

The Dynamics of Access to ICT and Technology Practices of Secondary School Teachers

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Abstract: The COVID-19 pandemic highlighted the importance of access to Information and Communication Technology (ICT) for effective teaching and learning. Access to ICT is a complex and dynamic phenomenon that significantly impacts teachers' technology practices. There is a need for more extensive studies to explore the dynamics of access and teacher technology practices in various contexts. This study explored the influence of access on the technology practices of secondary school teachers in the Western Cape, South Africa. A qualitative online survey was used to explore the lived experiences of teachers during the COVID-19 pandemic. A diverse sample, in terms of gender, age, years of experience of teachers, and socio-economic status of schools, of 22 teachers voluntarily participated in the study. Van Dijk's cumulative model of access to ICT provided a useful lens to explore how and when the dimensions of access supported or hindered teachers' appropriation of ICT. This study found that most respondents were primarily exposed to traditional face-to-face teaching before March 2020. The suspension of in-school teaching, however, caused a dramatic shift in the way teachers interacted with technology, learning materials and learners. Three dimensions of digital inequality, associated with physical access, manifested in South Africa, namely the Virtual Classroom, WhatsApp, and Radio-Television groups. Most participants in this study returned to traditional teaching practices with increased use of technology when schools reopened again. The findings of this study suggest that access to technology is not a linear progression of successive stages that by default culminates in usage. This paper proposes a more holistic contextualised approach to access to create enabling environments for the use of ICT and empower teachers to use ICT in their teaching practices.

Keywords: Information and Communication Technology (ICT), Access to ICT, Teacher technology practice, COVID-19 pandemic

1. Introduction

The COVID-19 pandemic highlighted the importance of teachers' access to Information and Communication Technology (ICT) for effective teaching and learning. This study explored the technology-mediated teaching practices of secondary school teachers in the Western Cape, South Africa. This paper reports on how and when the dimensions of access supported or hindered teachers' technology practices during the pandemic.

The concept of access refers to the process of appropriation of technology with the purpose of actual usage (van Dijk and Hacker, 2003). Before the COVID-19 pandemic teachers could decide whether they would use technology in their teaching practices (Giacosa, 2020). The pandemic brought normal classroom activities to an abrupt halt and compelled teachers to implement technology as a mitigating strategy (Bozkurt and Sharma, 2020; Hodges, Moore and Lockee, 2020).

Teachers suddenly found themselves in a new relationship with technology and teaching (Adov and Mäeots, 2021; Bond et al., 2021). The affordances of 21st-century technologies provided teachers with a substantive way to remain operational during the COVID-19 pandemic (Bozkurt and Sharma, 2020; Arnett, 2021). Despite emergency measures implemented by the South African government to ensure continued teaching and learning, most schools and teachers had insufficient access to ICT and were unprepared for technology-mediated remote teaching.

The phenomenon of access to ICT is complex and multidimensional and the theories of access have in recent years evolved to include more than just physical access (Czerniewitz, 2005; Soomro, 2018). This study addresses the need to further explore and uncover how and when the dimensions of access to ICT may influence teacher's use of ICT in their teaching practices in various contexts, for example, the COVID-19 pandemic (Jelińska and Paradowski, 2021; Moorhouse and Kohnke, 2021).

The theoretical and conceptual underpinning of this study is illustrated in Figure 1. Van Dijk's cumulative model of access to ICT, in conjunction with Jansen's dimensions of digital inequality, provides a useful lens to explore the role of access within the context of the COVID-19 educational disruption and response.

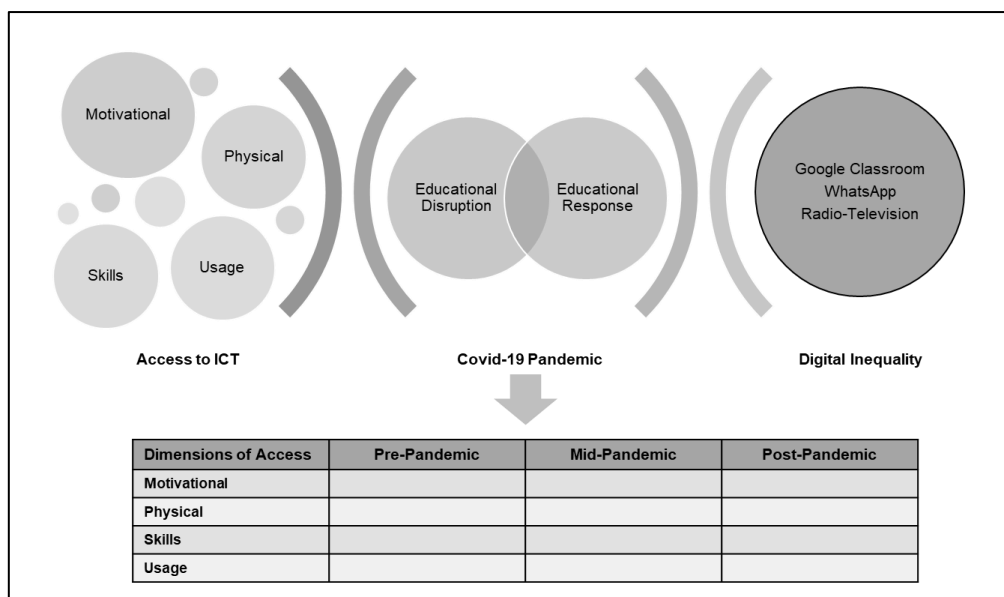


Figure 1: Theoretical and Conceptual Underpinnings

This study aims to contribute to scholarship by uncovering how and when the dimensions of access influence teachers' use of technology. This knowledge is essential to create enabling environments for the use of ICT and empower teachers to use ICT in their teaching practices.

2. Research Problem

The problem driving this study is that despite enthusiastic national policy support for access to ICT in education, there is limited research dealing with ICT integration within an educational context during times of crisis (Mailizar et al., 2020; Sukendro et al., 2020). The current literature does not provide us with a clear understanding of the dynamics of the various dimensions of access to ICT and teachers' appropriation of ICT (Sadeck, 2016; Padayachee, 2017).

This study addresses this problem by exploring the dimensions of access to ICT and how they may support or hinder teachers' technology practices.

Question 1: How do the various dimensions of access to ICT influence teachers' appropriation of ICT in their teaching practices?

Question 2: When do the various dimensions of access to ICT influence teachers' appropriation of ICT in their teaching practices?

3. Literature Survey

This literature survey provides background regarding access to ICT and teacher technology. After considering the impact of and response to the COVID-19 educational disruption, the literature survey will consider access as a process of appropriation of ICT.

3.1 COVID-19 Educational Disruption and Response

To mitigate the spread of the virus in South Africa, President Cyril Ramaphosa declared a state of disaster. On 18 March 2020, South African schools closed for the first time bringing the normal classroom activities of an estimated 17 million learners to a sudden halt (StatsSA, 2020).

While 21st-century technological affordances enabled teachers to continue teaching remotely, technology-mediated teaching was new to most teachers (Sahin and Shelley, 2020). Schools and teachers struggled due to a lack of infrastructure and teaching practices that fell short of what was required to integrate ICT into teaching and learning (Hennessy et al., 2021; Moyo et al., 2022).

In South Africa, differing social and educational contexts had a significant impact on efforts to deliver education during the pandemic. Only a small number of well-resourced schools were able to shift seamlessly to remote

teaching (Landa, Zhou and Marongwe, 2021; Mbhiza, 2021). As a result of these digital inequalities, little or no teaching took place at most South African schools (Dube, 2020).

3.2 Access as a Process of Appropriation

Teachers' appropriation of technology depends on access to ICT (Maceviciute and Wilson, 2018). Van Dijk (2003) developed a cumulative model of access, whereby different kinds of access are experienced at successive stages and are conditional on one another. The relationship between the dimensions of access, i.e. motivation, physical, skills, and usage, are illustrated in Figure 2.

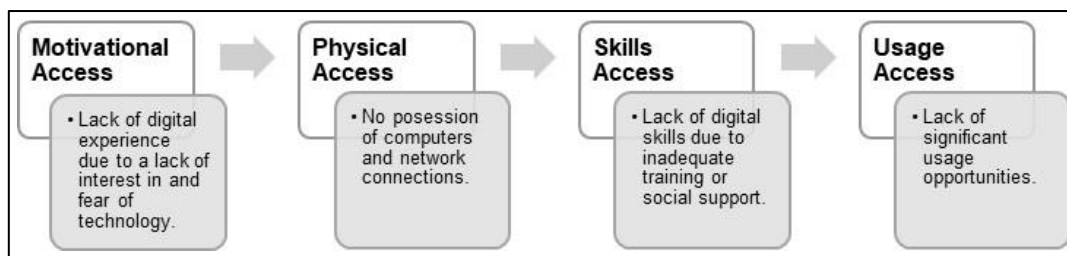


Figure 2: Access as a Process of Appropriation of ICT (Van Dijk, 2003).

3.2.1 Motivational access

Motivational access refers to the mental readiness and willingness to use digital technologies. While motivation plays a crucial role in the adoption and effective use of ICT, it is often ignored or neglected in practice. Motivational readiness drives individuals to develop competence in and adopt ICT. Ultimately, motivational readiness empowers individuals to leverage the potential of ICT for personal and professional growth.

3.2.2 Physical access

Physical or material access to ICT refers to the availability and provision of the necessary devices, infrastructure, and resources required to use ICT effectively. Physical access is an essential requirement for developing digital skills and ultimately using ICT. As a result, access to ICT as physical technology is also at the forefront of all accounts of access to ICT in the literature (Peters et al., 2020; Crompton et al., 2021).

Physical access to ICT in educational settings is essential for providing teachers and learners with opportunities to develop digital literacy skills and enhance their teaching and learning experiences. It enables teachers and learners to access digital resources, educational software, online libraries, and other educational materials. Physical access to ICT also allows teachers to incorporate technology into their teaching practices, promoting digital pedagogy and innovative instructional methods.

Jansen's dimensions of digital inequality

Jansen (2020), identifies three dimensions of digital inequality (associated with physical access) among teachers and learners in South Africa, i.e. Google Classroom, WhatsApp and Radio-Television groups. In this paper, the term "Google Classroom" is replaced with "Virtual Classroom" to include the use of other connecting platforms such as Moodle and Microsoft Teams. The dimensions of digital inequality, as illustrated in Figure 3.

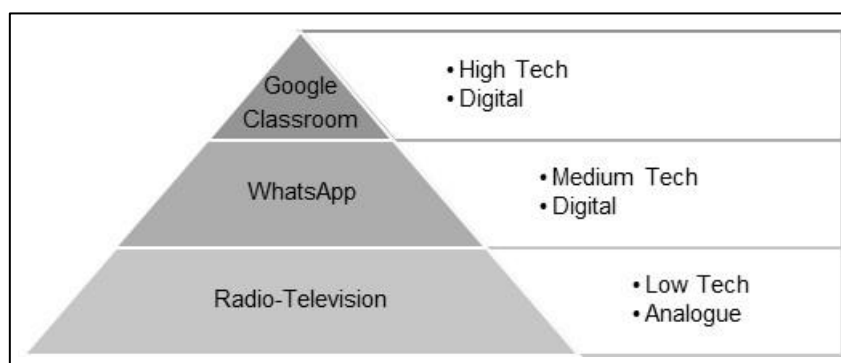


Figure 3: Dimensions of Digital Inequality (Jansen, 2020)

Virtual Classroom

This group refers to the small number of well-resourced schools. Many of these schools already offered some form of blended learning before the lockdown. As a result, they transitioned from face-to-face to remote teaching relatively smoothly and experienced fully online remote teaching and learning almost from the start of the lockdown. The percentage of individuals 5-24 who attended educational institutions that offered remote learning is summarised in Table 1. Approximately only one in ten learners (10%) were offered the option of remote learning, and approximately only 6% of learners participated in remote learning during the pandemic (StatsSA, 2020).

Table 1: Percentage of Individuals 5-24 who Attended Educational Institutions That Offered Remote Learning (StatsSA, 2020)

Geography type	Remote learning	No remote learning
Urban	14.7	85.3
Rural	7.6	92.4
RSA	11.7	88.3

WhatsApp

In practice, most teachers used the WhatsApp facility for educational interaction with learners. As illustrated in Figure 4, significantly more households with individuals aged 5–24 accessed the internet through mobile phones than other devices.

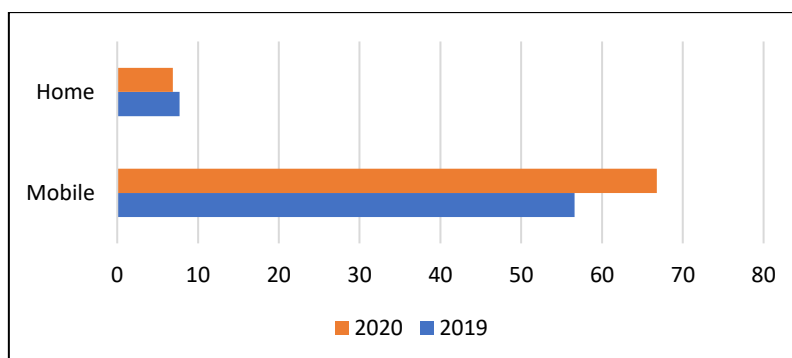


Figure 4: Percentage of Households with Individuals Aged 5-24 years by Internet Access in South Africa, 2019-2020 (StatsSA, 2020)

While WhatsApp enabled teachers and learners to interact remotely, the online uses of this application were rudimentary, and the learning process was often disrupted by the availability of devices, cost of data, and unstable internet connections. WhatsApp was, also, more suitable for secondary schools as the percentage of mobile phone ownership increased significantly by grade as illustrated in Figure 5.

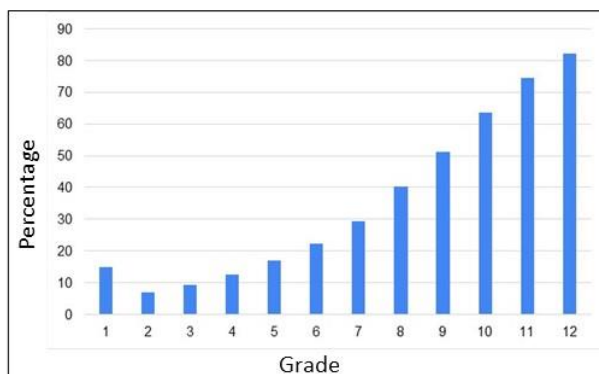


Figure 5: Percentage of Individuals Aged 10-24 years who Attended School and Owned a Functional Mobile Phone by Grade, 2019 (StatsSA, 2020)

Radio-Television

Most South African learners had no other option but to rely on educational radio and television programmes for remote learning. Due to the limitations of these broadcast media, the lockdown carried little if any academic benefit for this majority group.

3.2.3 Skills access

Skills access to ICT refers to the development and acquisition of digital skills and competencies necessary to effectively use ICT tools and resources. Skills access to ICT in education is crucial for developing digital literacy, fostering 21st-century skills, accessing educational resources, and enhancing learning experiences. Skills access consists of three levels:

- *Operational skills* - the ability to operate a computer and utility software.
- *Informational skills* - the ability to search, select, and process information in digital resources.
- *Strategic skills* - the ability to use digital technology as a vehicle to reach specific goals.

3.2.4 Usage access

Usage access to ICT refers to the ability and opportunity to effectively utilise ICT tools and resources in various contexts, such as education, business, or personal use. It thus refers to the deliberate decision to use digital technologies and is presumed to be the free choice of individuals determined by need, occasion, obligation, time, or effort to use ICT.

Within an educational context usage access to ICT enables teachers to incorporate technology into their teaching practices, leading to enhanced teaching and learning experiences. It allows teachers to use multimedia resources, interactive learning platforms, educational applications, and online tools to present information in engaging and interactive ways.

3.3 Critical Analysis

Access to ICT is essential for the successful adoption and use of ICT in teaching and learning. Unfortunately, the existing literature does not provide sufficient information on teachers' access to and use of ICT. While Van Dijk's model has been influential in exploring and understanding the complexities of access to ICT, the model also has some limitations and areas for critical analysis. One of the main concerns is its limited focus on human agency, i.e. how individual motivations, skills, and choices influence ICT access and use.

This paper argues that there is a need for a richer and more nuanced understanding of the multi-faceted concept of access to ICT that more accurately reflects how individuals actively engage with ICT in an increasingly technology-mediated society.

4. Research Design and Method

This exploratory study adopted a qualitative survey design to investigate the role of access in teachers' appropriation of ICT in their teaching practices before, during, and after the COVID-19 pandemic. An online survey, created using Google Forms, was used to explore secondary school teachers' lived experiences during the COVID-19 pandemic.

The survey consisted of six demographic questions, twelve open-ended questions, ten Likert-scale items, one select-all-that-apply item, and three multiple-choice items. A 4-point scale was used for the Likert-scale items (0=Low to 3=High). In terms of the content of the survey, the questions focused on teachers' experience of the transition to ERT, technological-pedagogical knowledge, and access to and use of ICT in their teaching practice. The survey included a consent statement and responses were submitted anonymously.

The study employed non-probability sampling to target secondary school teachers in the Western Cape since the researcher did not have a complete list of the population (Saunders & Lewis, 2012). This method is often associated with qualitative data collection (Saunders & Lewis, 2012; Taherdoost, 2016). The type of non-probability technique is purposive sampling. Purposive sampling is ideal for exploratory research design where the researchers use their judgement to choose who will best suit the objective of the research (Moser & Korstjens, 2018; Taherdoost, 2016).

A total of 22 teachers from government schools responded to the survey. The sample, illustrated in Figure 6, was diverse in terms of gender, age, years of experience of the teachers, and socio-economic status of the schools. The objective of this exploratory study was to do a small survey with the view of piloting for a larger

survey. A sample between 4 to 12 participants is likely to be sufficient in instances of homogeneous populations and between 12 to 30 for heterogeneous populations (Saunders and Lewis 2012).

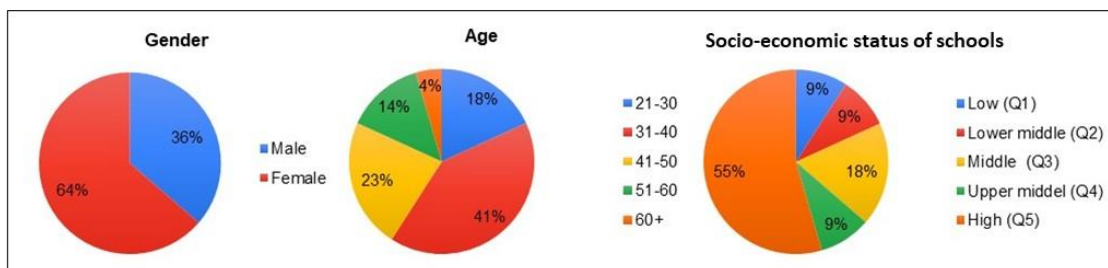


Figure 6: Respondent Demographics

5. Findings

Various interrelated factors promoted or hindered teachers' access to and use of ICT in their teaching practices. The findings of this study are reported and discussed with reference to the two research questions.

5.1 How did the Variables of Access to ICT Influence Teachers' Appropriation of ICT in Their Teaching Practices?

This discussion provides an overview of how the variables of access influenced teachers' appropriation of ICT in their teaching practices during the COVID-19 pandemic.

5.1.1 Motivational access

The respondents in this study confirmed, as illustrated in Figure 7, that despite having reasonable access to and proficiency in ICT, they had little or no experience of "teaching with technology" before the pandemic. The limited exposure to online and/or blended teaching and learning respondents can mainly be ascribed to a lack of mental readiness and willingness to adopt and use ICT. The following statement by a respondent aptly captures the fact that many teachers lack interest in and fear technology and consequently, prefer to teach the way they were taught:

"A lot of teachers are creatures of habit and don't like to try new technology - it scares them."

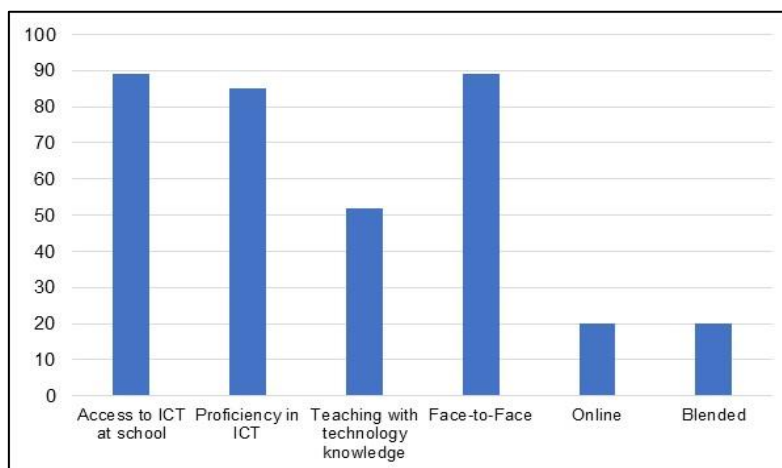


Figure 7: "Teaching with Technology" Before COVID-19

During the COVID-19 pandemic schools were forced to operate remotely and consequently teachers had no option but to use technology as the best alternative to ensure continued teaching and learning (Bozkurt and Sharma, 2020; Hodges, Moore and Lockee, 2020). The use of ICT in teaching practices was thus not by choice, but extrinsically motivated by the need to practice social distancing. The following comment by a respondent illustrates this externally forced obligation to use technology in teaching practices:

"I suppose being forced to make such radical changes to the way in which we do things was what we needed - it's very easy to have good intentions about using more or

unfamiliar technology, but the pandemic made it essential."

Following the pandemic, most respondents displayed a more positive perception and understanding of the benefits of "teaching with technology" and acknowledged that increased incorporation of ICT into teaching practices is a step in the right direction. Unfortunately, most of the respondents returned to traditional teaching practices, with increased implementation of technology, when schools reopened again.

While the pandemic acted as an extrinsic motivation for "teaching with technology", it did not automatically translate into higher levels of intrinsic motivation to adopt and use ICT in teaching practices when schools reopened again.

5.1.2 Physical access

While most respondents indicated that they had relatively high levels of access to ICT for teaching and learning at their schools, the closure of schools caused a major shift in the way teachers and learners interacted with each other, technology, and learning materials. As a result of the postponement of classroom-based teaching, their schools implemented various initiatives to support teachers in transitioning to remote online teaching during the COVID-19 pandemic. Schools in this study assisted with material access to ICT by providing teachers with digital devices such as laptops and allowances for data and internet connection required to work from home.

The transition to technology-mediated education not only increased the need for and reliance on hardware devices but also appropriate software applications such as a Learning Management System (LMS) for the administration and delivery of educational programmes. Unfortunately, most schools in this study did not have an LMS in place before the COVID-19 pandemic. Only 2 respondents reported the use of a traditional LMS, i.e. Moodle and Blackboard.

In the absence of a functional LMS, participants in this study used Google Classroom as the best alternative. While Google Classroom lacks some features associated with a traditional LMS, participants rated it as the most efficient online collaborative tool during the pandemic. WhatsApp was the most widely used social media platform for teacher-learner interaction, primarily because most learners had access to and were already using this platform.

5.1.3 Skills access

During the COVID-19 pandemic, most schools implemented training initiatives to enhance the technological and pedagogical skills of the teachers. While schools offered part-time online training programmes during the hard lockdown and in-school programmes when schools re-opened, most teachers also took responsibility for enhancing their own skills levels. While there was a significant increase in the "teaching with technology" knowledge of teachers, respondents in this study still rated their "teaching with technology" knowledge lower than their operational proficiency in ICT.

5.1.4 Usage access

Before COVID-19 the use of ICT in teaching practices was optional, and ICT was largely regarded as a supplementary tool and a nifty helper in the classroom. Teachers mostly used ICT to support or replicate conventional classroom practices. The COVID-19 pandemic created a novel usage opportunity for ICT in teaching and learning. The educational crisis thus generated the need, occasion, obligation, time, and effort to use ICT.

Because of inadequate "teaching with technology" knowledge, there was limited and very basic use of ICT in teaching practices before and during the pandemic. ICT was mostly used to substitute or augment conventional classroom practices by replacing traditional activities and materials with digital versions, e.g., PowerPoint presentations and YouTube videos. Despite the increase in knowledge, there was no significant change in the way teachers use ICT in their teaching practices. ICT was still primarily used to support and enhance, rather than transform traditional teaching practices (Figure 8).

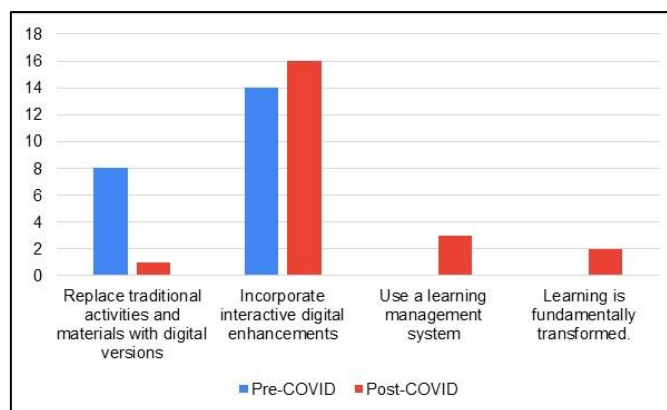


Figure 8: Use of ICT in Teaching Practice

While respondents developed a more positive perception and understanding of the benefits of ICT in teaching and learning, most returned to traditional teaching practices when schools reopened. The participants did, however, indicate that there was increased implementation of technology as a supplementary tool in a more blended approach to teaching.

5.2 When did the Various Dimensions of Access to ICT Influence Teachers' Appropriation of ICT in their Teaching Practices?

The influence that the dimensions of access to ICT had on teachers' appropriation of ICT, for example, promoted and/or hindered use, varied during the stages of the COVID-19 pandemic.

Physical access to ICT infrastructure and devices is essential for teachers to incorporate technology into their teaching during the pandemic. Most of the respondents indicated that they had reasonable to good access to devices and internet connectivity at their schools and home to integrate ICT into their teaching practices. The relatively high levels of physical access placed most participants, schools, and teachers, in this study in the minority "Virtual Classroom". These well-resourced schools and teachers were thus potentially well-positioned to transition from face-to-face to technology-mediated remote teaching and learning almost from the start of the lockdown.

Motivation plays a crucial role in teachers' adoption and effective use of ICT in teaching. Before the pandemic most respondents lacked the intrinsic motivation to enhance their teaching and engage students through ICT. This lack of motivation or perceived benefits of ICT hindered the adoption of ICT in teaching practices. During the COVID-19 pandemic, the shift to technology-mediated remote teaching necessitated a change in teaching methods, which required teachers to be motivated to adapt and integrate ICT tools into their practices. The pandemic thus acted as an extrinsic motivator. This extrinsic motivation plus the existing physical access enabled the teachers to use ICT for teaching and learning during the pandemic. Unfortunately, this temporary extrinsic motivation only translated into slightly higher levels of intrinsic motivation after the pandemic. As a result, most respondents returned to traditional teaching methods with a slight increase in ICT integration in their teaching practices.

Teachers' proficiency in using ICT tools and platforms is a critical factor influencing their appropriation of ICT in teaching. While respondents indicated fairly high levels of operational ICT skills before the pandemic, they had to quickly acquire or enhance their informational and strategic ICT skills to effectively utilise ICT for instructional purposes. Despite various training initiatives during the pandemic, most respondents in this study still rated their "teaching with technology" knowledge lower than their operational proficiency in ICT.

While the respondents rated teachers' access to ICT for teaching and learning at their school relatively high, they rated the school's use of ICT for teaching and learning significantly lower. Teachers' previous experiences and frequency of ICT usage also influenced their appropriation of ICT during the pandemic. Because the respondents were under no obligation to use ICT in their teaching practices before the pandemic, they had very limited prior experience with online and/or blended learning. Respondents who had prior experience integrating ICT into their teaching practices were more likely to adapt quickly to the technology-mediated remote teaching environment.

Unfortunately, the need, occasion, obligation, time, and effort to use ICT generated by the closure of schools was temporary. Despite the increased access to, skills in, and motivation to use ICT in teaching practices, most respondents returned to traditional teaching practices after the pandemic.

The influence of the dimensions of access during the stages of the pandemic is summarised in Table 2.

Table 2: Summary of the Influence of the Dimensions of Access to ICT

Stages	Promoted use of ICT	Hindered use of ICT
Pre-pandemic	Physical access (Operational) Skills access	(Intrinsic) Motivational access Usage access
Mid-pandemic	Physical access (Operational) Skills access (Extrinsic) Motivational access (Forced) Usage access	(Strategic) Skills access
Post-pandemic	Physical access (Operational and strategic) Skills access	(Intrinsic) Motivational access Usage access

6. Discussion

Before the pandemic, the use of ICT in teaching practices was optional, and respondents largely regarded ICT as a supplementary tool and a nifty helper in the classroom. ICT was mostly used to support or replicate conventional classroom practices. During the COVID-19 pandemic teachers were forced to use ICT to operate remotely. The use of ICT was thus extrinsically motivated by the need to practice social distancing. The participants did, however, have a more positive perception and understanding of the benefits of ICT after the pandemic. They also implemented technology in a more blended approach to teaching.

Participants in this study largely returned to traditional teaching practices when schools returned to “normal”.

There was no significant increase in the levels of intrinsic motivation to use ICT to its full potential. Motivation is thus not an automatic outcome of physical access, but rather a separate factor that drives teachers to explore and utilise ICT effectively. Motivational access to ICT implies that teachers recognise its value, perceive it as beneficial, and have the necessary pedagogical knowledge to integrate it into their teaching practices.

Overall, the findings of this study indicate that the relationship between teachers’ access to and usage of ICT is not a straightforward one. Physical access to ICT may be a primary condition, but it does not necessarily translate into actual use of the technology. Access is thus not a linear progression of successive stages. A more networked, relational perspective of access would be more appropriate and useful in developing enabling educational contexts that are conducive to using ICT.

6.1 Limitations

The study had a relatively small sample size of only 22 secondary school teachers in the Western Cape, South Africa. The results might not accurately represent the broader population. The study was also conducted over a short period which limits the ability to make conclusions about potential changes over time.

6.2 Further Research

The need for technology implementation in education will likely continue to grow, and access to ICT will continue to be critical. Further exploration of the 'new normal' within the context of this research would be valuable. A deeper understanding of access to ICT will inform and guide the development of policies and strategies to enhance technology integration in schools.

7. Conclusion

The ICT innovation triggered by the COVID-19 pandemic provided remarkable opportunities for blended teaching and learning approaches. The potential of this unique occasion should be harnessed by adopting a more holistic contextualised approach to access to transform schools into enabling environments that empower teachers to innovatively use ICT in their teaching practices.

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