Journal of Trends in Computer Science and Smart Technology (ISSN: 2582-4104)
www.irojournals.com/tcsst/

Educational Technology Adaptation & Implication for Media Technology Adoption in the Period of COVID-19

Ugochukwu Okwudili Matthew[1*], Ado Saleh Kazaure[2], Jazuli Sanusi Kazaure[3], Ibrahim Muhammad Hassan[4], Andrew Chinonso Nwanakwaugwu[5], Nwamaka U. Okafor[6]

[1,4]Computer Science Dept, Hussaini Adamu Federal Polytechnic, Nigeria.
[2]Library Information Science Dept, Hussaini Adamu Federal Polytechnic, Nigeria
[3]Electrical Electronics Engineering Dept, Hussaini Adamu Federal Polytechnic, Nigeria.
[5]Data Science Dept, University of Salford, United Kingdom.
[6]School of Electrical and Electronic Engineering, University College Dublin, Ireland

E-mail: *macdon4ru2003@yahoo.com

Abstract

Following the COVID-19 pandemic outbreak, many institutions immediately adapted multimedia electronic learning technologies, to provide enablement of electronic learning system, shifting from in-person classroom attendance to online synchronous and asynchronous transmissions. In the current paper, the goal of multimedia electronic learning system is reviewed through the combination of various pedagogical media tools that enabled wide range of curricula presentation. This study has considered four hundred postgraduate scholars from the faculty of computer science and information technology that adopted multimedia electronic learning systems to guarantee that the scheduled graduation date was not surpassed on the account of the institution lockdown. In this paper, the integrated system of creating personalized and self-directed learning through multimedia pedagogical methodology has been highlighted. The study sought to draw attention to the importance of creating an immersive and interactive learning environment using AI-mediated innovation, which provide students with the increased skills required to become cognizant and reflective digital natives. The paper has portrayed that an increased level of electronic engagement via interactive media tools, link to the requirements for the innovative educational transformation which demand an execution of educational curriculum. The educational goals and needs are first defined, and then the most effective learning environment for students has been designed.

DOI: https://doi.org/10.36548/jtcsst.2022.4.002
Received: 24.09.2022, received in revised form: 09.10.2022, accepted: 24.10.2022, published: 02.11.2022

Keywords: COVID-19, interactive multimedia learning, disruptive technologies, electronic learning Education, Interactive Pedagogy, educational technology

1. Introduction

The term educational technology refers to the study of approaches that analyze, design, develop, implement, and evaluate the appropriate instructional environment and learning materials in order to improve their pedagogical effectiveness (Lee et al., 2022). It is critical to remember that the goal of educational technology or instructional technology is to improve education for all types of students. Educational technologies were quickly transformed into critical instruments to enable all students in the twenty-first century, as evidenced by the adoption of Information and Communication Technologies (ICTs) to exploit the benefits of global digital diffusion. In response to COVID-19, there has been a substantial shift in how educational technologies and digital media are used in the classroom. The automation of lecture theater in schools have in recent times gained traction and have become a critical component of the twenty first century educational improvement (Craig, Smith, & Frey, 2022).

Another area where educational technology is influencing learning is multimedia learning. The educational experience is enhanced when students use more than one sense to learn something. The digital media and multimedia technology have expanded education's potential by providing an accessible introduction to the use of technology tools in formal learning, which includes pedagogical and psychological theories as well as the actual execution of educational curricula (Ramaila & Molwele, 2022). Teachers construct lesson plans using audio, video, and graphics aids via the computer for interactive classroom engagement. Interactive pedagogy makes appropriate use of multimedia software and technologies to create and deliver electronic presentations to audiences. These electronic presentations are shown in the classrooms on multimedia projectors and smart electronic platforms, with everyone participating in the current teaching style. The learners find this intriguing and simple to learn as teachers easily deliver multimedia presentations, which are ideal for interactive participative teaching.

This current study tried to fashion how educational technology's distinctive physical and social-interactive characteristics can help students form bonds with educational contents while allowing teachers to focus on their own unique teaching and learning approaches. This will empower advancement, organizes student intellectual adjustment, encourages

responsibility, and stimulates pedagogic resourcefulness alongside educational system when done correctly. Those interactive presentations save a lot of time and work, and they ensure that the overall classroom management is more productive (Mershad & Said, 2022). Furthermore, multimedia interactive presentations are entertaining to watch and listen to, and the use of sound and visual effects enhances the impact of lectures. Digital media technologies will assist in the educational process by making it less dull for active participation. The use of digital media resources in schools will have an impact on technological breakthroughs as well as teaching and learning methodology due to its overwhelming pedagogical connotations.

Teachers in the twenty-first century must be aware of the three technological configurations available for educational technology management: additive, integrated, and independent. They must comprehend which educational technology configuration they wish to implement, why this is the best option for them and their students, and how to carry out this method of integration. Teachers must understand how, when, and why to use technology in the classroom. To incorporate this technology, teachers must be able to change their teaching methods. From a technological standpoint, digital students in the twenty-first century are engaged in the multiplicity of digital media adaptations from an early age. Corresponding to the observations of Prensky in 2001, the current digital students who grew up in a knowledge driven world are "digital natives," or those who have spoken the language of technology since birth (Filho, Gammarano, & Barreto, 2021). Nowadays, scholars are absorbed in the technology-rich spaces in practically every area of their day-to-day life, making it difficult to distinguish between formal, semi-formal, and informal education. Despite the fact that digital natives have a harder time learning, they endeavor to grasp digital experiences and show a strong sense of responsibility in terms of technology characterizations.

In practice, print media and audio/video cassettes are used to represent ICT implements or multimedia Information Communication Technology for Development (ICT4D), in addition to radio, television broadcasts and broadband communications. Multimedia information technologies, often known as ICT, are the anthology of high-tech contrivances and resourcefulness that are utilized to communicate, store and administer communication between the sender and receiver. Multimedia combines various stages of education into a teaching instrument that promote a wide range of curricula presentation options. The power of digital technology can revolutionize the modern classroom, resulting in

some trendy experiences in terms of active classroom involvement that have been established in a variety of methods (Greve et al., 2022). The question of what these materials are and how to use them in the classroom is the first step toward assisting teachers in comprehending the larger picture of how technology can revolutionize education. When teachers understand how to use technology, the educational system's knowledge level will improve. Teaching them about technology's true potential will promote higher-level thinking, independent learning, and life-long learning. The current study pursued a goal of an improved coordination of learning experiences, in addition to electronic learning arrangement that complemented the specifications for an enterprise educational platform to enable consistent instructive achievement void of interruptive educational workflow in the world wide academic sustainability, irrespective of the seriousness of any impending contagion comparable to the current COVID-19. The paper is organized as follows: introduction, problem statement, research aims and objectives, research questions, literature review, research methodology, recommendation, followed by conclusion.

2. Problem Statement

Two significant issues are identified in the current paper with regard to the educational practice in the ongoing COVID-19 pandemic from the general education management. The identified problems and proposed solutions could as well be beneficial to other parts of the digitally connected world. The two issues are:

- Investigation into COVID-19 impediments on the educational sustainability of the worldwide knowledge improvement as it impacted Nigeria educational management.

- Sustainable teaching investment and scholarly survivability in the post COVID-19. In contrasting the current state of educational management from the world wide perspective, the researchers were inspired to conduct the current study. From all indicators, Sustainable Development Goal 4's **(**SDG4's) sustainable millennium development objective on education were focused on three key areas of didactic achievement: (i.) Admission into education for the purpose of acquiring knowledge (ii.) Achievement into education to ensure societal and environmental sustainability and (iii.) Completed educational outcomes for overall ecosystem manageability.

An attempt is made in this study to synthesize a technological resolution to the COVID-19 generated obscurities, because it is significantly exacerbating the preexisting

susceptibilities that the majority of the vulnerable scholars before now faced in obtaining standard and holistic didactic improvement. Even though the COVID-19 epidemic has jeopardized our collective efforts towards achieving SDG4, the current study is looking for ways to moderate the interferences instigated by COVID-19 and develop techniques for universal access to quality and affordable education, if similar situation occurs in the nearest future.

3. Purpose of the Study

The goal of twenty first century educational technology is reviewed in the current study as a valuable investment towards learning attainment for both teachers and students. Teachers and students can both be contemplated as learners when technology is directly implemented within the educational framework. As a matter of fact, it may be assumed that any improvement in teacher's knowledge will authentically lead to an advanced student learning capability and school achievement. The current study focuses on the present-day Nigeria educational development, alongside developing countries in Sub-Saharan Africa. The paper demonstrates how vital research and innovation in the enterprise educational environment can improve nation knowledge sustainability and why policymakers should continue to fund incremental development in technology automation for smart education. The current study has identified key areas of application in educational administration and academic workflow in the twenty-first century.

4. Questions Guiding the Research

This study is purposely designed to provide solutions to the subsisting enquiries:

- In the ongoing COVID-19 epidemic, to what extent the university lecturers and school teachers have conducted electronic teachings, implemented novel studying methods that will portray duty diversity that generated commendation, and organized online evaluations via enterprise electronic learning environments?
- At what degree, the multimedia pedagogical contrivances and electronic learning have been implemented for the demonstration and communication in the selected tertiary institution of the country throughout COVID-19 induced lockdown?
- In what ways do the lecturers manage the prospects for advancing digital revolutions during the COVID-19 outbreak?

- As classroom technologies evolved, in which manner do teachers and scholars combine these novel approaches for pedagogical enablement for knowledge cultivation and educational management during COVID-19 outbreak?
- Identify circumstances that could have limited the electronic learning implementation and exploitation for education and knowledge acquisition in higher education during COVID-19 pandemic escalation in Nigeria.

5. Literature Review

The miracle of COVID-19 outbreak was the systematic activation of the twenty first century educational technology in its existential reality (Kommers, 2022). Educational technology is the upright practice of facilitating learning and improving classroom performances through the management of appropriate technological processes and resources, which include a wide range of digital media tools, computer hardware and software, telecommunication and networking devices, as well as the consideration of underlying theoretical perspectives for their pedagogical connections and applications (Vrontis et al., 2022). To create educational technology, many disciplines were combined, including communication, education, psychology, sociology, artificial intelligence, and computer science. In other words, the digital world of the twenty-first century has revolutionized and authentically evolved to potentially groom today's digital natives for the benefits associated with the updated instructive design in the ongoing COVID-19 global pandemic and the next global bubonic plague. The educational technologists have attempted to assess, design, implement and evaluate processes and technologies in order to improve digital learning activities with an informed pedagogical development that encapsulated learning theories, computer-based training, online learning, and mobile learning (m-learning), in which mobile technologies are employed as pedagogical tools to improve learning experiences. According to Forde and Obrien (2022) , integrating technology into education is a positive way that promotes a more diverse learning environment and a way for students to leverage technology for practical study, with goals on maximizing educational effectiveness by controlling such relevant facts as educational purposes, educational environment, student conduct, instructor behavior, and student-instructor interrelationships.

According to Bazaluk (2021), educational technology incorporates e-learning, instructional technology, ICT for education, Technology-Enhanced Learning (TEL), computer-based instruction, computer managed instruction, computer-based training,

computer-assisted instruction or computer-aided instruction, internet-based training, flexible learning, web-based training, online education, digital educational collaboration, distributed learning, computer-mediated communication, cyber-learning, and multi-modal instruction, virtual education, personal learning environments, networked learning, Virtual Learning Environments (VLE) , m-learning, ubiquitous learning and digital education. The focus of educational technology is on using technology to meet evidence-based learning principles rather than simply employing technology at random (Kroesch et al., 2022). Contrastingly, e-learning and m-learning methodology entails the use of computer technology to deliver educational material in a classroom setting via synchronous or asynchronous mode (Berestova et al., 2022).

M-learning, also known as mobile learning, is the use of mobile technology for learning, such as mobile phones and tablets. Distance learning, or learning over long distances via the internet, makes use of both m-learning and e-learning. In the ICT based learning, the virtual classrooms are an example of this type of educational technology, which uses telecommunications, computers, and other technologies to provide students with real-time interaction with other students and the instructor. This concept was illustrated by Zoom Meetings and Google Meetings when engaged constructively. The TEL involved the application of various types of technology to create and improve educational experiences (Abu Arqub et al., 2022). Artificial reality, programs that allow students to share virtual learning experiences, and even in-person learning in a technology-enabled classroom are all included.

The VLE involves the collection of teaching and learning tools that use computers and the Internet to enhance a student's learning experience. Curriculum mapping (dividing curriculum into sections that can be assigned and assessed), student tracking, online support for both teachers and students, electronic communication (e-mail, threaded discussions, chat, Web publishing), and Internet links to outside curriculum resources are the main components of a VLE package. As part of the paradigm shift known as Education 4.0, educators must modify the ways in which educational instruction is delivered. The COVID-19 pandemic have provided a wake-up call that will facilitate the digital activation of the continent of Africa in terms of educational innovation, digital education and pedagogy model, that will facilitate economies of scale in knowledge engineering (Crawford et al., 2020). Indeed, educational robots are being used in classroom instruction in the twenty-first century, alongside mobile computing technology, augmented reality technologies, e-learning

education, distance education, smart learning, blended learning, and digital libraries, all of which have been adapted to provide access to the curriculum of education in order to motivate learners to linkup with digital adjustments and understand matters with the present-day electronic civilizations (Pasalidou & Fachantidis, 2021).

There are a plethora of different options available to help students become educated and scholarly successful in response to the continuous worldwide educational disruptions. These strategies incorporate pontification of the classroom using real textual digitization, adopting Zoom multimedia live streaming platform for computer-assisted presentations, engaging intelligent android computing devices, Robots that interact with students, handheld digital devices, and electronic household appliances (Hernández-de-Menéndez et al., 2019). The differences in how people view modernism are determined by their unique perceptiveness and access to a wide range of technologies, as well as by their geographic location and the surrounding infrastructure. The fascinating implication of educational technology is the availability of interconnected meetings and knowledge sharing via appropriate innovative learning environment where there is immeasurable intelligence for adoption. The augmented reality environment is without a doubt an effective enlightening invention for the twenty-first century classroom automation, dramatically altering the context and schedules of academic teaching and online engagement (Yu, 2022).

Figure 1. Telepresence robots for educational augmented reality pedagogy in the twenty-first century (Edwards, 2021)

The current overview of the literature describes the use of digital media in education today, how it influences both classroom instruction and hands-on learning, and its potential effects on the future of education. However, there are some concerns with the development and application of authentic and academic backgrounds that concentrated on the execution of curriculum, demonstration and instructional implementation throughout platforms and boundaries. Those apprehensions are centered on the approaches towards the adoption of digital media in the classroom in the twenty-first century, as well as how applications of these systems might increase the value and usefulness of academic coaching in the context of

scholastic and specialized educational involvement. The widespread use of zoom technology in the ongoing COVID-19 for attendance of online conferences, corporate meetings, distance learning and governmental appointment demonstrated the capabilities for the digital extreme automation that characterized the rise of Industry 4.0 and Education 4.0 in the twenty-first century.

According to Mailizar et al., (2022), educational institutions will develop into major nodes of connectivity in the twenty-first century, serving as places where teachers and students can interact with one another and their communities (Mailizar et al., 2022). In the emerging new environment, educators will play less of an instructor role and more of an information designer role, preparing students with the needed capabilities to convert knowledge into creative ideas through service branding (Cain & Henriksen, 2022). With regard to Figure 1, audio and augmented reality video communication experiences can be provided by telepresence robotic systems and they are becoming more common due to the rise of consumer electronics with video capabilities and easily accessible internet for ubiquitous interactivity (Kohli et al., 2022). The use of telepresence robots in the educational setting holds considerable promise for addressing challenges caused by the COVID-19 outbreak as the effects it had on the system in general as well as on the educational system is gradually diminishing (Stojan et al., 2022). There are countless reasons why children might not be able to attend physical school, including long-term illnesses, acute illnesses, the COVID-19 worldwide pandemic, psychological disorders, behavioral problems, and temper tantrums.

According to Gamage et al. (2022), the state-of-the-art methodology will necessitate revised instructional implements, digital skills and standards that must be ingrained in the technology structures of the modern-day educationalists to enable the twenty-first century comprehensive scholarly businesses. Such technological programs can be versatile and multifaceted for teachers to use as teaching and learning aids, with built-in pedagogical competency (Unsworth et al., 2022). For students to flourish in the rapidly changing digital world, they must receive the knowledge they need, as well as the confidence to tailor their talents to possibilities for innovation and investment. The 21st century talents are primarily focused on occasioning intelligence sharing and information internetworking and making sure that ideas, digital skills, and scientific knowledge are employed in the chicest technique possible given the endless digital information currently available to digital natives. Advancing the developments that will facilitate cooperative problem-solving communities of

educators, will eventually prepare citizens into full competition at the country level manpower requirements and global standard citizenships.

ICTs are the group of high-tech advancements, implements, and resourcefulness adopted in sharing, distribution, and management of information through a long channel data transmission. The computers, the internet, smart phones, personal digital assistants, satellite transmission channels, full duplex telecommunication systems, internet broadband connectivity and the more advanced twenty-first century educational robot for interactive pedagogy are just a few examples of ICT's technologies and tools for digital classroom management. Fundamentally, ICTs improve communication and device networking across geographic borders, as well as scientific platforms and digital manipulations. Similar reasoning can be applied to multimedia digital transmission across internetworked technologies, which are the innovative fusion of workstation computing devices linked to hardware systems and software platforms to permit logical and creative video sequencing, interactive animation, audio narrations, graphic and textual information to be manipulated collaboratively with digital synchronize-able data communication and network information administering supercomputers. The term "e-learning education" refers to a variety of electronic learning activities that use the Internet remotely in conjunction with personalized coursework delivered via the networked world wide web internet gateway and supplementary digital computing machines.

The students and teachers may wish to adopt communication platforms such as email, discussion forums, chats application for information sharing specifics, polls, whiteboard requirements, video computing platform to enable conferencing engagements, audio broadcast to collaborate across geographic divides, that will promote team work collaborations across multimedia interactive learning environment (Oloyede, Faruk, & Raji, 2022). Experts in interactive multimedia learning engagement, include Richard Mayer, who is a specialist in the field of creative multimedia education pedagogy and its application in electronic learning. Mayer's multimodal electronic learning education technique, was founded on Bruner's Constructivist theory, Sweller's Cognitive Load theory, and Paivio's Dual coding theory. Mayer noted that alongside new technological advancements and theories of learning, the field of creative multimedia for educational learning and reasoning has been established to be impactful within the context of electronic learning techniques (Makransky & Mayer, 2022). Particularly, an explosion in the use of multimedia to support cognition and learning across a range of educational platforms, including pedagogical agents that act as intelligent

virtual tutors, simulation-based environments, multimedia game environments that offer immersive learning experiences, and communication-based video technologies that offer opportunities for communities of users was witnessed. Richard Mayer and his co-researchers conducted a number of studies on the use of multimedia in delivering cognitive theory-based principles of instructional design in multimedia e-Learning. The key finding was that whenever learners engaged the three cognitive steps of selection, organization, and integration, very active participatory academic learning always occurred.

6. Research Methodology

The primary and secondary data sources were merged with the study findings in this investigation to address the core research objectives. Qualitative and quantitative methodology were also used. In an empirical sense, both quantitative and qualitative justifications were provided to back up the data analysis and interpretation of the findings. Structured surveys and questionnaires, personal observations, interviews, and discussions were used as research instruments for the current findings. These procedures were designed to gather data regarding the accessibility and deployment of interactive multimedia electronic learning required for pedagogical instruction delivery in the Faculty of Computer Science and Information Technology (CS&IT) that contained 4 accredited departments: Software Engineering, Information Technology, Computer Science and Computer Science Economics. The listed departments belonged to the selected case study who offered programmes during the current COVID-19 global pandemic and their students were at that time enrolled in the postgraduate programmes (PhD, MSc and PGD). Two components of the research equipment were used.

The demographic information of the correspondents was the focus of Section A (Tables 1 and 2), while the study objective was the focus of Section B's structured questions (Table 3). This survey was done during the time of the worldwide institutional lockdown around 2020. The comprehensive survey established on the research's objectives were initially administered to the postgraduate scholars who were undergoing study in the F(CS&IT) in the selected higher institution, which included both male gender and female gender currently enrolled in the department of Computer Science & Information Technology, respectively. 250 female postgraduate students and 200 male postgraduate students from a stratified random sample contributed in the data gathering process. The survey considered the composition of different digital experiences as well as the population's heterogeneous makeup of students. The students returned a total of 180 reusable questionnaires for male

respondents and 220 for female respondents, yielding response rates of 90% and 88.6%, respectively. Descriptive statistics tools were used to analyze the data.

7. Sample of the Population

The demographic sample for the research study included male and female postgraduate scholars as of the selected institution of higher learning in the North Western Nigeria at the start of the statewide shut down. In the study, two hundred and fifty (250) female and two hundred (200) male postgraduate scholars were chosen as the required sample size according to the research expectations using proportionate stratified random selection. The researchers employed questionnaires, and in-person interviews when necessary, to gather data, while descriptive statistics were adopted to analyze the attributed data that were considered relevant to the research. In contrast, 250 questionnaires were given to postgraduate female scholars, in addition to the 200 surveys given to postgraduate male scholars. 220 surveys from postgraduate female scholars and another one hundred and eighty (180) surveys from postgraduate male scholars were correctly completed, sent back and realized to be very useful for research thoughtfulness, corresponding to response proportions of 88 and 90 percent, respectively.

8. Data Collection Methods

The methods used to collect data were focused on the assessment of the core accomplishments of the educational objectives for electronic learning in the twenty-first century. These methodologies combined the previously described quantitative and qualitative data analysis with primary and secondary data collecting. In order to respond appropriately to the specific objectives of the research, data collection instruments have already been developed and organized using the proper approaches. The paper considered various sources of informative details, including direct observations, interviews, participant observations, documentation and archival documents. Cross-examination and inspection were combined for important aspects of data compilation. However, because a wealth of information was gathered about a particular occurrence, observational discoveries are thought to have significant validity. When individuals who are believed to be exceptionally knowledgeable about the topic of interest are appropriately involved, an interview may be well-thought-out qualitative. While semi-structured interviews are often conducted in person, which allows the researcher to ask questions, weigh events in unique judgments, and gain a thorough understanding of the subject of interest. Because the investigator had complete discretion

over the sample size and types of interrogations to ask, questionnaires were the most effective tool for obtaining the key evidence in a rational investigation. Research information may also be gleaned from expert viewpoints on the differences in knowledge exploitation and sub-factors in comprehension, organization, and relationships. This method of gathering data is prioritized and used for informed decisions.

9. Findings and Analyses of the Research

The findings of the present study demonstrated how familiar and influential digital media tools and e-learning educational features are to students of the twenty-first century. The utilization of ICTs and multimedia tools is beneficial for educational endeavors that have a focus on long-term development and growth. Therefore, educators, professors, lecturers, and teachers should take advantage of their digital skills, teaching prowess, and knowledge improvements for the upcoming digital natives in attending electronic learning environment. In an ideal world, creative media technology education pedagogies can be integrated into students' current motivations, which are critical aspects of digital natives' electronic means for innovative existence.

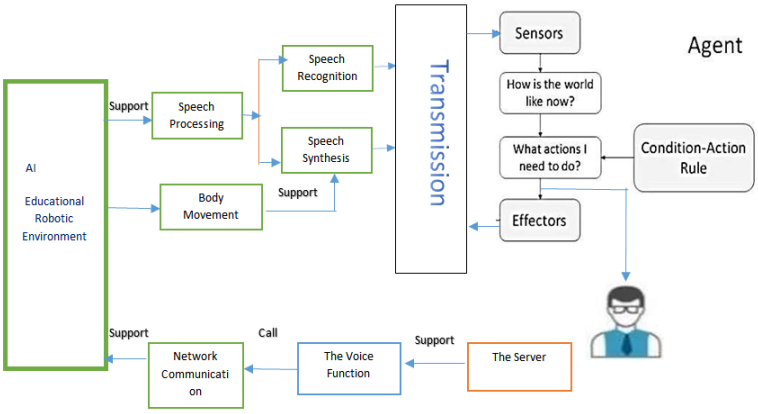

Figure 2. AI Educational Robotic Environment

Reviewing a lot of educational technologies platform for the twenty first century digital pedagogy reveals that the existing education technologies contain pedagogical deficiencies. This paper proposes and contributes an artificial intelligence actor network educational technology. The Actor Network Technology (ANT) is efficient, but it assumes that if one of the active players leaves the network, it will negatively affect all the other active players as well. However, networks are constantly evolving due to the complexity and unpredictability of social developments within organizations. Various studies have identified other agents and technical barriers as contributing to the constrained research in various higher education institutions. The literature identified cooperation at the local and

international levels, in addition to limited access and skill to ICTs, as barriers. The proposed ANT model is presented in Figure 2**,** although it may be expanded based on the development of future technologies and scientific knowledge. The ANT model suggests that more actors should be involved in creating the educational technology services portfolio and roadmap. The proposed ANT model could be used to direct future educational technology service requirements in order to raise the standard of teaching and research in Nigerian tertiary institutions and among the partnering institutions. It strengthens the adoption of traditional technology for modernism by determining technology end-user requirements. The current study discovered a wide range of unmet needs for a variety of services and technologies used in both education and research, and it focused on providing tools and services that help Nigerian public higher education institutions raise the standard of educational instruction and increase their research output as a matter of urgency.

10. Distribution of Demographic Information

Table 1. Distribution of the Gender of the Respondents (Source: The 2020 Field Survey)

Sex Category	Frequency Count	%(Percentage)
Women Gender(Female)	**220**	**55%**
Men Gender (Male)	**180**	**45%**
Total	**400**	**100**

According to the data in Table 1, 220 (55%) of the respondents are female, while 180 (45%) are male.

Table 2. Respondents' Educational Program Distribution (Source: 2020 Field Survey)

Enrolled Programme	Frequency Count	%(Percentage)
PHD	**20**	**5%**
MSC	**150**	**37.5%**
PGD	**230**	**57.5%**
Total	**400**	**100**

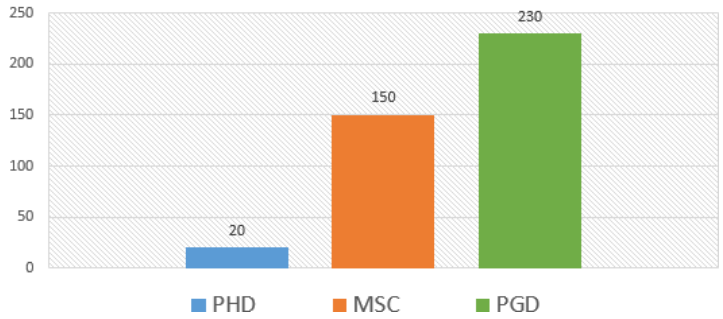

Figure 3. Educational Programme Distribution of the Respondents

Table 3. Classification of the ICT Computing Gadgets Exploitation by the Respondents for Electronic - Learning Activities (Source: 2020 Field Survey)

E-learning Computing Device	Frequency	Percentage (%)
Desktop	34	7.5
Laptops	230	50.7
Tables	150	33.0
Smart Phone	40	8.8
Total	700	100

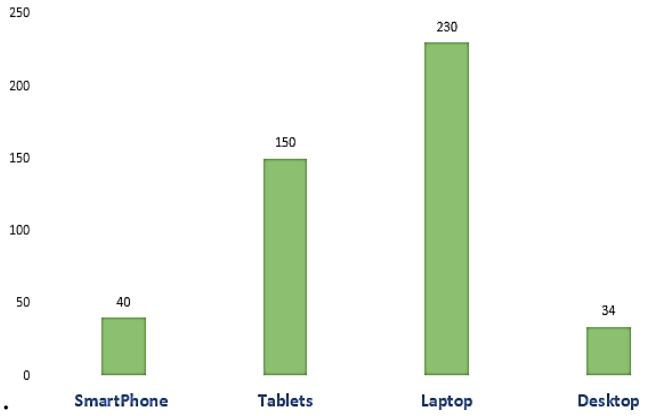

Figure 4. Distribution of the ICT Computing Devices Utilization (Source: 2020 Field Survey)

According to the data in Table 2 and Figure 3, 230 (57.5%) of respondents are enrolled in a PGD program, while 150 (37.5%) are enrolled in an MSc degree program, and 20 (5%) of respondents are enrolled in a PhD program. According to the data in Table 3 and Figure 4, 40.8% of respondents used smart phones, 50.1% used tablets, 150.0% used laptops, and 340.5% used desktop computers to participate in an Electronic learning education utilizing ICT digital gadget in overseeing the administration and management of coursework during the period of COVID-19 outbreak

11. Conclusion

The most flexible global educational method recommended for every student and institution for adoption in the ongoing pandemic and beyond has been confirmed by the current research, which also established the notion of education 4.0. This paper has studied a lot of educational technologies platform for the twenty first century digital pedagogy and found that the existing education technologies contain pedagogical deficiencies. In that regard, an artificial intelligence actor network educational technology has been proposed. Through a number of breakthroughs, education 4.0 modernization has transformed the

worldwide educational policy in the twenty-first century through educational automation. Along with the institution's attempts to expedite the knowledge management process, individualized adaptive learning played a crucial role in bolstering and supporting transformative teaching approaches. The current study has documented the university administration's evidential participation in utilizing digital media platforms to boost support for students' academic endeavors, emphasizing the role of the scholar's director when a learner is cut off from authentic learning undertakings. The current research has also shown that the electronic learning education can be used to ensure that academic activities continue uninterrupted in the event of a future worldwide pandemic that may have an influence on in-person classroom interactions.

Conflicting Interest/Acknowledgement

In the current research work, the authors have nothing to disclose as conflict of interest. The authors wish to acknowledge the immeasurable contributions of U&J Consult Limited for providing educational consulting services to the current work.

References

[1] Abu Arqub, S., Waleed, M., Al-Abedalla, K., Iverson, M. G., & Uribe, F. (2022). An insight on the influence of Technology Enhanced Learning (TEL) in orthodontics' education: A Systematic Review. European Journal of Dental Education.

[2] Bazaluk, O. (2021). The Sophia Republic: The Special Theory of Education. Philosophy and Cosmology, 26(26), 62-76.

[3] Berestova, A., Burdina, G., Lobuteva, L., & Lobuteva, A. (2022). Academic Motivation of University Students and the Factors That Influence It in an E-Learning Environment. Electronic Journal of e-Learning, 20(2), 201-210.

[4] Cain, W., & Henriksen, D. (2022). Creativity and Design Thinking: Crucial Mindsets in Instructional Design Education The Instructional Design Trainer's Guide (pp. 38-47): Routledge.

[5] Craig, S. L., Smith, S. J., & Frey, B. B. (2022). Professional development with universal design for learning: supporting teachers as learners to increase the implementation of UDL. Professional Development in Education, 48(1), 22-37.

[6] Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., . . . Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. Journal of Applied Learning & Teaching, 3(1), 1-20.

[7] Edwards, B. I. (2021). Emerging Trends in Education: Envisioning Future Learning Spaces and Classroom Interaction. Emerging Technologies for Next Generation Learning Spaces, 7-18.

[8] Filho, E. J. M. A., Gammarano, I. d. J. L. P., & Barreto, I. A. (2021). Technology-driven consumption: digital natives and immigrants in the context of multifunctional convergence. Journal of Strategic Marketing, 29(3), 181-205.

[9] Forde, C., & OBrien, A. (2022). A Literature Review of Barriers and Opportunities Presented by Digitally Enhanced Practical Skill Teaching and Learning in Health Science Education. Medical education online, 27(1), 2068210.

[10] Greve, S., Thumel, M., Jastrow, F., Krieger, C., Schwedler, A., & Süßenbach, J. (2022). The use of digital media in primary school PE–student perspectives on product-oriented ways of lesson staging. Physical Education and Sport Pedagogy, 27(1), 43-58.

[11] Hernández-de-Menéndez, M., Vallejo Guevara, A., Tudón Martínez, J. C., Hernández Alcántara, D., & Morales-Menendez, R. (2019). Active learning in engineering education. A review of fundamentals, best practices and experiences. International Journal on Interactive Design and Manufacturing (IJIDeM), 13(3), 909-922.

[12] Kohli, V., Tripathi, U., Chamola, V., Rout, B. K., & Kanhere, S. S. (2022). A review on Virtual Reality and Augmented Reality use-cases of Brain Computer Interface based applications for smart cities. Microprocessors and Microsystems, 88, 104392.

[13] Kommers, P. (2022). Media as Catalysts Sources for a Better Education (pp. 267-291): Springer.

[14] Kroesch, A. M., Jozwik, S., Douglas, K. H., Chung, Y.-C., Uphold, N. M., & Baker, E. (2022). Using Technology to Support Academic Learning. The Journal of Special Education, 00224669211070563.

[15] Lee, S., Kuo, L.-J., Xu, Z., & Hu, X. (2022). The effects of technology-integrated classroom instruction on K-12 English language learners' literacy development: a meta-analysis. Computer Assisted Language Learning, 35(5-6), 1106-1137.

[16] Mailizar, M., Johar, R., Sadli, R., & Zubaidah, T. (2022). Mathematics teachers' interactions on online community of practices: A social network analysis. Education and Information technologies, 1-19.

[17] Makransky, G., & Mayer, R. E. (2022). Benefits of Taking a Virtual Field Trip in Immersive Virtual Reality: Evidence for the Immersion Principle in Multimedia Learning. Educational Psychology Review, 1-28.

[18] Mershad, K., & Said, B. (2022). DIAMOND: A tool for monitoring the participation of students in online lectures. Education and Information technologies, 1-31.

[19] Oloyede, A. A., Faruk, N., & Raji, W. O. (2022). COVID-19 lockdown and remote attendance teaching in developing countries: A review of some online pedagogical resources. African Journal of Science, Technology, Innovation and Development, 14(3), 678-696.

[20] Pasalidou, C., & Fachantidis, N. (2021). Distance Learning in the Era of COVID-19: Supporting Educational Robotics with Augmented Reality. Paper presented at the Educational Robotics International Conference.

[21] Ramaila, S., & Molwele, A. J. (2022). The Role of Technology Integration in the Development of 21st Century Skills and Competencies in Life Sciences Teaching and Learning. International Journal of Higher Education, 10(5).

[22] Stojan, J., Haas, M., Thammasitboon, S., Lander, L., Evans, S., Pawlik, C., . . . Peterson, W. (2022). Online learning developments in undergraduate medical education in response to the COVID-19 pandemic: A BEME systematic review: BEME Guide No. 69. Medical Teacher, 44(2), 109-129.

[23] Unsworth, L., Tytler, R., Fenwick, L., Humphrey, S., Chandler, P., Herrington, M., & Pham, L. (2022). Multimodal literacy in school science: Transdisciplinary perspectives on theory, research and pedagogy: Taylor & Francis.

[24] Vrontis, D., Christofi, M., Pereira, V., Tarba, S., Makrides, A., & Trichina, E. (2022). Artificial intelligence, robotics, advanced technologies and human resource management: a systematic review. The International Journal of Human Resource Management, 33(6), 1237-1266.

[25] Yu, M. (2022). Technology-Enhanced Education: Improving Students' Learning Experience in the Higher Education Context. The Wiley Handbook of Sustainability in Higher Education Learning and Teaching, 133-151.

Author's biography

Ugochukwu Okwudili Matthew, presently is an Academic scholar with Hussaini Adamu Federal Polytechnic, P.M.B 5004 Kazaure, Jigawa State, Nigeria in the Department of Computer Science with specialty in AI, Big Data Science, Cloud Computing, Internet of Things, Data Mining, Multimedia and E-Learning Education. He is a member of Nigeria Computer Society (NCS), Nigeria Institute of Management (NIM), European Alliance for Innovation (EAI), International Association of Computer Science & Information Technology

(IACSIT), International Association of Engineers of Computer Society (IAENG-CS), Association for Computing Machinery (ACM) and also a member of Teaching & Education Research Association (TERA). Ugochukwu O. Matthew hold Masters in Computer Applications from Bayero University Kano, Nigeria. In 2020, Matthew won Federal Government of Nigeria Bilateral Postgraduate Scholarship to UFV Brazil to study Computer Science. Matthew had authored and co-authored several research papers published in high impact International Journals. Matthew had reviewed several Journals and is a member of Review Board Committee of Journals Indexed by Scopus and Web of Science including IEEE Access, SN Computer Science (Springer), International Journal of Information Communication Technologies & Human Development (IJICTHD)IGI Global Journal etc. with vast intellectual contributions in academics and among the Learned Societies, serving in several Technical Committee in International Conferences. Ugochukwu O. Matthew is a cofounder of U&J Digital Consult Limited, an IT and Educational Consulting Firm in Nigeria.

Ado Saleh Kazaure is the immediate past Head of Department of Library and Information Science, Hussaini Adamu Federal Polytechnic, Kazaure , Jigawa State , Nigeria and is presently the Chief Polytechnic Librarian. Adoh Saleh Kazaure is a seasoned Library & Information Scientist with over 20 years of cognizant working experience in Research and Academic Development. A scholar with distinction, Ado S. Kazaure had published several scholarly articles in International and Local Journals of high significance and is a Member of Chartered Library Registration Council of Nigeria.

Jazuli Sanusi Kazaure is an Electrical Engineer and IT Professional. He is a registered Engineer with Nigerian professional bodies. Jazuli is a certified Network Cabling Specialist in copper and fiber optic based systems and a certified instructor in Integrated System Voice and Messaging certified by C-Tech Inc. at Sparta, New Jersey, USA. Dr. Jazuli is an academician in Polytechnic and University in Nigeria as well other Universities in West Africa. He started his teaching career from the lowest rank of Assistant Lecturer to the highest rank of Chief lecturer in Hussaini Adamu Federal Polytechnic Kazaure. He was a visiting lecturer at Jigawa State Informatics Institute, a visiting Senior Lecturer with Sule Lamido University Jigawa State, a visiting Senior Lecturer with Maryam Abacha American University of Niger Republic, an External Examiner National Open University and Digital Bridge Institute of Nigeria. Dr. Jazuli held many academic positions in Hussaini Adamu Federal Polytechnic, among others are Head of Electrical Engineering Department, Director

Center for Information Technology, Director College of Engineering, Deputy Dean Student Affairs, Director of Academics & Research Development, and currently Director Centre for Information Technology. Engr. Dr. Jazuli S. Kazaure is a cofounder of U&J Digital Consult Limited, an IT and Educational Consulting Firm in Nigeria.

Ibrahim M. Hassan is a Lecturer in the Department of Computer Science, Hussaini Adamu Federal Polytechnic, Nigeria. Ibrahim M. Hassan obtained his MSc Degree Programme from Oxford University United Kingdom. He had served as the Head of Department of Computer Science, Director Centre for Information Technology.

Andrew Chinonso Nwanakwaugwu holds MSc Degree in Data Science from University of Salford United Kingdom with IT related working experience. He is the Founder of an IT Company known as Nacsoft Systems (www.nacsoft.com.ng). He is currently working as a PT Operations Advisor at HMRC UK. He studied Computer Engineering in his first degree and Data Science in his Second degree.

Nwamaka U. Okafor is a lecturer in the Department of Computer Science, Federal Polytechnic Nekede, Owerri. She holds an MSc in Computer Forensics and Cyber Security (Distinction) from University of Greenwich, London, United Kingdom. Her research interests span areas are Internet of Things (IoTs), Artificial Intelligence (AI), Machine Learning, Data Analytics and Security. She is currently undertaking PhD in the School of Electrical and Electronic Engineering, University College Dublin. Her research is supported by Schlumberger and TETFUND- Nigeria and is focused on the application of IoTs and AI in ecological sensing. She works under the supervision of Prof. Declan Delaney on the EPA funded SmartBog research project on Irish peatlands where she develops and deploys cost-effective IoT systems and AI solutions to corroborate remote and satellite-based surveillance. Nwamaka is a mentor and Judge in Technovation Girls, a member of the Elsevier's Advisory Panel and a member of the organizing committee for the Black in AI workshops. She is a recipient of several awards including the Schlumberger Faculty for the Future Fellowship Award, Google Women Techmaker, ACM Student Research Competition Award, Young Researcher, Heidelberg Laureate Forum and so on. She is a member of several academic bodies including International Association of Computer Science and Information Technology (IACSIT), Association for Computing Machinery (ACM), Nigeria Computer Society (NCS) and British Computer Society (BCS). She is happily married and blessed with children.