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*Original Paper*

# The Impact of the Covid-19 Pandemic on the Adoption of ICT Infrastructure in Institutions of Higher Learning in Zimbabwe: The Case of Bindura University of Science Education

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## Abstract

The impact of the COVID-19 pandemic on the adoption of Information Communication Technology (ICT) infrastructure in higher learning institutions in Zimbabwe, specifically Bindura University of Science Education (BUSE), was examined in this study. It is well-known that developing countries have been slow in embracing ICTs across all sectors. The purpose of this study was to assess how the COVID-19 pandemic affected the adoption of ICT-based teaching and learning in higher learning institutions. The evidence gathered indicated that ICT-enabled platforms were reliable in facilitating teaching under the restrictions imposed by COVID-19. Consequently, the study further focused on the ICT tools adopted by BUSE and aimed to determine the benefits and challenges associated with their adoption. The researchers used purposive sampling to select four BUSE IT personnel for semi-structured interviews, and they distributed thirty-six questionnaires to lecturers and students using a convenience sampling technique. The research philosophy guiding this study was social constructivism, and a qualitative research approach was adopted, supported by a case study research design. The findings revealed that the commonly adopted ICT tools at BUSE were Zoom, Google Classroom, MOODLE, and informal platforms like WhatsApp. WhatsApp was the most widely used tool due to its low cost and user-friendly interface. However, both lecturers and students lacked sufficient ICT skills to navigate the other recommended ICT tools. While ICT-based teaching and learning during the pandemic reduced costs, saved time, and enhanced student performance, it also presented more challenges than opportunities. The efficiency and effectiveness of ICTs at BUSE were hindered by a lack of ICT infrastructure and skills, high bandwidth costs, poor network coverage, and frequent power outages. In conclusion, the researchers found that the adoption of ICTs in higher learning institutions in Zimbabwe, particularly under pandemic conditions, is a complex process that requires addressing various challenges to ensure its success.

**Keywords:** COVID-19 pandemic, ICT, higher education, MOODLE platform, students

## 1. Introduction

The global outbreak of the COVID-19 pandemic led to the closure of educational institutions worldwide. To curb the rapid spread of the virus, governments implemented various measures, including the mandatory shutdown of schools and universities to promote social distancing and minimize the risk of infection. Consequently, educators were compelled to swiftly transition from traditional classroom settings to virtual platforms in early 2020. This unprecedented situation posed significant challenges to the education sector, but it also accelerated the adoption of online teaching and learning methods. In light of these circumstances, this study aims to evaluate the impact of the COVID-19 pandemic on the integration of Information Communication Technology (ICT) infrastructure in higher education institutions in Zimbabwe, with a specific focus on Bindura University of Science Education (BUSE).

## 2. Literature Review and Theoretical Framework

This section focuses on the theoretical framework guiding the study, ICT infrastructure in the Zimbabwean education sector, the impact of the COVID-19 pandemic on institutions of higher

education, and the adoption and use of ICT systems. The study was guided by the Technological Acceptance Model (TAM).

### *2.1 Technological Acceptance Model*

The Technology Acceptance Model (TAM) developed by Davis (1989) has emerged as one of the most influential models in the field of technology acceptance. According to TAM, the process of accepting technology involves three stages. In the first stage, external factors such as system design features trigger cognitive responses, specifically perceived ease of use and perceived usefulness. These cognitive responses then lead to the formation of an affective response, which is the attitude toward using the technology and the intention to use it. Ultimately, these factors influence the actual use behavior (Davis, 1989; Davis, 1993). The model represents behavior as the outcome predicted by perceived ease of use, perceived usefulness, and behavioral intention. Perceived ease of use and perceived usefulness capture the expectations of positive behavioral outcomes and the belief that using the technology will not be labor-intensive (Davis, 1989). A follow-up study suggests that behavioral intention can be replaced by the attitude towards behavior (Davis, 1993), which is an affective evaluation of the potential consequences of the behavior (Ajzen, 2011). The stronger the affective response, the more likely the behavior will occur. The impact of perceived usefulness on actual use can be direct, highlighting the significance of this variable in predicting behavior. Although perceived ease of use does not directly influence use behavior, it plays a crucial role in facilitating the effect of perceived usefulness (Davis, 1993). The model suggests that if an application is expected to be user-friendly, it is more likely to be perceived as useful by the user, thus increasing the likelihood of technology acceptance (Davis, 1989; Davis, 1993). Despite facing criticism on various grounds, TAM remains a valuable general framework and aligns with numerous studies investigating the factors influencing older adults' intention to adopt new technology (Braun, 2013). The development of this model and the measures for technology acceptance have made significant theoretical contributions and hold great practical value. The adoption and utilization of information technologies have the potential to yield both immediate and long-term advantages for organizations and individuals. These benefits include enhanced performance, increased financial and time efficiency, as well as added convenience. This has been supported by studies conducted by Curley (1984) and Sharda, Barr & McDonnell (1988).

### *2.2 ICT Infrastructures in the Zimbabwean Education Context*

The integration of information and communications technology (ICT) in education has led to several changes that affect students and educators alike. The reason for this is that educational institutions should adapt to a global environment where technology plays an increasingly important role. Kaisara (2021) notes that, before COVID-19, only a handful of institutions in developing countries made significant efforts to move away from traditional face-to-face teaching and towards remote learning. However, countries such as Rwanda and Mozambique, as well as South Africa, have actively adopted ICT to support their socio-economic growth, as Ezumah (2021) points out.

Based on data from Internet World Stats (2019), Zimbabwe has a population of 14,794,944, with 8,400,000 internet users. However, the country's internet growth rate of 16.7% is considerably lower compared to neighbouring countries like Zambia (36.1%) and Mozambique (21.6%). To promote the use of technology in education, the President's office in Zimbabwe initiated a campaign to equip schools with computer-related equipment, resulting in the integration of ICTs in the teaching and learning process. Despite these efforts, the impact of investing in ICT infrastructure in African countries has been limited due to a lack of coordination in policy, program, and project design, as well as proper implementation. As pointed out by Shoko (2012), the use of ICT in most African countries is primarily limited to basic purposes, with the internet mainly utilized for non-commercial activities such as social networking, entertainment, and accessing news sites. To tackle these challenges, Zimbabwe has established the Zimbabwe National ICT Policy framework to guide the formulation and implementation of ICT strategies and programs across all sectors of the economy. However, the access and utilization of ICT in Zimbabwe are hindered by a lack of knowledge and skills, as highlighted by Nhendere (2020). Despite the availability of ICT infrastructure, there is a need for adequate training and expertise to effectively utilize ICT resources in the country.

In the remote regions of Zimbabwe, there is a noticeable absence of infrastructure to support ICT services.

This lack of infrastructure has impeded the fulfilment of the main objective of the ICT policy, which is to enable and promote access to and increased utilization of telecommunications/ICT in all aspects of life. Nevertheless, evident endeavours are being made to enhance the utilization of ICTs in the country. These efforts primarily focus on modernizing the economy and integrating digital technology into the National Development Strategy 1 (NDS1) between 2021 and 2025. The NDS1 places significant importance on the government's goal of developing and providing appropriate ICT skills within the public sector. Furthermore, the civil society sector in Zimbabwe has also made progress in incorporating ICTs into the education sector. This is exemplified by the College IT Enhancement Programme (CITEP), which concentrates on building local capacity to maintain and manage ICT equipment, as well as implementing effective ICT strategies in colleges. Concerning the state of ICT infrastructure in Zimbabwe's education sector, this article examines the impact of COVID-19 on the adoption of such tools.

### *2.3 Impacts of the COVID-19 Pandemic on Institutions of Higher Education*

The COVID-19 pandemic originated in Wuhan, China, in December 2019 and was officially declared a global pandemic by the World Health Organization in March 2020. This declaration marked the beginning of an unprecedented public health crisis that spread rapidly worldwide (Karakose & Malkoc, 2021b). To combat the transmission of the virus, many countries, including China, Italy, the USA, England, and Georgia, implemented distance education measures by suspending in-person classes. As a result, higher education institutions, primary and secondary schools, and other educational establishments were forced to close, impacting millions of students (Hebebcı et al. 2020). This closure has the potential to be the most significant education crisis in history. Therefore, it is crucial to prioritize the sustainability of education for the progress and development of all nations.

In March 2020, Zimbabwe, like many other countries, took the precautionary measure of closing schools and tertiary institutions to prevent the spread of COVID-19. This global crisis resulted in one in five students worldwide being unable to attend school, and one in four students being barred from higher education institutions. The closure of these institutions had a significant impact on the economies of various countries. For example, UK universities lost over £800 million in income for the 2019-2020 academic year due to the pandemic. In the USA, the higher education sector experienced a drop in income from \$44.6 billion in 2017 to around \$30 billion in 2020. Similarly, Australia's higher education sector suffered losses between AUS\$ 3 billion and \$4.6 billion in 2020. UNESCO reported that 13 countries implemented measures such as school closures, affecting 290.5 million students globally. In response, UNESCO called on countries to support affected students and families and promote inclusive distance learning programs. As a result, institutions had to adapt and utilize alternative methods of teaching and learning, which is the focus of this article - assessing the ICT infrastructures adopted by institutions during the pandemic.

### *2.4 The Adoption and Use of ICT Systems in Institutions of Higher Education as a Response to the COVID-19 Crisis*

Governments across the globe have encountered significant obstacles as a result of the global coronavirus pandemic since the beginning of 2020. This has led to a renewed emphasis on the role of technology in public services. The unprecedented nature of this situation has created a strong demand for information and communication technologies (ICTs) to facilitate remote work solutions, promote social distancing, and effectively manage the healthcare crisis. Even before the pandemic, ICTs were already experiencing rapid expansion worldwide, as highlighted by Milakovich (2021). However, the COVID-19 outbreak further underscored the importance of ICTs, particularly in enabling distance education and online learning activities, as noted by Sanchez et al. (2020). By harnessing the power of ICTs, the education sector was able to mitigate the negative impacts of the pandemic, both at the national and international levels. Al-Husban (2020) also highlights the numerous advantages of distance education, including cost reduction. The closure of schools and universities had a significant impact on in-person courses, affecting approximately 72.4% of enrolled students, according to UNESCO (2020).

The COVID-19 pandemic has highlighted the importance of online teaching and learning in higher education, including international education. To ensure the safety of both teachers and students, virtual teaching has become the preferred option. UNESCO has recommended the use of online learning tools

to address the closure of educational institutions caused by the pandemic. As a result, higher learning institutions have quickly transitioned their courses and programs from face-to-face to online delivery. However, this sudden shift has raised concerns about the technological capabilities of these institutions. While virtual education has been around since the latter half of the 20th century, not all educational systems were adequately prepared. Despite the unexpected transformation brought about by COVID-19, researchers like Selwyn (2010) had previously predicted that ICT would disrupt or revolutionize education. In response to the pandemic, countries such as Liberia and Sierra Leone have utilized ICTs to promote online education. Meanwhile, some universities with sufficient IT access and resources have been able to establish online support systems and counseling sessions to assist staff and students during these challenging times.

Sanchez et al. (2020) highlight that virtual education faced a significant challenge due to the slow acceptance by some teachers who lacked sufficient training in utilizing ICT for online teaching. On the other hand, De Wit and Altbach (2021) point out that colleges and universities have been dealing with recruitment uncertainties while collaborating with new industry partners and philanthropic organizations to navigate the changing landscape caused by COVID-19. Institutions of higher education, particularly those from middle and upper-income countries, have implemented new technologies and approaches across all departments as a direct response to the pandemic. However, there has been limited consideration of how these ICTs will be utilized in the future. The use of audio and video conferencing has become essential for faculty members and staff to deliver content in various formats since the COVID-19 lockdown (Chan et al. 2022). According to the International Association of Universities (IAU, 2020b), a global survey revealed that two-thirds of institutions worldwide have replaced classroom teaching with distance learning. Integrated hybrid and blended learning formats have provided students with convenience, flexibility, and a safety net to pursue tertiary education remotely. Despite the substantial growth of online and distance education in the past decade, literature on the impact of the pandemic on the adoption and use of ICTs in the education sector remains limited. This article aims to address this gap and identify the ICT infrastructures adopted by BUSE specifically.

### 3. Research Methodology

This study was conducted under the framework of social constructivism, which posits that meanings are constructed by individuals as they interact with the world. The researchers aimed to explore the impact of the COVID-19 pandemic on the adoption of ICTs in higher education institutions, with a specific focus on the case of BUSE. To achieve this, a qualitative research approach was employed, allowing for a deeper understanding of the topic and the opportunity for participants to expand on their responses and explore new areas of discussion. The case study approach was chosen as it enabled the researchers to delve into the complexities of ICT infrastructure development at BUSE by asking "how" and "why" questions. This approach also offered practical advantages in terms of time and resource management, particularly when dealing with a large sample population. The study involved gathering information from personnel in the Department of IT, lecturers, and students at BUSE. A sample size of forty individuals was selected, including IT personnel, lecturers from the four campuses, and students from each campus. Purposive sampling was used to select the targeted department, while convenience sampling was employed to select lecturers and students based on their availability and willingness to participate.

### 4. Discussion of Findings

The findings of the study are discussed in this section.

#### 4.1 Teaching and Learning before the COVID-19 Pandemic

Before the COVID-19 pandemic, BUSE primarily used the traditional face-to-face method of instruction and learning. This aligns with the opinions of Kaisara & Bwalya (2021), who stated that before the COVID-19 outbreak, very few developing country institutions had made significant efforts to transition from traditional in-person instruction to remote instruction. The ones that made an effort were distance learning institutions that primarily used hybrid teaching and learning techniques. Before the COVID-19 pandemic, BUSE lecturers and students were only exposed to ICT use when giving in-person lectures using laptops and projectors. A lecturer expressed the following:

*To us, ICT use meant projecting slides in the lecture room. Uploading material on the MOODLE*

*platform was a rare thing. We were not used to that.*

According to the collected data, it was found that before the COVID-19 pandemic and the subsequent closure of schools and institutions, teaching and learning at BUSE primarily took place through in-person interactions. The majority of lecturers expressed that they rarely utilized e-learning resources, and teaching and learning activities were primarily limited to the physical lecture rooms. Occasionally, students who encountered difficulties in submitting hard copies of their assignments were allowed to send them via email. An overwhelming 98% of students appreciated the benefits of the traditional face-to-face learning method that they were accustomed to. As one student put it:

*We always conducted lectures at the campus and I was used to one on one education. Only 2 modules were done online in part 1. Listening to the lecturer in the lecture room has always been advantageous.*

Exceptions, however, were observed among lecturers teaching Health Education and Computer Science. Lecturers from these departments highlighted that they frequently utilized the MOODLE platform for teaching and learning purposes, specifically for all first-year students. These modules were mandatory for all first-year students, regardless of their degree programs, and were taught online using the MOODLE platform due to their integration of ICTs. Consequently, lecturers from these departments emphasized that the large number of students necessitated the early adoption of ICTs even before the COVID-19 outbreak. These modules provided BUSE students with exposure to ICT tools like MOODLE in their first year, except for the final exam. However, concerns were raised regarding the limited exposure to MOODLE after completing these modules, as it was only a one-year experience. Nevertheless, the IT Department staff had a different perspective, as they reported a higher level of ICT usage compared to lecturers and students before the pandemic. In an interview with an IT personnel, she stated:

*The blended learning model was used, face-to-face supported by a learning management system (MOODLE).*

Prior to the outbreak of the COVID-19 pandemic, the primary mode of teaching and learning at BUSE involved face-to-face interactions within lecture rooms. However, despite the encouragement to utilize the MOODLE platform for uploading teaching materials, lecturers seldom made use of this online platform. Instead, they preferred sharing materials directly with students on campus through the use of USB flash drives. Moreover, it was observed that fifty percent of lecturers acknowledged that not all students possessed compatible devices to access online platforms, resulting in their inability to access the posted materials. This finding aligns with Fuchs' (2020) perspective, which emphasizes the need for tertiary institutions worldwide to evaluate the blended learning approach in universities post-COVID-19. This is particularly crucial in low-income countries where online teaching can further widen the skills and poverty gap due to limited access to ICT gadgets. Additionally, it was discovered that ninety percent of lecturers only logged into the MOODLE platform on the day their accounts were created, indicating a lack of proper training sessions. However, it is worth noting that training sessions for each faculty are now being conducted during the first semester of 2023 by members from the Centre for Educational Technologies Innovation and Design. A member of the IT department expressed their thoughts on this matter.

*We have a Centre for Educational Technologies Innovation and Design at the institution to promote the design and use of digital teaching methods, improve learning outcomes, and increase flexibility for staff and students across Faculties. We are strongly working with the department so that they continuously train lecturers from time to time on using the MOODLE platform since we have now moved towards blended learning.*

Before the emergence of the COVID-19 pandemic, students had the opportunity to familiarize themselves with ICT tools by utilizing library e-resources, which was a proactive initiative undertaken by BUSE. This finding indicates that BUSE had already taken steps to integrate ICTs into their educational practices. This aligns with the viewpoint expressed by Mutsvangwa (2017) that Zimbabwe acknowledged the significance of technology and established specialized Ministries of Information Communication and Technology to encourage the utilization of ICTs across different sectors. Furthermore, a student also acknowledged this favorable progress.

*All first years during their orientation week receive a library training session on how to access journals, dissertations, and articles, past exam papers online without physically visiting the library.*

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#### *4.2 Teaching and Learning at BUSE and the Outbreak of the COVID-19 Pandemic*

In March 2020, the government of Zimbabwe implemented a complete shutdown of all institutions, leading to the suspension of educational activities at the BUSE campus. In response to the pandemic, both lecturers and students embraced distance learning as a means to minimize the impact on education. The data collected from interviews and questionnaires revealed that online teaching and learning became the sole option during the COVID-19 crisis, surpassing the traditional face-to-face approach. This aligns with Jandric's (2020) observation that tertiary institutions globally, including those in South Africa, were significantly affected by the urgent need to adopt digital learning platforms as quick solutions. A member of the BUSE IT staff expressed their perspective on the matter.

*Due to the rapid spread of the Coronavirus as well as the need to adhere to the restrictions put forth by the government of Zimbabwe, the delivery mode of lectures at the campus changed to virtual platforms.*

Based on the data collected from lecturers and students, it has been discovered that nearly all participants (99%) have identified the same ICT tools that were utilized for teaching and learning purposes. BUSE specifically emphasized the use of the MOODLE platform, Google Class, Zoom, and informal social media platforms like WhatsApp Messenger during the COVID-19 pandemic. These findings are consistent with the research conducted by Williamson (2020), which found that various South African universities also adopted similar ICT tools during the COVID-19 crisis, including Zoom, Telegram, Microsoft Teams, Blackboard, Google Classroom, and MOODLE. It is important to note that these ICT tools were predominantly accessed through smartphones or laptops. Interestingly, 87% of lecturers and students reported that they primarily used their smartphones for teaching and learning activities due to their convenience in terms of battery capacity and faster performance compared to laptops.

#### *4.3 ICT Facilities Adopted by BUSE during COVID-19 Pandemic*

Several ICT facilities adopted by BUSE are discussed in this section.

##### *4.3.1 Zoom*

Lecturers initially chose to use Zoom as an online platform for teaching and learning during the COVID-19 pandemic. Zoom provides a space where individuals can join a scheduled meeting, with the host having the ability to view and edit meeting details. To ensure continuity in education during the pandemic, lecturers were encouraged to utilize Zoom as it allowed for screen sharing to present slides to students while providing narration, and it also offered the option to record sessions. South African universities also adopted Zoom as one of their ICT tools for learning during COVID-19. However, the use of Zoom for teaching and learning posed challenges due to the high amount of data required for meetings. Eighty-seven percent of students expressed that they couldn't afford to use the Zoom platform for learning due to data costs and network connectivity issues. Additionally, ninety-nine percent of lecturers agreed with the student's perspective that using Zoom was the least effective method for delivering education during the pandemic. One student specifically highlighted this concern.

*Zoom was too consuming in terms of data. I never attended any Zoom meetings in the first month of learning online when Zoom was the only adopted platform.*

The IT Department members expressed that, due to the rapid shift towards e-learning amid the COVID-19 pandemic, the institution has promoted the utilization of Zoom as the most suitable and

formal ICT tool for teaching and learning during times of crisis. Nevertheless, lecturers and students have highlighted the platform's inefficiency in situations where data poses a challenge. Therefore, it is imperative to explore alternative platforms as distance teaching and learning still need to be initiated.

#### 4.3.2 Google Classroom

During the COVID-19 pandemic, BUSE also implemented Google Classroom. Similar to Zoom, Google Classroom presented challenges in terms of data usage. Among the sixteen lecturers who were consulted, only two confirmed utilizing Google Classroom for teaching in the initial two weeks of the pandemic. One of the two lecturers stated:

*Being a Computer Science lecturer with great ICT skills, I opted for Google Classroom for teaching my students during the COVID-19 lockdown. All my students complained of data challenges and opted for other cheaper platforms like WhatsApp.*

Students indicated that Google Classroom and Zoom were quite complex to use for learning during the COVID-19 pandemic. It was only in the first two weeks of the lockdowns that students and lecturers adopted Google Classroom and Zoom for teaching and learning. With the hurdles faced in accessing these ICT tools, their effectiveness was rendered weak hence other tools were considered.

#### 4.3.3 Modular Object-Oriented Dynamic Learning Environment (MOODLE)

The MOODLE platform offers a virtual learning space that grants both students and lecturers virtual access to lectures, course content, assessments, grades, feedback, educational tools, and a wide range of external academic resources. Even before the COVID-19 pandemic, BUSE had been utilizing this platform for delivering Health Education and Computer Science modules. In addition to its educational functionalities, MOODLE also serves as a social space where lecturers can engage with students through threaded discussions, instant messaging, and chat rooms. This platform proves to be an effective tool for teaching and learning as it ensures that all information is documented and managed, allowing for data recovery, unlike other platforms such as WhatsApp. Surprisingly, despite the efforts of lecturers to upload teaching materials on MOODLE, it was observed that none of the students accessed the material. This issue was brought to my attention by one student.

*I had challenges accessing learning material on the MOODLE platform because some of my registered courses did not appear on the platform. Learning material can only be accessed when the module appears on the MOODLE platform.*

The MOODLE system was found to have gaps by the researchers because certain students were not automatically enrolled in the modules they were supposed to take during a specific semester. A representative from the IT Department mentioned that students are typically added to their respective courses on the MOODLE platform upon registration. However, inconsistencies were observed where some students were inadvertently left out and consequently unable to access learning materials from certain modules on the MOODLE platform.

#### 4.3.4 Social Media Platforms

According to the researchers, a significant number of lecturers turned to social media platforms to share educational content and engage in discussions with students. As universities closed down, teaching and learning activities predominantly shifted to platforms such as WhatsApp, Meta, and X. The study conducted at BUSE revealed that WhatsApp was the most widely used social media platform, with 84% of the surveyed students stating that it was the most affordable ICT tool available for remote learning during the COVID-19 pandemic. One student specifically mentioned their reliance on WhatsApp for educational purposes.

*WhatsApp was a better platform to use because we could always revisit the sent audio and take down notes at any time.*

The investigation revealed that WhatsApp emerged as the primary platform for teaching and learning at BUSE during the COVID-19 pandemic. It was chosen due to its affordability and widespread availability, making it the preferred choice for all lecturers. The utilization of WhatsApp also proved beneficial for students, as it allowed them to conveniently access and review lectures at their

convenience.

#### 4.4 Effects of Adopting ICT Facilities on Teaching and Learning in the Context of COVID-19

The shift from traditional face-to-face education to online teaching has brought numerous advantages to higher education institutions, including BUSE. Despite the challenges associated with online learning, both lecturers and students at BUSE have acknowledged the benefits of utilizing online platforms for teaching and learning. This aligns with the findings of Allen et al (2010), who assert that distance education is a promising innovation due to its adaptable learning environments. In the context of the COVID-19 pandemic, the adoption of ICTs has highlighted several commonly emphasized advantages, which will be discussed below.

##### 4.4.1 Minimizing Costs

According to a recent study, a significant majority of students and lecturers, precisely 93%, have recognized the efficacy of online learning in terms of cost reduction and time-saving. This finding aligns with the perspective presented by Al-Husban (2020), who emphasizes the numerous advantages of distance education, including the ability to minimize educational expenses. A specific student further emphasized this point, underscoring the positive impact of online learning on financial aspects.

*Online learning helped our parents reduce the costs that come with campus life. The rents at the boarding houses stress our parents but with online learning, we would just access lectures in the comfort of our homes.*

The opinions expressed by students align with the findings of Chan et al. (2022), who assert that the combination of hybrid and blended learning formats has offered students the benefits of convenience, flexibility, and a safety net for pursuing higher education remotely. The utilization of ICT tools for teaching and learning during the COVID-19 pandemic proved to be instrumental in reducing costs for students. Some lecturers also shared similar sentiments, as the researchers discovered that a few lecturers commute daily from Harare to Bindura to deliver lectures, highlighting the positive impact of adopting ICTs.

##### 4.4.2 Saving Time

Lecturers have expressed that online learning has allowed them to save time and allocate it towards other educational activities in line with the principles of education 5.0. By delivering lectures online, they can condense the time required to just an hour or two, as opposed to the entire day spent in a lecture room. Lecturers have enthusiastically praised the advantages that come with utilizing ICT tools for teaching, with one lecturer stating:

*I would record my lecture through WhatsApp in mini-audios for less than one hour and send supporting reading material for further research. This saved a lot of time and I got enough time to conduct my research and community extension services. During that period only, I managed to publish 7 articles and 2 book chapters.*

During the COVID-19 pandemic, WhatsApp emerged as the primary ICT tool utilized by both BUSE students and lecturers. Its usage proved to be highly beneficial, particularly for lecturers, as it significantly saved their time. Additionally, students also greatly benefited from this platform, as it allowed them to access recorded lecture voice notes and uploaded documents, even if they faced network challenges or missed the lectures for up to a week. In comparison to face-to-face meetings and other ICT tools, WhatsApp ensured that no one was left behind, making it an inclusive and efficient platform for remote learning.

##### 4.4.3 Enhancing ICT Skills and Academic Performance

Most participants indicated that before COVID-19, they did not possess standard ICT skills. Using ICT tools, being the only option, during the COVID-19 pandemic enhanced the ICT skills of both affected groups. Continued use of ICTs in accessing learning material exposed students to great research skills therefore improving pupils' academic performance. This concurs with the views of Somuyiwa & Adewoye (2010) who acknowledged ICTs as fast becoming one of the main drivers of change and helping management in tackling new strategic challenges. One of the interviewed IT staff said:



*Online learning using the various adopted ICT tools facilitated a digital collaboration between the class facilitator and his/her audience. ICT skills of both lecturers and students were enhanced. Students were exposed to research platforms which improved the performance of most.*

According to Matthew & Kazaure (2020), the utilization of ICT in education has proven to be beneficial in enhancing the learning process. Its implementation in educational institutions has had positive impacts on administrators, students, and lecturers. Similarly, Fraillon et al. (2019) highlight that teachers from Chile, Denmark, Kazakhstan, and Portugal agree that the use of ICT in education helps students develop a greater interest in learning and improves their academic performance. However, despite the recognition of the advantages of online platforms by most lecturers and students, 87% of them argue that online learning cannot fully replace the benefits of face-to-face learning. Students express their longing for campus life and the traditional lecture room environment, especially during times when online learning becomes the only option. One lecturer even shared their perspective on this matter.

*In as much as we devoted to WhatsApp for teaching during the COVID-19 pandemic as it was the most economical platform, it limited interaction between the lecturer and student.*

The researchers discovered from the collected data that the integration of ICTs during the COVID-19 pandemic significantly contributed to the improvement of teaching and learning at BUSE. Nevertheless, both students and lecturers faced challenges due to inadequate preparation, indicating the need for further efforts to maximize the benefits and opportunities associated with ICT utilization.

#### 4.5 Challenges Faced in Adopting ICT Facilities

The transition to virtual learning was abrupt and filled with difficulties, as it required new advancements and interventions in education for both developing and underdeveloped nations. When online teaching and learning became compulsory due to the COVID-19 outbreak, students and lecturers encountered numerous challenges. At BUSE, lecturers and students expressed that they faced various obstacles that hindered their effective utilization of ICTs for education during the lockdowns. This aligns with the findings of Sarkar et al. (2021), who noted that online learning posed significant challenges for the university system in Chile. The main challenges reported included technophobia, lack of access to ICT devices, insufficient ICT skills, power outages, expensive internet connectivity, and network issues.

##### 4.5.1 Techno-phobia

The successful integration of ICT infrastructures in the field of education relies heavily on the positive attitudes of both higher education lecturers and students. While the participants recognized the significance of ICTs in teaching and learning, they also highlighted the specific conditions necessary for its effective implementation. A notable 87% of the lecturers expressed their concerns regarding the circumstances in which they adopted ICTs at BUSE. The responses from the teaching staff indicated that they view ICT as a valuable educational tool that can only be fully utilized when favourable conditions are in place. As one lecturer aptly stated, the utilization of ICTs is contingent upon the creation of a conducive environment.

*Yes, using ICTs is the modern way to go but not without the skills, the infrastructure, or even stable WIFI. This is our main challenge at our workplace and because of this I therefore opt for face-to-face teaching.*

The adoption of ICTs at the BUSE was met with negative perceptions from lecturers due to the unfavorable conditions they faced, as observed by the researchers. This observation is further reinforced by Mirete et al. (2020), who found that teachers who adhere to traditional teaching methods tend to hold a negative perspective towards incorporating technology into their work.

##### 4.5.2 Lack of ICT Infrastructures

The COVID-19 pandemic arrived during a time when most educational institutions were hesitant to fully incorporate ICT tools into their teaching and learning methods. The IT staff at BUSE acknowledged that the sudden transition to online learning occurred when many institutions, including BUSE, were

unprepared to fully embrace technology. This aligns with the perspective of Zhong (2020), who states that the closure of schools and universities during the pandemic had a significant impact on students. The lack of ICT infrastructure was identified as one of the various hindering factors that affected the effectiveness of utilizing ICTs during the COVID-19 pandemic. A majority of the lecturers, specifically 82%, expressed concerns about the inadequate ICT infrastructure, such as laptops, which posed one of the primary challenges they encountered when adopting distance learning. One lecturer even remarked:

*The institution expected us to deliver yet we were not given computers or tablets to use. We ended up just using our gadgets in delivering lectures yet most of them are too old and slow which slows down progress.*

According to Sahu (2020), there is a consensus that many higher education institutions (HEIs) in developing countries, along with their staff and students, faced significant obstacles in transitioning to online learning due to a lack of necessary infrastructure. This lack of resources has hindered the efficiency and effectiveness of information and communication technologies (ICTs) in delivering educational services. A survey revealed that 15% of students reported not having access to smartphones, which put them at a disadvantage in online learning. While students could share ICT devices within campus premises, accessing laptops and smartphones for online learning proved to be difficult for some in the comfort of their own homes. To address this issue, one ICT staff member mentioned that laptops were distributed to all departments to assist lecturers in teaching through online platforms. However, lecturers expressed that this solution was insufficient, as only one laptop was provided per department, failing to adequately address the challenges they faced.

#### 4.5.3 Lack of ICT skills

Seventy-five percent of the lecturers emphasized the lack of ICT skills as a significant challenge they encountered during the COVID-19 pandemic when adopting ICTs. The lecturers were accustomed to traditional face-to-face teaching methods, resulting in a deficiency of adequate ICT skills among them. Due to the lecturers' insufficient competency and mastery of ICT integration tailored to their specific needs, the effective utilization of ICT for instructional delivery was hindered. Additionally, the lecturers' lack of pedagogical skills to navigate online platforms emerged as a major concern. Many faculty members lacked the necessary proficiency in digital tools to successfully transition to an online learning environment. A lecturer at BUSE further highlighted this issue.

*This COVID-19 era forced all to resort to online learning yet some of us had very limited ICT skills. As for me, it was a challenge to get feedback from students through the MOODLE platform that's why I moved to WhatsApp which I understand much better. Truly speaking, distance learning can never be as effective as the lecture room environment.*

Nhendere (2020) argues that although there may be ICT infrastructure available, there is a lack of knowledge and skills to effectively utilize ICT in Zimbabwe. This is particularly evident in remote areas where there is a lack of infrastructure to support ICT services. Many lecturers have expressed difficulties in using online platforms for student follow-ups, mainly due to a lack of ICT skills needed to fully utilize these platforms. Dhawan (2020) supports this view, stating that lecturers often lack the knowledge and skills to convert offline materials into online formats and share them on digital platforms. The pandemic has highlighted the importance of ICT in teaching and learning, but the lack of proper ICT skills has hindered the progress of many lecturers. Additionally, the inability of lecturers and students to share the same physical environment has limited interaction and reduced the efficiency of ICT. Despite these challenges, the researchers discovered that the Centre for Educational Technologies Innovation and Design at the institution lacks ICT skilled manpower to consistently offer ICT programs. This shortage has further hindered the availability of ICT training for lecturers and students at BUSE, putting them at a disadvantage.

#### 4.5.4 High Cost of Bandwidth

All IT personnel who were interviewed expressed that the high cost of bandwidth was a significant challenge they encountered when implementing ICTs during the pandemic. This challenge was further compounded by the inadequate and unreliable telecommunication services and applications for the audience who received the services off campus. The lecturers at BUSE, as well as the students, faced

numerous difficulties in online teaching and learning. This aligns with the findings of Izhar et al. (2021), who noted that students in Chile faced obstacles in terms of internet accessibility, purchasing data bundles, and having user-friendly tools. Since BUSE students were studying from their homes, they were unable to access internet services within the campus premises, resulting in many complaints about poor network connectivity and expensive data. One student specifically mentioned:

*In most cases, I would catch up with sent course material after several days due to poor network and at times even due to lack of money to purchase data.*

Jarke & Breiter (2019) provided evidence that limited student data has posed a significant issue. This challenge has the potential to hinder academic progress and exacerbate inequalities among students from low-income families who are unable to afford data. However, IT staff have put forth arguments stating that service providers have been quite supportive during these times, as data prices have been made affordable for students and various promotions have been introduced to ensure inclusivity. For instance, the Dzidzo data bundles offered by Netone were particularly affordable during the difficult period when online learning was the only viable option. Nevertheless, it is important to acknowledge that not all students were able to take advantage of these promotions.

#### 4.5.5 Network Challenges

During the COVID-19 pandemic, the adoption of ICTs faced various obstacles, with network challenges being a prominent issue. Arora and Srinivasan (2020) support this notion, highlighting that while some teachers expressed positive views on distance education, the majority emphasized the problems associated with network challenges, education, and awareness. Both lecturers and students encountered difficulties with network issues when utilizing ICTs for teaching and learning purposes. A student even expressed their frustration with the network challenges.

*Some of us come from difficult backgrounds, I live in Chawarura 40 km from Centenary where the network can only be accessed from the nearby mountain. This online learning was a nightmare for me. I submitted one of my assignments 2 weeks after others had already submitted it.*

Survey reports conducted by Songca (2021) have highlighted the drawbacks of online education and learning in rural universities, specifically Walter Sisulu University (WSU) in South Africa. These reports shed light on the existing socioeconomic inequalities among students, which further exacerbate the disadvantages. One of the major challenges faced by students was the poor network connectivity, which hindered their access to study materials and timely submission of assignments. However, it is important to note that this issue did not solely affect the students, but also the lecturers. Many lecturers expressed their concerns regarding recurring power cuts, which significantly impacted the network connectivity and consequently hindered their ability to deliver the required content within the expected timeframe. The data obtained by the researchers aligns with the findings of Reimers & Schleicher (2020), who also emphasized the limited internet access caused by unstable internet connections, slow internet speeds, and insufficient data for those relying on mobile data.

#### 4.5.6 Rampant Power Outages

The widespread availability of 'affordable data bundles' did not mitigate the significant obstacles posed by frequent power outages, which greatly impeded the successful integration of ICTs during the pandemic. The implementation of COVID-19 total lockdowns coincided with a period of extensive power disruptions across various regions in the country. Moreover, the impact of online learning was particularly felt by students residing in remote areas where access to electricity was already a prevailing challenge. As one student aptly expressed, the circumstances proved to be a hindrance to their learning experience.

*In Budiro we had massive load shedding from 4.30 am to 11 pm and this meant I could not follow lectures online during times when they were conducted. I would download reading material sent by the lecturer and follow lecture chats after 11 pm. At times we would go for the whole day or two without electricity.*

The occurrence of power outages presented a significant obstacle for both students and lecturers alike. The absence of electricity had a detrimental effect on individuals who depended on Wi-Fi for

connectivity, and it was also noted that power cuts directly affected network signals. According to a report by UNESCO (2020), a staggering eighty-two percent of students in Sub-Saharan Africa are unable to access the internet due to expensive data bundles, unreliable network signals, and frequent power outages. Consequently, this widespread issue of power cuts becomes a major hindrance to the successful integration of ICTs during the COVID-19 pandemic.

#### 4.6 Solutions Adopted by BUSE to Counter ICT Adoption Challenges

Despite the challenges encountered in the adoption of ICTs amidst the COVID-19 pandemic, the implementation of online teaching and learning became imperative. Consequently, the IT department, lecturers, and students at BUSE had to devise innovative approaches to overcome the obstacles they encountered in their educational ICT endeavours. The research participants highlighted several noteworthy strategies they employed to enhance the efficiency and effectiveness of ICTs in the context of teaching and learning during the pandemic. These solutions encompassed transitioning to user-friendly online platforms to facilitate seamless delivery of educational content, as well as the provision of laptops to various departments.

##### 4.6.1 Adopting Cheaper and User-friendly Online Platforms

Despite the aforementioned challenges experienced in the uptake of ICTs during the COVID-19 pandemic, online teaching and learning still had to be done. This meant that the BUSE IT department, lecturers, and students all had to improvise ways to counter the negatives they faced in their ICT journey in education. The research participants outlined a few key solutions they resorted to in a bid to maximize the efficiency and effectiveness of ICTs in teaching and learning during the COVID-19 pandemic. Some of the solutions indicated include switching to user-friendly online platforms for easier delivery and provision of laptops to departments.

The IT staff could not train lecturers on the use of formal online platforms (Zoom, Google Meet) which they were expected to use during teaching in times of COVID-19. Face-to-face training sessions were the most appropriate yet the country was under a total lockdown. This resonates with Chimbunde (2021) who supports that those old lecturers who had no previous digital training, had to undergo retraining to equip and align them with the dictates of the online teaching and teaching in the area of pedagogics and didactics. Teaching and learning were therefore shifted to platforms that both lecturers and students were not well versed with. In an interview with one of the BUSE IT staff, he said:

*When it came to solutions to these challenges faced in using ICTs, most of the challenges were intermittent. We however encouraged lecturers and students to switch from platforms like MOODLE and Google Class to the cheaper WhatsApp messenger which can be accessed by all. It was also commendable in such difficult times since audio and text files could be downloaded at the students' convenience.*

The results indicate that during the COVID-19 period, all lecturers opted for the informal WhatsApp platform as it was deemed more accessible and effective in utilizing ICTs. The researchers observed that using formal ICT tools such as MOODLE and Google class platforms for teaching and learning proved to be challenging for both groups affected. This was primarily due to their lack of adequate ICT skills required to navigate these platforms efficiently. These findings align with the AU's (2020) report, which highlighted that European universities were better equipped to transition to online teaching compared to African universities, thanks to their proficiency in ICT. Many lecturers expressed concerns regarding the institution's slow adoption of e-resources for teaching and learning. BUSE lecturers emphasized the importance of enhancing their e-skills to better prepare for future outbreaks and disasters that may disrupt face-to-face learning.

##### 4.6.2 Provision of ICT Infrastructure

During the COVID-19 pandemic, lecturers faced challenges in effectively adopting ICTs due to the limited availability of ICT gadgets. They resorted to using their laptops and smartphones, which they found incompatible with modern applications. To address this issue and promote the use of ICT tools for teaching and learning, the institution distributed laptops to lecturers. However, this solution was not sufficient as only one laptop was provided to each department, failing to address the overall inadequacy

of ICT infrastructure. Lecturers expressed their concerns about this limitation, emphasizing the need for a more comprehensive approach.

*Our department consists of 12 lecturers yet a single laptop was provided for the entire Department. This was not feasible at all.*

The lack of action taken to address the challenges faced in teaching and learning with ICTs during the COVID-19 pandemic was highlighted by the researchers. Nhendere (2020) emphasizes the importance of having sufficient ICT devices, particularly in remote areas of Zimbabwe where there is a lack of infrastructure to support ICT services. This absence of ICT infrastructure has hindered the achievement of the primary goal of the 2016 ICT policy, which aims to enable and promote access to and increased utilization of telecommunications/ICT in all aspects of life.

## 5. Conclusions

The impact of the COVID-19 pandemic on the adoption of ICT infrastructure in Zimbabwean higher learning institutions was analyzed in this study. Specifically, the research focused on the Bulawayo University of Science and Engineering (BUSE). The findings revealed that during the pandemic, BUSE adopted various ICT tools, including Zoom, Google Classroom, MOODLE, and informal platforms like WhatsApp. However, the utilization of these tools posed a challenge due to the lack of proper ICT skills among the users. Consequently, many individuals opted for the most common and user-friendly tool, which was WhatsApp. Despite the challenges, using these ICT tools offered several benefits compared to the traditional face-to-face learning approach that was employed at BUSE before the COVID-19 outbreak. The adoption of ICT tools facilitated cost reduction, time-saving, and the enhancement of ICT skills for both students and lecturers. Additionally, students were exposed to research opportunities, thereby improving their academic performance. Nevertheless, the adoption of ICTs in teaching and learning at BUSE during the pandemic also encountered several challenges. These challenges included a lack of ICT skills to effectively use tools like Zoom, inadequate ICT infrastructure, high costs of bandwidth, frequent power outages, and network issues. The institution embraced ICTs at a time when many were unprepared, resulting in a learning process that involved overcoming numerous obstacles while still ensuring that teaching and learning continued.

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