Infrastructure, human capital, and online teaching during the COVID-19 disruptions: Teachers' experiences at five South African private schools

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Abstract
This study explored the lessons that were learnt about online teaching during the COVID-19 pandemic in five private high schools in a suburb of Pretoria. Qualitative data was collected through interviews with 15 schoolteachers (three from each school), in which they were asked about their experiences with, and perceptions of, the online teaching that they and their schools provided during the periods in 2020 when in-person schooling was prohibited in South Africa due to the pandemic. Thematic analysis of the interview data produced two categories of factors that affected the ability of teachers to successfully offer online-only teaching and learning: infrastructural factors and human capital factors. Drawing on the teachers' inputs in these thematic areas, four lessons learnt were determined, as follows: ensure reliable power supply in support of internet connectivity; allow teacher internet connectivity on a bring your own device (BYOD) basis; ensure practical and up-to-date teacher skills in online teaching; and harness the power of peer-to-peer knowledge-sharing.

Keywords
COVID-19, lockdowns, online learning, private schools, South Africa, infrastructure, internet connectivity, human capital, teachers, peer-to-peer learning

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1. Introduction

The COVID-19 pandemic disrupted education systems around the world (Duby et al., 2022; Faturoti, 2022; Mathrani et al., 2022), and the adverse effects on education are already widely documented (Faturoti, 2022; Mhlanga et al., 2022; Mukuna & Aloka, 2020). Among the numerous challenges posed by the pandemic were the challenges encountered by schools, as face-to-face teaching methods were disrupted and had to be temporarily replaced, where possible, by remote online teaching (Lemay et al., 2021). Moving to online teaching challenged the ways in which teachers performed their core duties with respect to class management, sharing learning resources, motivating, disciplining, teaching, protecting, and socialising with students (Paliwal & Singh, 2021). In addition, schools' ability to adapt core teaching duties to online learning depended on, among others, network connectivity, access to devices connected to the internet, access to content creation software, and online teaching skills (Maree, 2022; Nakhriyah & Muzakky, 2021). In sub-Saharan Africa, it is documented that numerous schools could not cope with the challenges and stopped teaching, thus depriving students of learning (Faturoti, 2022).

The literature on online learning prior to COVID-19 documented critical challenges that obstructed school delivery (Aruleba & Jere, 2022; Kearsley, 2002) and the challenges included, but were not limited to, unskilled teachers, teacher resistance, poor network connectivity, and lack of resources. However, previous research focused on well-resourced schools that had voluntarily pursued online teaching and thus had been able to plan carefully for it. In the case of the emergency environment of COVID-19, schools in most African countries were forced to embark on online learning provision without significant preparation time (Faturoti, 2022). Consequently, much can be learnt from examining the strategies that schools such as those examined in this study used to adapt to a largely unfamiliar mode of education delivery, and the challenges that such schools encountered in implementing these strategies.

In South Africa, according to Statistics South Africa (StatsSA, 2022), only 11.7% of schools in the country offered online learning during the lockdown period of COVID-19. Even for the minority of schools (typically urban schools) that were able to offer online learning, there were, nevertheless, numerous challenges (Maree, 2022; Nakhriyah & Muzakky, 2021). Therefore, the objective of this study was to learn from a group of South African schools that were able to offer online teaching and learning, and to explore teachers' experiences with, and perceptions of, the online teaching that was offered.

The research question for this study was: "What lessons can be learnt from schools that provided online teaching when face-to-face teaching was suspended during COVID-19 lockdown?" The focus of this study was on the experiences and perceptions of teachers in five private high schools in South Africa—all in the

urban community of Centurion, next to Pretoria[1]—that managed to provide online teaching during the COVID-19 disruptions. The lessons learnt through this study were thus derived inductively from the views of educators, who are the front-line workers in online teaching (Dhawan, 2020; Lemay et al., 2021; Masry-Herzalah & Dor-Haim, 2022).

2. Literature review: Challenges of online teaching during the pandemic

Research on the challenges of online teaching during the COVID-19 pandemic has identified difficulties related to internet connectivity, device ownership, and training.

Internet connectivity

The online teaching and learning ecosystem is grounded in reliable internet connectivity, without which it cannot be implemented. In the sub-Saharan African context, South Africa has relatively high internet penetration, but with a substantial (though narrowing) urban–rural internet penetration divide (StatsSA, 2022). Therefore, the penetration of the internet in urban South Africa presents significant potential for online teaching and learning. Before COVID-19, the potential offered by South African internet penetration was embraced to a much greater degree in higher education compared to primary and secondary education. South African schools were encouraged to take up online teaching and learning only with the arrival of the COVID-19 pandemic (Maree, 2022).

Some challenges identified as affecting this transition were cyber safety issues, unreliable network connectivity, limited coverage in rural areas, and expensive bandwidth (Chipangura & Dtendjo-Ndjindja, 2022; Mukuna & Aloka, 2020). Mukuna and Aloka (2020) found that online teaching and learning in rural areas was mainly constrained by poor connectivity to the internet network, slow connections, and broadband costs. The cost of bandwidth packages affects the frequency and duration of online teaching and learning (Mhlanga et al., 2022). Due to the high cost of bandwidth observed in online teaching and learning during COVID-19, some researchers have recommended that governments should subsidise bandwidth so that students from marginalised families can afford online learning (Faturoti, 2022; Mhlanga et al., 2022; Mukuna & Aloka, 2020).

Device ownership

Owning an internet-connected device is a key enabler for online teaching and learning. Research has revealed that both students and teachers in developing countries had limited access to usable devices for online teaching and learning during

1 Both Centurion and Pretoria (the South African capital) fall under the City of Tshwane Metropolitan Municipality.

the COVID-19 disruptions (Faturoti, 2022; Mathrani et al., 2022; Pather & Booi, 2020). The lack of device ownership is also documented in the literature on the digital divide (Aruleba & Jere, 2022; Chisango & Marongwe, 2021). Faturoti (2022) is of the opinion that, among other things, COVID-19 exposed the digital divide between the rich and poor in many African countries. In South Africa, a significant digital divide between rural and urban schools was found to exclude rural students from online learning opportunities during the COVID-19 pandemic (Monareng et al., 2020; Pather & Booi, 2020). The findings of Pather and Booi (2020) and Monareng et al. (2020) are aligned with the findings of the 2003 Draft White Paper on e-Education, which acknowledged the digital gap between poor and rich learners, as well as the gap between rural and urban learners (Department of Education, 2003).

Training

Teachers have numerous responsibilities, which can be summarised as classroom management, motivating, disciplining, supervising projects, preparing lessons, teaching, and assessing students (König et al., 2020). Because COVID-19 forced teachers to adopt online teaching without significant preparation or training, it was difficult for some teachers to perform all their duties (Faturoti, 2022). Some teachers were found to have experienced challenges with, inter alia, sharing study material, protecting learners from cyber risks, and engaging with students (Masry-Herzalah & Dor-Haim, 2022). Some studies pointed to the fact that the adoption of online teaching faces resistance if deployed without training of teachers (Dhawan, 2020; Gratz & Looney, 2020; Masry-Herzalah & Dor-Haim, 2022). During the COVID-19 period, resistance to online teaching was also found to be associated with low technological competence (Kundu et al., 2020; Masry-Herzalah & Dor-Haim, 2022). Meanwhile, teachers with high technological competence were found to be proactive in providing students with online learning (Kundu et al., 2020).

Core literature review findings

Online teaching strategies adopted during COVID-19 were influenced by the teaching technologies used and the existing knowledge of how to use them (Lepp et al., 2021)—which is to say, during the pandemic, some teachers were incapacitated by technology. To meet their obligations, teachers required a variety of online teaching tools (König et al., 2020). Teachers needed, inter alia, subject-specific online tools (Mishra & Koehler, 2006); online tools to manage classrooms; and online tools to ensure that students were disciplined, ethical, and cyber-protected (Chipangura & Dtendjo-Ndjindja, 2022). When schools provided numerous new tools in a short period of time, the situation became highly complex for teachers.

3. Study design

This was an interpretive study that collected qualitative data from teachers in five private high schools. The advantage of interpretive research is that it allows for the collection of thick data on the lived experiences of the participants (Creswell & Plano, 2011). Semi-structured interviews were used to explore the perceptions of teachers at selected private high schools that provided online learning during the COVID-19 disruptions. The interviews were face-to-face and were conducted between 2 August and 26 November 2021, when South African schools had returned to face-to-face teaching.

Sample

The data was collected from five private high schools in Centurion. The schools studied were selected based on the criterion that they had used online teaching to mitigate school closures during the COVID-19 disruptions. The school principal at each school recommended three teachers to serve as interviewees. All recommended teachers agreed to participate, resulting in fifteen interviews. The interviewees comprised eleven female and four male teachers. In terms of teaching experience, four teachers had between one and five years' experience; three teachers had between six and ten years' experience; four teachers had between eleven and fifteen years' experience; three teachers had between sixteen and twenty years' experience; and one teacher had more than twenty years' of experience.

Data collection instrument

An open-ended interview protocol was used for semi-structured interviews. The questions asked each teacher about: how the teacher's school provided online teaching during COVID-19; technologies that the teacher used for online teaching; support received from the school for teaching online; the extent to which teachers at the school influenced each other's online teaching; the challenges encountered when providing online teaching; and how the challenges were overcome.

Data analysis

Data, in the form of transcripts of the interview audio recordings, was thematically analysed and the coding was carried out with the help of a research assistant. We each read the transcripts several times to generate codes, review the codes, and name the thematic factors. At the end of the data analysis cycle, six categories of thematic factors were agreed on and were coded as follows:

- Enabling environment (EN);
- Shared computer resources (SCR);
- Bring your own device (BYOD);
- Building on existing practices (BEP);
- Social influence (SI); and
- Training (TR).

Ethical considerations

The schools and the teachers who participated in this study were anonymised. The five schools were labelled A, B, C, D, and E. The teachers who participated in the study were given pseudonyms that associated them with the school label. For example, a teacher from school A was identified as teacher A1. The teachers were informed of their right to withdraw from interviews, and informed consent was obtained.

4. Results

For the purposes of presenting the findings in this section, the six thematic factors of the data, as listed above, have been split into two overarching themes (groupings of factors), as follows:

- **Infrastructural factors**: enabling environment (EN); shared computer resources (SCR); bring your own device (BYOD); and
- **Human capital factors:** building on existing practices (BEP); social influence (SI); training (TR).

Infrastructural factors

Enabling environment (EN)

During the pandemic, the provision of online learning in the five schools depended on the level of lockdown imposed by the government. When students were not allowed on the premises, the schools provided full-time online teaching. When the schools were allowed to open for teaching, the teachers returned to class and provided face-to-face lessons, but continued to use online platforms to provide additional learning resources to students. According to teacher E13:

> Like any other school, COVID-19 affected us, but I can say that we were fortunate not to completely stop teaching. We quickly moved to online teaching. Within the first week of complete shutdown, we were online […] because we [were] already used to online learning.

At all five schools, online teaching was made possible by the fact that all the parents of the learners could afford to provide their children with online learning resources (such as tablets), and with an internet connection. According to teacher B2:

> Prior to COVID-19, we promoted online learning and requested that parents buy tablets for their kids because they are less expensive than laptops. Several parents were very eager for tablets, [so] they said yes and went for it.

In the words of teacher C7:

> At this school, […] there are no parents who struggle. All our learners are equal. We are fortunate in the sense that our parents can buy tablets for the children. […] I know that in underprivileged schools, some parents may not be able to provide their children with tablets.

All the interviewed teachers pointed out the importance of internet connectivity for the successful implementation of online learning. The teachers appreciated that their online access, when they were on school premises, was paid for by their schools, which allowed them to have unlimited research, interaction with students, content sharing, and online lessons during the COVID-19 lockdowns. In all the schools, the internet connection was made available through the Wi-Fi infrastructure. The teachers at three schools (B, D, and E) said that their schools provide them with unlimited internet access, for both work and personal use. For the teachers in schools A and C, internet access was limited to work purposes only. In the words of teacher D12:

> We have Wi-Fi throughout the school. Each teacher has access to the internet in the classrooms, offices, school grounds, and even in the halls. I can say that the internet access is not limited here.

Teachers at all five schools noted the negative impact of erratic power supply on their internet connectivity and thus online teaching. In South Africa, during the pandemic, it was common for electricity outages to occur for at least two hours a day, due to "loadshedding" by Eskom, the electricity parastatal company (made necessary by insufficient generation capacity),[2] and due to the theft of electricity grid equipment, particularly copper cables. Teacher B4 stated as follows:

> Loadshedding affects us. It makes teaching difficult. You cannot teach in a classroom without electricity. We need lights. It is even worse with online learning, when there is a power cut, our computer system is shut down, all the servers are down, and communication is broken. I can say that without electricity, all forms of teaching cannot take place here in this school.

Teacher E14 said:

> If there is loadshedding, we cannot teach. [There is] no internet and students cannot connect to our servers even if they are in regions where there is power. […] Sometimes we do not have power due to cable theft. I can say that we did not have electricity for three to four days in June/July [2020] due to cable theft.

2 Eskom loadshedding was not linked to the pandemic. It began in 2007 and continues today in 2023.

The teachers from school A indicated that, to keep the school online in future situations where students cannot be present in classrooms, their school was in the process of acquiring an off-grid source of energy. The school had budgeted to purchase a fuel-powered generator or to instal solar panels. In the words of teacher A3:

> We are budgeting for alternative sources of power. Yes, we have very limited funds, but we must continue teaching. […] The issue of power affects our IT systems. Therefore, we are approaching this from the IT budget.

All five schools provided teachers with the Microsoft Office software suite, which enabled teachers to create content in the form of Word documents, PowerPoint slides, and Excel spreadsheets. For online teaching—via video conferencing, file-sharing, and discussion forums—the teachers primarily used MS Teams or Google Classroom. According to teacher A3:

> We use MS Word, PowerPoint presentation, or any other application to create online content. We also use Microsoft Teams. In fact, you can access the other apps from Teams […]. We are free to use any apps since the school policy does not indicate which apps we should use.

Teacher B6 said:

> On Google Classroom, we provide additional worksheets. For instance, with the Grade 10s, we [upload] their novels and drama, and things like that. So, it makes the paperwork less.

It was found that MS Teams and Google Classroom were also used as assessment platforms in all five schools and were used to upload questions for homework and to create quizzes. Teacher E14 said:

> For knowledge quizzes, we use Google Forms. I load some questions in Google Classroom for homework. Learners open a link to the quiz, do the multiple choice, and it is immediately graded.

Teacher D10 used the Kahoot application for assessments:

> Kahoot helps us with assessing our kids through quizzes to find out if objectives for a lesson were met. The tool can also be used for many other things, such as surveys or revision questions.

Shared computer resources (SCR)

All five schools had resource centres equipped with computers that teachers could use for teaching. The computers in the resource centres were connected to the internet and loaded with all the software required for teaching. At three of the schools, B, D, and E, teachers had the option of being assigned an individual laptop for teaching, in their offices on school premises or at home (provided they covered the internet connectivity cost when working from home). In the words of teacher B5:

> At this school, all teachers [can have] laptops to do their work. There [are] also desktops available for those who want to use them […]. Some teachers prefer desktops, okay, which is obviously fine, but I would say maybe 80% or 90% have laptops issued by the school.

School D also made tablets available to teachers for work on-site or at home. As teacher D11 explained:

> We have everything here. We have computers, mobile devices, laptops, and Wi-Fi is available to all teachers. [...] If an application is a mobile application and cannot run on desktops or laptops, teachers have tablets.

At schools A and C, the two schools where teachers did not have the option of being assigned a dedicated school laptop, the resource centres did not have sufficient laptops and PCs for all the teachers to work at the same time, which meant that teachers who did not own a laptop or PC would have to take turns using the school's devices. According to teacher A2:

> There are a couple of computers/laptops in the resource centre for teachers, and if you plan to use one, then you book with the IT committee. […] Teachers come to the resource centre to do their work, especially if they run out of data on their personal computers (broadband credit) and want to connect [to] the internet.

According to teacher C8:

> We do not have a great computing infrastructure here to allocate to each teacher for online teaching. We do have some computers and a few laptops that have internet access in the resource centre. Teachers can research and teach there.

Bring your own device (BYOD)

At schools A and C, where teachers did not have access to dedicated school laptops, some teachers used their own laptops for work purposes at school and at home. At school C, the IT policy did not normally allow bring-your-own-device (BYOD) connectivity to its Wi-Fi network, but this policy provision was set aside during COVID-19. According to teacher C8:

> Well, yes, teachers can bring their own devices if they can afford [them]. The school provides some computers [desktop PCs], but they are not enough for everyone. [...] During COVID-19, we made it easier for teachers by giving them access to the Wi-Fi to personal devices. However, for now, [there is] no access with personal devices because the policy does not allow that.

Summary of findings on infrastructural factors

The table below provides an overview of the findings with respect to infrastructure support in the five schools.

Table: Infrastructure support

School	Means of internet connectivity for teachers at school	Shared desktop PCs available to teachers (Y/N)	Dedicated laptops made available to teachers (Y/N)	BYOD internet connectivity permitted during pandemic (Y/N)	Work from home (on school or personal device) allowed (Y/N)
A	Wi-Fi	Y	N	Y	Y
B	Wi-Fi	Y	Y	Y	Y
C	Wi-Fi	Y	N	Y	Y
D	Wi-Fi	Y	Y	Y	Y
E	Wi-Fi	Y	Y	Y	Y

Human capital factors

Building on existing practices (BEP)

It was found that prior to the COVID-19 lockdown in 2020, the five schools had been using some online tools to provide additional learning resources to supplement face-to-face teaching. For example, teachers in all five schools had used online assessments and shared online resources such as videos and prescribed textbooks. Therefore, some of the skills for online teaching were already in place when the COVID-19 pandemic required a shift to fully online learning. According to teacher C7:

> Our school has been online for some time. I have been sharing YouTube videos, PowerPoint slides, or any other additional resources, online. I have been posting past examination question papers.

In the words of teacher E13:

> We have been using applications like ITSI,[3] where we load textbooks to improve the convenience of access from anywhere and to reduce the number of books that learners carry. We also upload extra resources such as videos, reference links, and PowerPoint presentations on ITSI.

However, despite their previous use of some of the online learning tools, a clear majority of the respondents—10 of the 15 teachers across the five schools—stated that the sudden shift to fully online teaching was extremely difficult and stressful. They also said that their success in providing remote online teaching was due to the mentorship that they received from a few "tech-savvy" teachers who had adopted MS Teams earlier. According to teacher B4:

> [Now, post-lockdown] we are moving forward with pushing the use of Microsoft Teams, but before that [only some] teachers had been doing it, all alone, in providing online classes. It was an individual thing, per subject, per teacher. [...] These are our most tech-savvy teachers.

In the words of one of such respondent who was comfortable using all of the online teaching resources even before the pandemic, teacher E15:

> I am the Microsoft Teams team leader at this school. My role is to guide and give confidence to teachers. My observations were that some teachers were nervous when they were providing live classes in the early days of lockdown. With all the experience they have in teaching, they struggled to manage online classes.

3 See https://itsieducation.com/

Social influence (SI)

It was found that the aforementioned "tech-savvy" teachers tended to assume the role of technology champions and influencers in schools. These online teaching champions informally trained and helped other teachers to get started in providing online teaching. They helped other teachers with activities such as downloading software, configuring the software, and using all the necessary teaching features of the software. According to teacher C7, who was one of the technology champions among the interviewees:

> […] especially new teachers, if they come to you and say they are not sure about some teaching aspect, then you can guide them. For example, if a science teacher needs help uploading a YouTube video or slides to MS Teams, things like that.

Participants pointed to this element of volunteerism—volunteering to teach others, as evidence of an inherent culture of peer-to-peer knowledge sharing in schools, which became an important factor in ensuring successful online teaching during the COVID-19 lockdowns. According to teacher B6:

> The school has a culture of knowledge sharing among teachers and they are very open to helping each other. […] We learn a lot from each other, and it [was] very encouraging when teachers came together to share knowledge and experiences about the use of technology in online teaching at that time.

A teacher from school D indicated that most of the teachers at that school were inspired by a particular teacher who was outstanding in providing online learning. In the words of teacher D4:

> Teacher Maria [name anonymised] does amazing things in the classroom. Did someone mention that to you? Maria did many different things [in] her virtual classroom. Her MS Teams class site has everything: content, references, video, class recordings, I would not be able to tell you everything.

Training (TR)

All the teachers interviewed said that their schools had a tradition of continuous professional development, including through online training. As described above, prior to COVID-19, all the interviewed teachers had received training in the use of online tools for teaching and learning. But it was found that the training received by teachers prior to COVID-19, even if it included the use of platforms such as Google Classroom, had not had a strong focus on live online teaching skills. It was only during the pandemic, as live remote online teaching and learning became essential

and thus gained momentum, that two of the schools, D and E, provided teachers with more intensive training on the provision of online teaching and learning.

At school D, the teachers received specialised virtual training, through MS Teams, during which time they learnt how to use several Microsoft 365 tools, including MS Teams for teaching. The school D teachers attended online training on game-based learning. As teacher D10 explained:

> We attended online training on MS Teams, where we were taught how to use the Microsoft Office 365 tools for teaching in any subject, [and] how to create content using the tools, share resources, [provide] game-based learning, and have live lessons.

School E's teachers underwent training through Microsoft Education courses. According to teacher E15:

> We are using [the] Microsoft Education platform. It provides tutorials that teachers can do on their own pace. You just log on to the platform, pick a topic, and learn. This is the opportunity that the school gave us to learn and was helpful.

However, the teachers at schools A, B, and C said that their schools did not provide formal training in online teaching during the lockdown periods.

5. Discussion: Lessons learnt

Based on the findings presented above, the following lessons were identified:

Ensure a reliable power supply in support of internet connectivity

The findings revealed that online teaching in all the schools that participated in this study was challenged by intermittent internet connectivity resulting from erratic electrical power supply. Without electricity, the schools' computer network systems, including internet access, shut down, thus bringing teachers' provision of online teaching to a halt. To overcome this challenge, at least one of the schools in the study was found to be planning to invest in an alternative power source, such as a fuel-powered generator or solar panels.

Allow teacher internet connectivity on a BYOD basis

It was found that due to the urgency of providing online learning, teachers in two of the schools brought their own devices to school to alleviate the shortage of computing devices. Teachers did that because they believed in the value of mitigating the disruption of teaching caused by COVID-19. The two schools allowed the teachers to use their personal devices to access the school internet. Allowing internet connectivity on a BYOD basis can increase the uptake of online teaching.

Ensure practical and up-to-date teacher skills in online teaching

The findings demonstrated that schools should provide all teachers with training in, and practical exposure to, the use of live online teaching technologies. With the sudden move to live online teaching, some teachers were not ready because they did not have the necessary practical experience. Additionally, new online teaching technologies were introduced that the teachers had never used before. Most of the teachers surveyed were overwhelmed. This lesson aligns with a study that concluded that skills gained from face-to-face teaching are not adequate for online teaching (Paliwal & Singh, 2021).

Harness the power of peer-to-peer knowledge-sharing

The findings revealed that peer-to-peer knowledge-sharing was a critical element in the transition to online teaching in schools. The teachers who were already comfortable with the necessary technologies helped other teachers to get started with online teaching. This finding is aligned with Sims and Baker's (2021) finding that some teachers switching over to online teaching needed mentors for guidance and knowledge-sharing, and Plummer et al.'s (2021) finding that peer-to-peer collaboration amongst teachers facilitated successful online teaching. Additionally, unlike the findings of some other studies on online teaching (Gratz & Looney, 2020; Nurse-Clarke & Joseph, 2022), teacher resistance to online teaching was not among the elements identified by the respondents in this study.

6. Conclusions and potential limitations

A key practical implication of the lessons learnt is that if a school has any infrastructure or human capital development deficiencies that could prevent its teachers from providing high quality online teaching, these deficiencies must be addressed urgently. As new technologies are introduced to facilitate online teaching, teachers must receive the necessary training. The differences in the level of uptake in a school's corpus of teachers can then hopefully be compensated for by the social influence (via voluntary knowledge-sharing) that this study found was crucial to increasing the successful implementation of online teaching.

Among the potential limitations of the study was the small sample of five schools. I could have interviewed teachers at more schools, but I found that data saturation (sufficient data to answer my research question) was reached after 15 interviews at five schools. Another potential limitation was that I did not conduct direct observation of teachers who provided online teaching during COVID-19. Undoubtedly more insights could have been obtained from that kind of data. However, direct observation was not possible because of the risk of contracting COVID. Another potential limitation was the time lag between when the teachers provided online teaching and when I conducted the interviews, meaning that some teachers may have forgotten some important details from their teaching during the COVID-19 lockdowns, thus affecting the accuracy of the collected data.

References

Al-Emran, M., Alkhoudary, Y., Mezhuyev, V., & Al-Emran, M. (2019). Students and educators attitudes towards the use of m-learning: Gender and smartphone ownership differences. *International Association of Online Engineering*. https://doi.org/10.3991/ijim.v13i01.9374

Aruleba, K., & Jere, N. (2022). Exploring digital transforming challenges in rural areas of South Africa through a systematic review of empirical studies. *Scientific African*, *16*, e01190. https://doi.org/10.1016/j.sciaf.2022.e01190

Biesta, G. (2009). Good education in an age of measurement: On the need to reconnect with the question of purpose in education. *Educational Assessment, Evaluation and Accountability (Formerly: Journal of Personnel Evaluation in Education)*, *21*, 33–46. https://doi.org/10.1007/s11092-008-9064-9

Chipangura, B., & Dtendjo-Ndjindja, G. (2022). Securing the cybersafety of South African online high school learners beyond COVID-19. *The Journal for Transdisciplinary Research in Southern Africa*, *18*(1), 1–8. https://doi.org/10.4102/td.v18i1.1256

Chisango, G., & Marongwe, N. (2021). The digital divide at three disadvantaged secondary schools in Gauteng, South Africa. *Journal of Education (University of KwaZulu-Natal)*, *82*, 149–165. https://doi.org/10.17159/2520-9868/i82a09

Creswell, J. W., & Plano, V. L. (2011). *Designing and conducting mixed methods research* (2nd ed.). SAGE.

Daniel, S. J. (2020). Education and the COVID-19 pandemic. *Prospects*, *49*(1), 91–96. https://doi.org/10.1007/s11125-020-09464-3

Department of Education. (2003). *Draft white paper on e-education: Transforming learning and teaching through ICT*. Government of South Africa.

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems*, *49*(1), 5–22. https://doi.org/10.1177/0047239520934018

Duby, Z., Jonas, K., Bunce, B., Bergh, K., Maruping, K., Fowler, C., Reddy, T., Govindasamy, D., & Mathews, C. (2022). Navigating education in the context of COVID-19 lockdowns and school closures: Challenges and resilience among adolescent girls and young women in South Africa. *Frontiers in Education*, *7*, 856610. https://doi.org/10.3389/feduc.2022.856610

Faturoti, B. (2022). Online learning during COVID19 and beyond: A human right based approach to internet access in Africa. *International Review of Law, Computers & Technology*, *36*(1), 68–90. https://doi.org/10.1080/13600869.2022.2030027

Ghasia, M. A., De Smet, E., Machumu, H., & Musabila, A. (2018). Towards mobile learning deployment in higher learning institutions: A report on the qualitative inquiries conducted in four universities in Tanzania. *Afrika Focus*, *31*(1), 115–132. https://doi.org/10.1163/2031356X-03101007

Gratz, E., & Looney, L. (2020). Faculty resistance to change: An examination of motivators and barriers to teaching online in higher education. *International Journal of Online Pedagogy and Course Design (IJOPCD)*, *10*(1), 1–14. https://doi.org/10.4018/IJOPCD.2020010101

Jaoua, F., Almurad, H. M., Elshaer, I. A., & Mohamed, E. S. (2022). E-learning success model in the context of COVID-19 pandemic in higher educational institutions. *International Journal of Environmental Research and Public Health*, *19*(5), 2865. https://doi.org/10.3390/ijerph19052865

Kearsley, G. (2002). Is online learning for everybody? *Educational Technology*, *42*(1), 41–44.

König, J., Jäger-Biela, D. J., & Glutsch, N. (2020). Adapting to online teaching during COVID-19 school closure: Teacher education and teacher competence effects among early career teachers in Germany. *European Journal of Teacher Education*, *43*(4), 608–622. https://doi.org/10.1080/02619768.2020.1809650

Kundu, A., Bej, T., & Dey, K. N. (2020). An empirical study on the correlation between teacher efficacy and ICT infrastructure. *The International Journal of Information and Learning Technology*, *37*(4), 213–238. https://doi.org/10.1108/IJILT-04-2020-0050

Kursun, E., & Turgut, Y. E. (2020). Mobile internet experiences of the children in Turkey and European countries: A comparative analysis of internet access, use, activities, skills and risks. *Eurasian Journal of Educational Research*, *20*(88), 225–248. https://doi.org/10.14689/ejer.2020.88.10

Lemay, D. J., Bazelais, P., & Doleck, T. (2021). Transition to online learning during the COVID-19 pandemic. *Computers in Human Behavior Reports*, *4*, 100130. https://doi.org/10.1016/j.chbr.2021.100130

Lepp, L., Aaviku, T., Leijen, Ä., Pedaste, M., & Saks, K. (2021). Teaching during COVID-19: The decisions made in teaching. *Education Sciences*, *11*(2), 47–68. https://doi.org/10.3390/educsci11020047

Maree, J. G. (2022). Managing the Covid-19 pandemic in South African schools: Turning challenge into opportunity. *South African Journal of Psychology*, *52*(2), 249–261. https://doi.org/10.1177/00812463211058398

Masry-Herzalah, A., & Dor-Haim, P. (2022). Teachers' technological competence and success in online teaching during the COVID-19 crisis: The moderating role of resistance to change. *International Journal of Educational Management*, *36*(1), 1–13. https://doi.org/10.1108/IJEM-03-2021-0086

Mathrani, A., Sarvesh, T., & Umer, R. (2022). Digital divide framework: Online learning in developing countries during the COVID-19 lockdown. *Globalisation, Societies and Education*, *20*(5), 625–640. https://doi.org/10.1080/14767724.2021.1981253

McQuirter, R. (2020). Lessons on change: Shifting to online learning during COVID-19. *Brock Education: A Journal of Educational Research and Practice*, *29*(2), 47–51. https://doi.org/10.26522/brocked.v29i2.840

Mhlanga, D., Denhere, V., & Moloi, T. (2022). COVID-19 and the key digital transformation lessons for higher education institutions in South Africa. *Education Sciences*, *12*(7), 464–481. https://doi.org/10.3390/educsci12070464

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Monareng, J., Ramraj, A. B., & Mashau, P. (2020). The rise in online learning in South African schools due to coronavirus pandemic. *Gender & Behaviour*, *18*(4), 16753–16762.

Mukuna, K. R., & Aloka, P. J. (2020). Exploring educators' challenges of online learning in COVID-19 at a rural school, South Africa. *International Journal of Learning, Teaching and Educational Research*, *19*(10), 134–149. https://doi.org/10.26803/ijlter.19.10.8

Nakhriyah, M., & Muzakky, M. (2021). Online teaching learning during Covid-19 outbreak: Teacher's [sic] perception at junior high school of Fathimatul Amin Jakarta. *Faktor: Jurnal Ilmiah Kependidikan*, *8*(1), 39–49. https://doi.org/10.30998/fjik.v8i1.8618

Nurse-Clarke, N., & Joseph, M. (2022). An exploration of technology acceptance among nursing faculty teaching online for the first time at the onset of the COVID-19 pandemic. *Journal of Professional Nursing*, *41*, 8–18. https://doi.org/10.1016/j.profnurs.2022.04.002

Paliwal, M., & Singh, A. (2021). Teacher readiness for online teaching-learning during COVID-19 outbreak: A study of Indian institutions of higher education. *Interactive Technology and Smart Education*, *18*(3), 403–421. https://doi.org/10.1108/ITSE-07-2020-0118

Pather, S., & Booi, E. (2020). An assessment of student resource readiness for online learning during COVID 19: A South African case study. In *ICERI2020 proceedings* (pp. 9753–9762). https://doi.org/10.21125/iceri.2020.2186

Plummer, L., Belgen Kaygısız, B., Pessoa Kuehner, C., Gore, S., Mercuro, R., Chatiwala, N., & Naidoo, K. (2021). Teaching online during the COVID-19 pandemic: A phenomenological study of physical therapist faculty in Brazil, Cyprus, and the United States. *Education Sciences*, *11*(3), 130–146. https://doi.org/10.3390/educsci11030130

Sims, S. K., & Baker, D. M. (2021). Faculty perceptions of teaching online during the COVID-19 university transition of courses to an online format. *Journal of Teaching and Learning with Technology*, *10*, 337–353. https://doi.org/10.14434/jotlt.v10i1.31621

Statistics South Africa (StatsSA). (2022). *COVID-19 and barriers to participation in education in South Africa.* Education Series Volume VIII. Report No. 92-01-08. https://www.statssa.gov.za/publications/Report-92-01-08/Report-92-01-082020.pdf