Chapter 16
Adapting Virtual Laboratories in Post-COVID-19 Pandemic Learning Landscapes:
An Exploration of Science Teacher Perceptions and Adoption in Rural Schools

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ABSTRACT

The COVID-19 crisis spurred significant advancements in education, leading to the emergence of innovative tools like virtual labs (VL). This chapter presents a qualitative study employing interpretative phenomenological design to explore rural science teachers' perceptions and adoption of VL post-pandemic. Guided by the unified theory of acceptance and use of technology (UTAUT), seven participants from rural schools in South Africa's Eastern Cape province were purposively sampled. Thematic analysis of data from interviews, sharing circle discussions, and document analysis revealed a notable shift in teachers' attitudes towards VL. Perceived initially as daunting, VL evolved into an essential teaching tool in the post-pandemic era,

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representing an unforeseen yet advantageous outcome for rural science education. While the pandemic acted as a catalyst for adoption, persistent challenges such as inadequate internet access and technical support hindered its effective implementation. Addressing these barriers is crucial for meaningful integration of VL into post-COVID-19 education.

INTRODUCTION

The COVID-19 outbreak in 2019 significantly impacted various facets of human existence. In response, governments worldwide implemented unprecedented measures such as quarantines and travel restrictions, with 191 nations instituting nationwide closures and five enforcing regional lockdowns (WHO, 2023). These interventions, aimed at curbing the transmission of the disease, necessitated the closure of schools in many countries. According to UNICEF (2022), the pandemic closures affected over 1.6 billion students, constituting approximately 91.3% of the global student population. Particularly vulnerable to the impact of these closures were students in rural regions of the Global South. Amidst this crisis, the utilisation of technology in education garnered significant traction as a means of facilitating virtual learning from home (Thapaliya et al., 2024).

Notably, even prior to the COVID-19 outbreak, several pre-pandemic studies reported a surge in integrating technology into the classrooms, including embracing innovative and cutting-edge immersive technologies. One of these novel technologies is the Virtual Lab (VL), which sparked a global revolution that extended to science education in rural schools in developing countries. This transformative paradigm promised to enrich students' understanding of abstract concepts through experiential learning, effectively replicating real-world laboratory experiences. VL technology has the potential to empower students to immerse themselves in experiments within a fully interactive virtual environment, employing computer-simulated laboratory equipment that remains perpetually functional. This eliminates concerns related to wear and tear, ensuring the enduring utility of chemical reactants (Mohammad Ayasrah et al., 2024). Pioneers in VL adoption have affirmed its efficacy in studying three-dimensional (3D) objects, including minute particles like atomic structures, across varying dimensions, including their interiors (Kapilan et al., 2021).

The literature demonstrates the substantial contribution of VL to improved learning outcomes. Shambare and Simuja's (2022) comprehensive review of 32 pre-pandemic empirical studies across 16 countries unequivocally illustrates the positive impact of VL on students' academic performance. Studies conducted in diverse regions, such as Malaysia (Oloruntegbe & Alam, 2010), Slovenia (Herga et al., 2014), Italy (Pellas, 2014), the USA (Davenport et al., 2018), and Turkey (Kapici et al., 2022),