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Medical Students' Perception of the Effectiveness of Zoom Technology for Clinical Learning in the Post-COVID-19 Era: A Study of two State Universities in Edo State, Nigeria

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Abstract
This study assessed medical students' perception of the effectiveness of Zoom technology for clinical learning in the post-COVID-19 era, using two state universities in Edo State, Nigeria. A descriptive survey design was adopted. A total of 300 questionnaires were distributed, with 264 (88%) returned and analyzed using SPSS version 21. Findings showed that 26.9% of students used Zoom once a month, while only 9.8% used it daily. A majority (88.3%) perceived Zoom as effective for clinical learning. Key benefits identified were enhanced independent learning (100%) and ease of accessing recorded lectures (88%). However, challenges included insufficient computer skills (100%), poor digital literacy (99%), and high data costs (89%). These results indicate that while Zoom offers benefits for clinical education, its adoption is hindered by infrastructural and skill-based limitations. Institutions must address these gaps to support sustainable digital learning environments by investing in regular digital literacy training, upgrade library and ICT centers to support digital learning among others.

Keywords: Zoom technology, Clinical learning, Medical students, Digital literacy, Online education

1. Introduction

Modern interactive technologies have made it possible to easily share information throughout the world through the use of video conferencing for teaching and learning which is generally refer to as e-learning. E-learning refers to the process of delivering training through the use of computers, encompassing technology-supported learning both online and offline. E-learning is also known as digital learning or online learning. E-learning is an innovative way of learning new skills, expanding horizons, and gaining access to learning courses at a cheaper rate than the traditional learning process. Digital electronic media, including the internet, are used to facilitate e-learning. Besides, e-learning can be accessed through electronic devices such as computer, laptop, tablet, or smart-phones thereby making zoom technology a convenient and adaptable alternative for students to learn at their own pace. There are numerous but different types of e-learning materials, including interactive web platforms and apps such as Zoom technologies, software programmes, digital courses, and digital software. Universities currently use Zoom technology to improve communication between students and lecturers. As a result, cutting-edge teaching techniques have been introduce to revolutionized support of medical education, and encourage efficient learning. This suggests that online learning provides medical students with an engaging and motivating learning experiences by combining traditional classroom learning with contemporary classroom techniques. The integration of modern interactive technologies into educational practices has dramatically transformed teaching and learning processes, particularly in the wake of the COVID-19 pandemic. Among these technologies, Zoom has emerged as a prominent platform to facilitate communication and collaboration between students and educators. As universities navigate the challenges posed by the pandemic and prepare for a post-COVID era, the adoption of Zoom technology in medical education has become increasingly prevalent. Zoom technology is an intuitive video conferencing tool that supports multiple participants, audio and video, screen sharing, working on a whiteboard, and recording. Zoom technology enhances communication, teaching, learning, entertainment, and decision-making.

Zoom technology runs on complex software that allows advanced interactivity with new hardware and technologies for learners and educators. Therefore, web conferencing audio, meetings, live chats, and meeting records can be performed using Zoom technology through a cloud-based internet platform (Bernazzani, 2020). Zoom meetings are online platforms that use video conferencing to provide free, instantaneous communication between local and remotely located participants such that a participant can join the Zoom meeting without having an account which is a part of e-learning.

E-learning provides clinical students with more flexibility that allows them the freedom to choose when and how to work. Clinical students must be aware of the appropriate resources to satisfy their unique information needs (Iroaganachi & Ilogho, 2012). If adequate training on zoom technology is not provided, the e-learning resources will gradually become obsolete and redundant and underutilized. According to Jonathan & Udoh (2015), it would be expensive to acquire information sources that users are unaware of hence it is essential to increase users' awareness of electronic resources e-learning.

The sustained utilization of zoom technology as examine in this study is to unearthered the extent to which clinical students are continuing to exploit and benefit from zoom technology for learning in the post-COVID-19 pandemic. The use of zoom technology is important for achieving educational objectives. Therefore, the level of zoom technology used affects how well students learn in the post-COVID-19 era. Web conferencing for education has also been linked to the benefits of both students and teachers. Zoom conferencing technology is used to foster collaboration between educational institutions. This study aims to explore medical students' perceptions of the effectiveness of Zoom technology for clinical learning in the post-COVID-19 era, focusing on two selected state universities in Edo State, Nigeria. By examining the frequency of Zoom usage, perceived benefits, and challenges encountered, this research seeks to shed light on the role of Zoom technology in enhancing medical education in two selected state university in Edo State, Nigeria.

Statement of the Problem

The current COVID-19 pandemic's negative impact on human existence has resulted in providing efficient zoom technology on electronic learning to satisfy the information needs of clinical students. It facilitates the ability to exchange and search for information on medicines and healthcare services. Zoom web conferencing tools support a collaborative online learning environment based on the needs of each student that encourages innovation and creativity. It is inexpensive, students have 24/7 access to knowledge, learn at their own pace and access learning materials regardless of location or time (Roy, Ray, Saha, & Ghosal, 2004).

Despite, the benefits of zoom technology, preliminary observation by the researcher revealed that zoom application is still not fully implemented. Furthermore, it has been observed by the researcher that most tertiary institutions in Edo State have not embraced the application of Zoom technology for teaching and learning due to shortage of internet or e-learning platforms and facilities in the universities in the post-COVID-19 era in Edo State, Nigeria. It has been found that studies relating to this area were very scarce; however, none of the studies reviewed captured all the variables in this present study. This has created a knowledge gap, and it is against this background that this study seeks to examine the awareness and use of Zoom technology for electronic learning by clinical science students in the post-COVID-19 era at Ambrose Alli University, Ekpoma, Edo State, Nigeria.

Objectives of the Study

The main objective of this study is to examine the use of zoom technology for clinical learning by medical students in the post-COVID-19 era in two selected State universities in Edo State, Nigeria. Specific objectives are to:

1. To determine the frequency of using zoom technology use by medical students in two universities in Edo state.
2. To determine the level of medical students perception of the effectiveness of Zoom technology use by medical students in the post-COVID-19 in the selected two state University in Edo State, Nigeria.
3. Identify the benefits of zoom technology for clinical learning by medical students in the post-COVID-19 era in the selected Universities in Edo State, Nigeria.
4. Identify the challenges that affect the use of zoom technology for clinical learning by medical students in the selected Universities in Edo State, Nigeria.

Research Questions

1. What is the frequency of Zoom technology use by medical students for clinical learning in the post-COVID-19 era in selected Universities in Edo State, Nigeria?
2. Do you think zoom technology is effective in clinical learning in post-COVID-19 era?
3. What are the benefits of zoom technology for clinical learning by medical students in the post-COVID-19 era in selected Universities in Edo State, Nigeria?
4. What are the challenges that affect the use of zoom technology for clinical learning by medical students in selected Universities in Edo State, Nigeria?

Literature review

The role of Zoom technology in clinical education has garnered significant attention, with researchers exploring its impact on skills development, clinical reasoning, and patient interaction. A study by Chen *et al*. (2023) [42] investigated the effectiveness of Zoom-based simulations in enhancing clinical skills proficiency among medical students and found that virtual simulations facilitated realistic learning experiences and improved students' confidence and competence. Ifeanyi *et al*. (2021) [3] underscores the cost-effectiveness and convenience of Zoom-based learning, alleviating financial burdens and providing students with the flexibility to learn at their own pace. Ogwunte *et al*. (2020) [29] found that Zoom Cloud technology facilitates real-time communication between educators and dispersed students, enabling secure session recording and storage, group collaboration, and encryption of meetings. Crompton (2013) [16] and Cohari (2013) [15] caution against the misapplication of Zoom technology, which may lead to cognitive overload. However, Chipunza (2013) [14] and Mbah (2016) [28] argue that when used effectively, Zoom enhances knowledge transfer and student learning. The integration of technology into classroom learning has not only stimulated engagement but also enhanced interaction among learners (Guzacheva, 2020) [2]. Zoom, as a prominent

technology in education, relies on electronic devices and robust library systems with online resources accessible globally (Haqien *et al*., 2020) [21]

Online learning can also be used to maximize the teaching learning process although it is conducted without face-to-face meeting. Shadat *et al*., (2017) [34] stated that in using zoom for distance learning process for clinical science students is more interactive, creates satisfaction, provide positive experiences in learning process. The innovative of zoom increases better learning outcomes for different groups of students. The classroom action research about e-learning model with zoom application to improve the ability of giving strengthening skills in mathematics learning was carried out to the fourth semester medical students of Bengkulu University, the result indicated that the lecturer activities in the teaching learning process with e-learning model with zoom application was in a good category and the students' activities improved and the ability of giving strengthening skills in learning also increased (Andriyani & Sari, 2020) [9].

Another research was carried out by Brahma, (2020) about the use of Zoom as an online based learning among medical students at STKIP Kusumanegara Jakarta. The result showed that medical courses become more interactive and in demand by students because the online learning media used were very innovative and effective according to the current development. Through zoom, lecturers and students can conduct video conference which is used as a means of communicating in online learning and the recordings made during the meeting are more secure. On the contrary Haqien & Rahman, (2020) [21] revealed that lectures activities using Zoom Meeting are considered less effective for the university students in Jakarta and Depok because of the network problem or internet signal for students who do not use Wi-Fi which will have an impact on the quality of learning they receive. Moreover, the COVID-19 pandemic has accelerated the adoption of Zoom technology in medical education, with institutions worldwide leveraging its capabilities to ensure continuity of learning amidst disruptions. Research by Wang *et al*. (2022) examined the challenges and opportunities of Zoom-based education during the pandemic and identified strategies for enhancing the effectiveness of online learning, including faculty training, technological support, and pedagogical innovation According to Guzacheva (2020) [2], online distance learning in educational process has become a buzz in the medical education and today it caters to the needs of many modern-day learners. Infusing technologies into classroom learning have added to the stimulus and enhancement of learner's interaction within the classroom. A study by Li *et al*. (2023) explored the impact of Zoom-based learning on medical students' academic performance and found that students who participated in Zoom lectures demonstrated higher levels of engagement and comprehension compared to traditional classroom settings. This highlights the efficacy of Zoom in fostering interactive and immersive learning experiences conducive to knowledge retention and application.

According to Ifeanyi *et al*., (2021) [3] concerning the challenges of participating in online zoom, all the participants mentioned that buying data bundle for the internet is expensive and therefore frustrating. Using the zoom platform requires reasonable bandwidth, which will be problematic for participants who lack strong internet connections or have limited data plans and lack of computer/android phone. Agbo *et al*., (2020) [7] stated that ownership of desktop, laptops, smart phones is a condition for use of social media and lack of skills/experience in using the zoom application. Baro and Godfrey (2015) [10] stated that lack of skills power failure, lack of time, lack of facilities and the attitude of some zoom user were deterrent to the use of Web 2.0 tools in Africa.

Julius *et al*., (2021) [23] investigated the challenges and opportunities of using ZOOM app in the teaching and learning during COVID-19 from lecturers' and medical students' perspectives. The study sought to establish challenges lecturers' and medical students' encounter when using zoom app in the teaching and learning during COVID-19 pandemic and determine opportunities lecturers' and medical students' encounter when using zoom app in the teaching and learning during COVID-19 pandemic. Fifty (50) medical students and ten (10) lecturers at five (5) institutions in the Lusaka District of Zambia participated in this study. A mixed method approach which followed a descriptive survey study design was used. Data was collected using a semi-structured questionnaire and a semi-structured interview schedule. Data was analyzed descriptively and thematically.

The challenges faced in using zoom app in teaching and learning include the limited capacity of zoom app has accommodate more participants during the teaching and learning process; lack of good network connection; power outages; lack of technological knowledge; high bundle consumption; and lack of devices for online learning such as smart mobile phones, computers, tablets, desktop, and smart televisions. Despite the challenges, the benefits of incorporating Zoom technology into medical education are evident. Shadat *et al*. (2017) [34] emphasize two major benefits as interactive nature of Zoom, and the promotion of the satisfaction and positive learning experiences among clinical science students. Andriyani & Sari (2020) [9] demonstrate the efficacy of Zoom in strengthening skills in mathematics learning, while Brahma (2020) highlights its role in enhancing the interactivity and effectiveness of medical coursesthe. However, Haqien & Rahman (2020) [21] note connectivity issues as a barrier to effective Zoom-based lectures in some region. Research by Jones *et al*. (2023) [40] examined the use of Zoom for interdisciplinary case discussions and found that virtual collaborations enhanced students' understanding of holistic patient care and promoted teamwork skills essential for effective healthcare delivery. Guzacheva (2020) [2] emphasizes its significance in facilitating uninterrupted learning during cris es. Julius *et al*. (2021) [23] shed light on the challenges faced by both lecturers and medical students in using Zoom during the pandemic, including limited capacity, network issues, and technological barriers. Nevertheless, the study also underscores the opportunities presented by Zoom, such as cost-effectiveness, remote accessibility, and simplified group work. While Zoom offers numerous benefits, concerns have been raised regarding its potential drawbacks, particularly in terms of digital fatigue and screen time. Recent studies by Johnson *et al*. (2023) and Smith *et al*. (2023) [39] have highlighted the importance of incorporating strategies to mitigate digital fatigue and promote well-being in online learning environments. These include implementing frequent breaks, encouraging physical activity, and fostering social connections among students.

Zoom technology offers immense potential for medical education, its effective implementation requires addressing various

challenges, including connectivity issues, technological literacy, and pedagogical strategies. By leveraging its benefits and mitigating its limitations, Zoom can continue to revolutionize medical education in the post-COVID era.

Methodology

This study employed a descriptive survey research design to evaluate the perception and use of Zoom technology for clinical learning among medical students. The study population consisted of all 400–600 level medical students enrolled in two state universities in Edo State, Nigeria. A simple random sampling technique was used to select participants, ensuring each student had an equal chance of being included. Data were collected using a structured questionnaire validated by subject experts. Out of 300 distributed questionnaires, 264 were returned and found valid for analysis, representing an 88% response rate. The data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 21. Descriptive statistics, including frequencies and percentages, were used to summarize the responses.

Findings and Analysis

A total of 264 copies of the questionnaire (%) were returned and found usable for analysis. Data generated were analyse using frequency counts and percentages.

Demographic data of the respondents

Table 1: General Information of the Respondents

Questions	Response option	N (%) total=264
Gender	Male	158 (59.8%)
	Female	106 (40.2%)
Age	<20yrs	12 (4.5%)
	21-30yrs	176 (66.7%)
	31-40yrs	62 (23.5%)
	>40yrs	14 (5.3%)

The table below analysis the respondents frequency of using zoom technology in clinical learning

Table 2: Frequency of using zoom technology

Frequency	Frequency	Percentages (%)
Daily	26	9.8%
2-3 times a week	15	5.7%
Once a week	53	20.1%
Twice a week	28	10.6%
Once a month	71	26.9%
Occasionally	60	22.7%
Never	11	4.2%
Total	264	100

Table 1 indicate that most medical students use zoom technology once a month (26.9%). This is followed by those that use the application occasionally (22.7%), Once a week (20.1%) and 11 respondents representing 4.2% of the students claimed they never use the technology in clinical learning.

From the figure above, it shows that 48.1% of the respondents perceived that zoom platform is effective for clinical teaching, while 40.2% agreed to very effective; 8.3% of the respondents said it is not effective and the least is 3.4% respondents that had indifferent opinion.

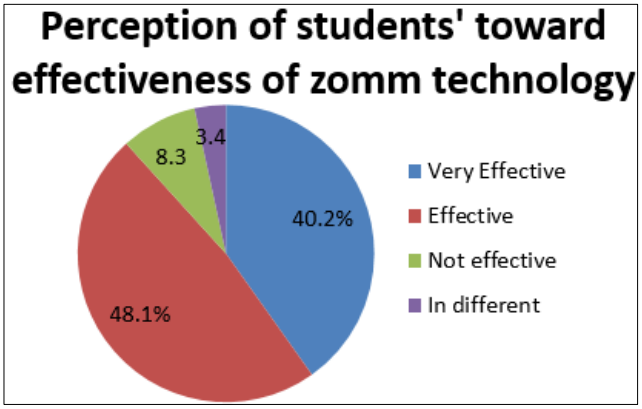

Fig 1: Perceived effectiveness of zoom technology in clinical learning

Table 3: The benefits of zoom technology in clinical learning by medical students

S/N	Benefits	Frequency	Percentages (%)
1.	it boost independent learning	264	100
2.	Flexibility in instruction cum learning	123	47
3	Time saving	130	49
4	It encourages self-pace learning as recordings can be replay	233	88
5	Learning with other interactive network is made possible	120	46
6	Materials can be shared ahead of the class	232	88
7	It has ability to connect users together regardless of location	120	46
8	Allow seamless communication	100	38
9	Clinical learning is made simple	100	38
10	Link is easy to navigate through	132	50

The most acknowledged benefit is that Zoom *boosts independent learning* (100% of respondents). *Self-paced learning* is highly appreciated, with 88% of students valuing the ability to replay recorded sessions. The ability to *share materials ahead of class* is also recognized by 88% of students. *Flexibility in instruction* (47%) and *time-saving* (49%) are noted as moderately beneficial. 46% of students recognize that Zoom enables learning through interactive networks and connects users regardless of location. Only 38% of students highlighted that Zoom allows seamless communication and simplifies clinical learning. The ease of navigation through links was rated by 50% of students.

Table 4: The challenges medical students encountered while using zoom technology for clinical learning

s/n	Challenges	Frequency	Percentages (%)
1.	Poor quality of service	200	76
2	Network issue	161	61
3	Insufficient computer skills	264	100
4	Workload	245	93
5	Lack of time	212	80
6	Inadequate library facilities	255	97
7	Poor digital literacy skills	262	99
8	Noise and distraction	122	46
9	Improper breakout	100	38
10	limited capacity to accommodate more participants during the teaching and learning process	201	76
12	High bundle consumption	234	89
13	lack of good network connection	134	51
14	lack of technological knowledge	154	58
15	lack of devices for online learning such as smart mobile phones, computers, tablets etc	67	25

Most significant challenges are *Insufficient computer skills* is a major challenge, with all students (100%) acknowledging this issue. Poor digital literacy skills (99%) and inadequate library facilities (97%) are also highly problematic. High workload (93%) and high internet bundle consumption (89%) are significant concerns.

Moderate Challenges: Issues such as network problems (76%), poor quality of service (76%), and lack of time (80%) were reported by a majority. Lack of good network connection (51%) and lack of technological knowledge (58%) are notable barriers.

Less Significant Challenges: Noise and distraction was reported by 46% of students. Improper breakout sessions and limited capacity to accommodate participants were reported by 38% and 76%, respectively. Only 25% of students mentioned the lack of devices as a challenge.

Discussion of Findings

The findings revealed that the use of Zoom for clinical learning among medical students is not consistent. Only 9.8% of respondents used Zoom daily, while the majority (26.9%) used it only once a month. This shows that although Zoom was adopted, its regular use has not been sustained post-COVID-19. According to Adedoyin and Soykan (2020) [5], online learning tools like Zoom became critical during the pandemic but their effectiveness depends on frequency and purpose of use.

In terms of effectiveness, 40.2% of students considered Zoom very effective, while 48.1% found it effective. Only a small proportion (8.3%) viewed it as not effective. This suggests a generally positive perception. This aligns with the work of Martin *et al*. (2020) [26], who found that students valued virtual tools for their flexibility and accessibility, particularly during disrupted academic sessions.

Benefits identified include enhanced independent learning (100%), availability of recorded sessions (88%), and easier material sharing (88%). These findings confirm those of Dhawan (2020) [17], who highlighted that asynchronous learning options improve student engagement and knowledge retention.

Challenges encountered include insufficient computer skills (100%), poor digital literacy (99%), inadequate library facilities (97%), and high data costs (89%). These align with Adeoye *et al*. (2020) [6], who reported that digital infrastructure and skills remain major barriers in Nigerian higher education institutions.

Conclusion

The study concludes that while Zoom technology presents clear benefits for clinical learning—such as flexibility, accessibility, and enhanced independent study—its effectiveness is undermined by infrastructural limitations, lack of digital skills, and inconsistent usage among students. There is a need to bridge the gap between technology availability and student preparedness for digital learning.

Recommendations

Based on the findings from this research work, the following recommendations are made:

- Incorporation of information literacy skills into the medical education curriculum as this will assist in computer skills development that will facilitate the use of technologies by medical students
- Provision of alternative source of power supply in the medical schools as this will enhance the effectiveness and proper usage of Zoom technology for medical teachings
- There should be provision of internet facilities in medical campuses as this will improve internet connectivity within the universities to facilitate effective use of zoom technology for improved medical knowledge and practices.
- Institutions should invest in regular digital literacy training for students and faculty.
- Government and school management should improve internet infrastructure and subsidize data costs for students.
- Academic staff should integrate Zoom sessions into clinical curricula consistently.
- Libraries and ICT centers should be upgraded to support digital learning requirements.

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Conflict of interest

There are no conflicts of interest

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