that engaging with online learning materials fostered the development of critical thinking and problem-solving skills. Additional effects of ICT engagement identified by the students included the enhancement of knowledge acquisition through collaborative online activities, as well as the assessment and reinforcement of their learning. However, these findings may be influenced by self-selection bias (more engaged students responding) and social desirability (overreporting positive views).

Discussion of Findings

The demographic analysis of undergraduate students indicates that most (88.7%) fall within the 15–25 year age range. Whether younger students engage with ICT more than older students was not examined in this study and warrants future investigation. Jackman et al. (2021) noted that younger generations show greater digital fluency due to early exposure to technology, offering one plausible explanation. Nearly half of the respondents (46.0%) were fourth-year students. The study design does not permit a comparison of ICT engagement across academic levels, whether engagement varies by year of study, and whether any such variation is attributable to academic demands, which remains an open empirical question for future research.

The findings indicate that most students actively utilize digital devices, such as smartphones, laptops, and tablets, for academic-related activities. This observation is consistent with that of Pokhrel and Chhetri (2021). The results suggest that technology enhances student engagement and success in learning, highlighting the pervasive presence and integration of digital technology in the educational pursuits of undergraduate students. The students expressed confidence in using various ICT tools and technologies to support learning, a finding corroborated by Noor et al. (2022). Digital literacy, defined broadly as the competencies required to find, evaluate, create, and communicate information using digital technologies, is increasingly recognized as a foundational graduate attribute in 21st-century higher education (Reddy et al., 2020). Furthermore, this indicates a high level of technological proficiency and comfort among the student population, reflecting the growing digital competence of university students, who are considered “digital natives” because of their early exposure to technology.

Furthermore, students reported their engagement in online discussions and forums that were relevant to their academic pursuits. This observation is corroborated by Al-Fraihat, Joy, and Sinclair (2020), who suggest that students acknowledge the benefits of utilizing information and communication technology (ICT) for e-learning, which can enhance the academic experience of university students through the integration of e-learning. This finding underscores a significant inclination toward collaborative learning and the use of online platforms for academic discourse, which also facilitates peer-to-peer learning and engagement (Chiu 2022; Pokhrel & Chhetri 2021). Additionally, the findings suggest that the respondents possessed a certain level of digital citizenship skills, including the ability to access, communicate, collaborate, create, and participate in online activities, as supported by Jackman et al. (2021). These findings indicate that the majority of undergraduate students at the Lagos State University College of Medicine extensively engaged with and utilized ICT in their daily activities for both academic and non-academic purposes.

Despite the pervasive use of digital technology and the extensive engagement of undergraduate students with ICT, the findings highlight the multifaceted nature of information sources, with lecture notes, educational websites, and e-books emerging as the most prominent channels for knowledge acquisition in this study. This underscores the enduring importance of traditional classroom instruction (Martín-Lucas & García del Dujo, 2022) and print media in the learning process and information acquisition. Even in the digital age, handwritten or typed lecture notes remain a staple among Nigerian students, as supported by Martín-Lucas and García del Dujo (2022) and Pokhrel and Chhetri (2021). This preference may arise from the immediacy and personalized nature of lecture notes, which allow students to capture and review the key concepts presented in class. Similarly, despite the rapid digitalization and proliferation of digital educational resources, a substantial number of students still value the tactile experience

and comprehensiveness of physical textbooks (Martín-Lucas & García del Dujo, 2022; Noor et al., 2022).

Educational websites and e-books have emerged as the second most prevalent source of knowledge among students, alongside video lectures, webinars, online databases and academic journals. This outcome underscores the increasing dependence on digital platforms, such as e-books, online databases, video lectures and webinars, to access educational content (Haleem et al., 2022; Noor et al., 2022; Pokhrel & Chhetri, 2021). The availability of e-books and online educational resources offers students a convenient and extensive repository of information, often supplementing or complementing traditional textbooks (Pokhrel & Chhetri, 2021). This finding also indicates a growing recognition of the significance of online scholarly resources for comprehensive research and academic exploration (Martín-Lucas & García del Dujo, 2022). Notably, a gradual decline in the use of university and faculty libraries has been observed among students since the pandemic. This decrease may reflect a shift in students' information-seeking behavior. In an era dominated by Information and Communication Technology (ICT), students may rely less on physical libraries for their academic information needs.

The findings demonstrate a highly favorable perception among undergraduate students regarding the influence of ICT engagement on their learning experiences and knowledge acquisition. Most respondents acknowledged that ICT tools and resources play a crucial role in enhancing their comprehension of course content, underscoring the significant contribution of technology in facilitating effective learning experiences. This observation aligns with Haleem et al.'s (2022) assertion that digital technologies are fundamental enablers of learning in higher education institutions. Most respondents also concurred that access to digital resources extended their knowledge beyond what was covered in class. Engaging with online learning materials is believed to foster critical thinking and problem-solving skills among students. Alshammari and Alanazi (2023) support this finding, highlighting the potential of technology to enhance learning among nursing researchers. By providing tools and resources, technology enables access to information, collaboration, and networking opportunities, which are crucial for developing critical thinking skills.

The results of this study corroborate existing research that underscores the importance of technology in nursing research. The availability of online databases, search engines, and electronic health records is recognized as enhancing information accessibility for nurse researchers, thereby enabling them to remain informed about the latest research findings (Alsayed et al., 2021). Causal claims and generalization to actual knowledge acquisition require experimental or longitudinal evidence.

Limitations

This study had several limitations. First, the cross-sectional design precludes causal inference; the associations between ICT engagement and knowledge acquisition may reflect confounding by motivation, prior ability, or socioeconomic factors. Second, all data were self-reported, which may have introduced social desirability and recall biases. Third, the sample was drawn from a single institution, with 83.0% of respondents from the Faculty of Clinical Sciences, limiting the generalizability to other disciplines and institutions. Fourth, actual learning outcomes (e.g., exam scores and skill assessments) were not measured, and the findings reflect perceptions only. Fifth, non-response bias cannot be ruled out, as the response rates and characteristics of non-responders are unknown. Future research should employ longitudinal or

experimental designs, include objective performance measures, and sample across multiple institutions and disciplines.

Conclusion and Recommendations

This study documents the coexistence of traditional (lecture notes, print textbooks) and digital resources in medical students' knowledge acquisition practices at LASUCOM. The findings indicate high self-reported ICT engagement and positive student perceptions of ICT's utility at LASUCOM, suggesting that digital tools are valued components of the contemporary learning environment at this institution. However, the cross-sectional, self-report design and single-institution sample limit causal inference and generalizability; convenience sampling and reliance on self-report likely introduced self-selection bias (more digitally engaged students may have been more likely to respond) and social desirability bias (students may have overreported positive views of ICT), which may inflate the reported levels of engagement and positive perceptions. Future research with longitudinal designs, objective performance measures, and multi-site samples is needed to verify these perceptions and assess actual learning impacts.

Lecture notes have emerged as the primary source of knowledge acquisition for a significant majority of students, underscoring the importance of classroom instruction in the learning process. Educational websites and e-books closely follow this trend, highlighting the increasing reliance on digital learning platforms. Despite competition from digital resources, print textbooks have retained their relevance, emphasizing the lasting value of traditional learning materials. The study also revealed a rising trend toward multimedia learning, with video lectures and webinars becoming increasingly popular in the learning process. Furthermore, the use of online databases and academic journals indicates a growing appreciation for scholarly resources in this field. This reflects the evolving learning preferences of students, characterized by their inclination toward diverse and multimedia-rich content.

Only 34.6% of respondents reported using university or faculty libraries, suggesting a relatively low reliance on physical library resources at the time of the survey. Whether this represents a decline over time and whether it reflects a shift toward online platforms cannot be determined from these cross-sectional data. Longitudinal or comparative studies are needed to assess trends in library use and information-seeking behavior. Nonetheless, this finding suggests that libraries may benefit from reassessing their services to remain congruent with current student preferences and practices.

Recommendations and Policy Implications

Based on the study's findings, the following recommendations are proposed primarily for LASUCOM, with tentative relevance to other Nigerian universities pending further research, to enhance students' knowledge acquisition and support their leadership in digital-age education.

1. **Enhanced digital literacy programs:** Educational institutions must implement comprehensive digital literacy programs to equip students with the necessary skills and competencies to navigate the digital landscape effectively and responsibly.
2. **Diverse Learning Resources:** Educational institutions are encouraged to offer a comprehensive selection of current and accessible learning resources, encompassing both traditional and digital formats, to accommodate the varied preferences of students.

3. **Library Modernization:** Libraries should modernize by integrating digital resources and creating collaborative spaces, helping them remain relevant centers for academic engagement and knowledge acquisition.
4. **Faculty Training:** Faculty members are encouraged to pursue training and professional development to effectively incorporate digital tools and resources into their pedagogical strategies, thereby fostering an enriched learning environment and stronger student engagement with ICT.
5. **Accessible E-learning Platforms:** Based on the findings from LASUCOM clinical sciences students, it is recommended that LASUCOM invest in user-friendly and accessible e-learning platforms to facilitate seamless access to educational materials, particularly benefiting students with diverse learning needs. Whether similar patterns hold in other faculties, institutions, or regions of Nigeria requires further investigation before generalizing this recommendation nationally.
6. **Continual Research and Adaptation:** Educational institutions should conduct continuous research to monitor trends in knowledge acquisition, thereby enabling them to adapt their strategies and resources accordingly.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

In this article, I used the paper pal AI tool for proofreading and refining the language used in the manuscript. Its use was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The outputs were reviewed, adapted, and integrated into my work, which reflects my personal understanding and complies with the academic integrity policies of my institution.

References

- Akour, M., & Alenezi, M. (2022). Higher education future in the era of digital transformation. *Education Sciences*, 12(11), 784. <https://doi.org/10.3390/educsci12110784>
- Akram, H., Abdelrady, A. H., Al-Adwan, A. S., & Ramzan, M. (2022). Teachers' perceptions of technology integration in teaching-learning practices: A systematic review. *Frontiers in Psychology*, 13, 920317. <https://doi.org/10.3389/fpsyg.2022.920317>
- Al-Fraihat, D., Joy, M., Masa'deh, R., & Sinclair, J. (2020). Evaluating e-learning systems success: An empirical study. *Computers in Human Behavior*, 102, 67–86. <https://doi.org/10.1016/j.chb.2019.08.004>
- Alsayed, S., Alshammari, F., Pasay-An, E., & Dator, W. L. (2021). Investigating the learning approaches of students in nursing education. *Journal of Taibah University Medical Sciences*, 16(1), 43–49. <https://doi.org/10.1016/j.jtumed.2020.10.008>
- Alshammari, A., & Alanazi, M. F. (2023). Use of Technology in Enhancing Learning Among Nurses in Saudi Arabia: A Systematic Review. *Journal of Multidisciplinary Healthcare*, 16, 1587–1599.
- Assefa, Y., Tilwani, S. A., Moges, B. T., & Majeed, H. (2025). Unpacking student engagement and its mediating role in predicting the relationship between self-determination and academic satisfaction among undergraduate students in higher education. *Social Sciences & Humanities Open*, 12, 101797. <https://doi.org/10.1016/j.ssaho.2025.101797>
- Bagheri-Nesami, M., Ahmady, S., & Kohan, N. (2021). Relationship between information and communications technology engagement and online self-regulated learning in nursing students of Mazandaran University of Medical Sciences. *Journal of Nursing and Midwifery Sciences*, 8(4), 253. https://doi.org/10.4103/jnms.jnms_27_21
- Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. *Human Behavior and Emerging Technologies*, 2(2), 113–115. <https://doi.org/10.1002/hbe2.191>
- Baradaran Abdollahy, S., Mahmoodi, F., & Tagavi, N. (2020). Validating the Persian version of the ICT engagement questionnaire. *Interdisciplinary Journal of Virtual Learning in Medical Sciences*, 11(2), 92–101. <https://doi.org/10.30476/ijvllms.2020.85628.1027>
- Basilaia, G., & Kvavadze, D. (2020). Transition to online education in schools during a SARS-CoV-2 coronavirus (COVID-19) pandemic in Georgia. *Pedagogical Research*, 5(4), em0060. <https://doi.org/10.29333/pr/7937>
- Burgos-Videla, C. G., Castillo Rojas, W. A., López Meneses, E., & Martínez, J. (2021). Digital competence analysis of university students using latent classes. *Education Sciences*, 11(8), 385. <https://doi.org/10.3390/educsci11080385>

- Chiu, T. K. (2022). Applying self-determination theory (SDT) to explain student engagement in online learning during the COVID-19 pandemic. *Journal of Research on Technology in Education*, 54(sup1), S14–S30. <https://doi.org/10.1080/15391523.2021.1891998>
- Czerniewicz, L., Trotter, H., & Haupt, G. (2019). Online teaching in response to student protests and campus shutdowns: Academics' perspectives. *International Journal of Educational Technology in Higher Education*, 17(1), 1–16. <https://doi.org/10.1186/s41239-019-0170-1>
- Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Duckworth, D. (2020). Students' Engagement with Information and Communication Technologies. In J. Fraillon, J. Ainley, W. Schulz, T. Friedman, & D. Duckworth (Eds.), *Preparing for Life in a Digital World: IEA International Computer and Information Literacy Study 2018 International Report* (pp. 113–173). Springer. <https://doi.org/10.1007/978-3-030-38781-5>
- Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, 3, 275–285. <https://doi.org/10.1016/j.susoc.2022.05.004>
- Ho, N. T. T., Sivapalan, S., Pham, H. H., Nguyen, L. T. M., Pham, A. T. V., & Dinh, H. V. (2021). Students' adoption of e-learning in emergency situation: the case of a Vietnamese university during COVID-19. *Interactive Technology and Smart Education*, 18(2), 246–269. <https://doi.org/10.1108/ITSE-08-2020-0164>
- Jackman, J. A., Gentile, D. A., Cho, N.-J., & Park, Y. (2021). Addressing the digital skills gap for future education. *Nature Human Behaviour*, 5(5), 542–545. <https://doi.org/10.1038/s41562-021-01074-z>
- Kunina-Habenicht, O., & Goldhammer, F. (2020). ICT engagement: A new construct and its assessment in PISA 2015. *Large-Scale Assessments in Education*, 8(1), 1–21. <https://doi.org/10.1186/s40536-020-00084-z>
- Manca, S. (2020). Snapping, pinning, liking, or texting: Investigating social media in higher education beyond Facebook. *The Internet and Higher Education*, 44, 100707. <https://doi.org/10.1016/j.iheduc.2019.100707>
- Martín-Lucas, J., & García del Dujo, Á. (2022). Knowledge building in an environment mediated by digital technology: A case study in higher education. *Education and Information Technologies*, 27, 12041–12059. <https://doi.org/10.1007/s10639-022-11304-0>
- Mishra, L., Gupta, T., & Shree, A. (2020). Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. *International Journal of Educational Research Open*, 1, 100012. <https://doi.org/10.1016/j.ijedro.2020.100012>
- Mpungose, C. B. (2020). Is Moodle or WhatsApp the preferred e-learning platform at a South African university? First-year students' experiences. *Education and Information Technologies*, 25, 927–941. <https://doi.org/10.1007/s10639-019-10005-5>

- Noor, U., Younas, M., & Aldayel, H. S., Menhas, R., & Qingyu, X. (2022). Learning behaviour, digital platforms for learning, and their impact on university students' motivations and knowledge development. *Frontiers in Psychology, 13*, 933974. <https://doi.org/10.3389/fpsyg.2022.933974>
- Onyema, E. M., Eucheria, N. C., Obafemi, F. A., Sen, S., Atonye, F. G., Sharma, A., & Alsayed, A. O. (2020). Impact of coronavirus pandemic on education. *Journal of Education and Practice, 11*(13), 108–121. <https://doi.org/10.7176/JEP/11-13-12>
- Pokhrel, S., & Chhetri, R. (2021). A literature review on impact of COVID-19 pandemic on teaching and learning. *Higher Education for the Future, 8*(1), 133–141. <https://doi.org/10.1177/2347631120983481>
- Reddy, P., Sharma, B., & Chaudhary, K. (2020). Digital literacy: A review of literature. *International Journal of Technoethics, 11*(2), 65–94. <https://doi.org/10.4018/IJT.2020070105>
- Rosli, M. S., & Saleh, N. S. (2022). Technology-enhanced learning acceptance among university students during COVID-19: Integrating the full spectrum of Self-Determination Theory and self-efficacy into the Technology Acceptance Model. *Current Psychology, 43*(1), 1–20. <https://doi.org/10.1007/s12144-022-02996-1>
- Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology, 61*, 101860. <https://doi.org/10.1016/j.cedpsych.2020.101860>
- Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S. V., Giannoutsou, N., Cachia, R., Mones, A. M., & Ioannou, A. (2023). Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. *Education and Information Technologies, 28*(6), 6695–6726. <https://doi.org/10.1007/s10639-022-11431-8>
- Wargadinata, W., Maimunah, I., Dewi, E., & Rofiq, Z. (2020). Students' responses to learning during the early COVID-19 pandemic. *Tadris: Jurnal Keguruan dan Ilmu Tarbiyah, 5*(1), 141–153. <https://doi.org/10.24042/tadris.v5i1.6153>