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Exploring Pre-Service Mathematics Students' Videoconferencing Experiences: A Case of Open and Distance e-Learning in South Africa

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Abstract

Using Videoconferencing (ViCon) for mathematics instruction has transformed the discipline into a more interactive and engaging field, debunking its reputation as a difficult subject. This qualitative study, which employed phenomological research design, focused on purposively sampled 30 first year Unisa students in the Measurements course, exploring their ViCon experiences. Utilising the transactional distance theory (TDT), it investigated the complex interplay between students and their learning spaces, highlighting ViCon's diverse impacts i.e., it explored the technical, logistical, and educational challenges faced by pre-service mathematics students during videoconferencing sessions, while also identifying its potential benefits. Additionally, it sought to explore students' perceptions and attitudes towards videoconferencing, including their satisfaction and how they perceive its effectiveness in facilitating their mathematics learning. The study utilised a semi-structured questionnaire, which was piloted as part of the quality criteria to ensure high standards in the collection and analysis of primary data. The study revealed that students appreciated Open and Distance e-Learning (ODeL)'s location flexibility but faced challenges like work conflicts and isolation. It identified obstacles to ViCon usage, such as motivation, time constraints, and socio-economic and logistical issues, including travel and connectivity difficulties. However, students' willingness to explore alternative collaborative methods and their preference for interactive learning signal a shift towards more inclusive ODeL models. Consequently, the study recommends that institutions, particularly Unisa, should broaden their digital offerings, establish virtual study groups, provide asynchronous resources like ViCon recordings, and emphasise collaborative, active learning. These strategies aim to reduce transactional distances, making ODeL benefits widely accessible and enriching the educational experience for all students, irrespective of their backgrounds. Therefore, videoconferencing, with adequate support, is highlighted as an efficient educational tool in ODeL settings. The study advocated for integrating various digital tools into ODeL to enhance accessibility and cost-effectiveness.

Keywords: Session bunking; videoconferencing sessions; mathematics education; students' perceptions

Introduction

Amid the COVID-19 pandemic, the urgent need to transition to emergency online distance learning has compelled educators, students, parents, and administrators to depend on Videoconferencing (ViCon) tools for real-time communication. This sudden shift, necessitated by social distancing measures, presents unique challenges due to its unprecedented and spontaneous nature (Correia, Liu, &Xu, 2020). However, institutions like University of South Africa (Unisa), which have long depended on technology for content delivery, do not face the same level of difficulty.

ViCon, as described by, among others, Krutka and Carano (2016), refers to the real-time video and audio interaction among users located in different geographical areas. Considering platforms that emerged after Videoconferencing (ViCon), such as Moodle, Canvas, and Google Classroom—collectively known as Learning Management Systems (LMS)—as well as Google Expeditions, zSpace, and AltspaceVR, which fall

under Virtual and Augmented Reality (VR/AR), ViCon is the oldest. Its origins can be traced back to the 1960s, although it was not widely used at that time due to the high costs associated with it (Sondak & Sondak, 1995). This technology is [now] considered in advantageous way to connect with people anywhere in the world.It is among the array of digital tools employed to enhance online educational practices. Over the years, ViCon has become increasingly favoured as a method for augmenting direct interpersonal interactions in settings that utilise open and distance learning approaches (Verma, Getenet, Dann, & Shaik, 2023; Nehls, Smith, & Schneider, 2015). The authors highlight that various computer-based platforms, including Wimba, Google Chat, Adobe Connect, Skype, and Apple's FaceTime, serve as effective mediums for enabling such face-to-face communications.

Rob and Bett (2014) and Pedroso et al. (2023) explored the role of ViCon in distance education, underscoring its utility as a teaching tool in academic environments. They posited that ViCon allows teachers to bridge the gap created by physical separation, facilitating the virtual conveyance of educational content, fostering more meaningful interactions between teachers and students, and making the explanation of complex topics more straightforward, thereby enhancing student comprehension (Pedroso et al., 2023; Rob & Bett, 2014). Additionally, Correia et al. (2020) observed that ViCon equips educators with innovative methods for presenting materials and engaging with students, suggesting that ViCon platforms are instrumental in improving educational outcomes and ensuring the transfer of knowledge to subsequent generations (Cavus & Sekyere-Asiedu, 2021).

Similarly, Nguyen and Nguyen (2021) researched educators' readiness to adopt ViCon in their instructional methods, highlighting the critical role teachers play in tailoring ViCon sessions to meet the diverse needs of students effectively (Alqahtam & Rajkhan, 2020). Furthermore, Nguyen and Nguyen (2021) stressed the importance of regular and consistent use of ViCon by educators to develop a comfort level and proficiency with online teaching techniques. This ongoing engagement is predicated on the provision of thorough training and instructions on leveraging ViCon efficiently to maintain and enhance the quality of remote education.

The ViCon tool is crucial for supporting Open and Distance e-Learning (ODeL) students, especially in rural areas with limited higher education access. It helps overcome the physical separation between lecturers and students, as highlighted by Perraton (1988) and Rennar-Potacco and Orellana (2018) and exemplified by institutions like Unisa. ODeL aims to address challenges related to geography, communication, time, social and economic factors, and interactions between students, lecturers, course materials, and peers (Unisa, 2008). The approach emphasises flexible, student-centered learning, ensuring students receive adequate support from lecturers and that the programmes align with their expectations to enhance their chances of success (Ntuli & Gumbo, 2019).

Fatani (2020) emphasised that ViCon facilitates uninterrupted teaching and bolsters online education in remote learning contexts. According to Gladović, Deretić, and Drašković (2020), along with Klenke (2014), employing ViCon offers educators and subject matter experts the chance to conduct online teaching, enhancing classroom experiences through student collaboration, social engagement, and the development of literacy skills. Dung (2020) argue that ViCon enables educators and learners to explore new scenarios, establish connections across different locations globally, and access a wide array of information. In other words, as argued in Candarli and Yuksel (2012) and Correia et al. (2020), ViCon improves learning by meeting people who were previously inaccessible due to several problems such as time and financial constraints. Mukhtar et al. (2020) points out that ViCon supports flexible, learner-centric educational approaches. It facilitates meaningful interactions between instructors and students in scenarios where in-person interactions are not feasible (al-Samarraie, 2019). Importantly, leveraging ViCon as a supportive strategy is vital for fostering global collaborations and educational exchanges (Rennar-Potacco & Orellana, 2018; Klenke, 2014). Aslam (2017) found that the use of ViCon enhances class interactivity, addresses

students' needs, and promotes higher-order learning.

Recently, ViCon platforms like Zoom, Google Meet™, and Microsoft Teams have become increasingly prevalent in both business and educational sectors, as highlighted by Peters (2020) and Thorp-Lancaster (2020). The expectation is that ViCon's popularity will continue to rise in the foreseeable future, extending beyond the current period. Research has already demonstrated the practicality of ViCon. For example, Candarli and Yuksel (2012), and Cartis (2022) investigated how participants perceive and utilise ViCon tools in educational contexts. Archibald, Ambagtsheer, Casey, and Lawless (2019) found that users preferred Zoom over other interview methods, including face-to-face and telephone conversations. Furthermore, Standaert, Muylle and Basu (2021) projected that by 2024, only a quarter of businesses will continue to conduct meetings in person.

Although numerous studies have highlighted the advantages of using ViCon and have described its application, there is still a significant concern regarding the low attendance rates of Unisa students in ViCon sessions intended to support their learning in the module Measurements in the Intermediate and Senior Phases (MAE103L). As a result, the study explored the technical, logistical, and educational challenges encountered by pre-service mathematics students during videoconferencing sessions, identified its potential benefits, and explored students' perceptions, attitudes, satisfaction, and views on its effectiveness in supporting their mathematics learning.

Study rationale

The challenge of low student attendance is increasingly troubling for educators, university administrators, lecturers, and stakeholders alike. Jameel, Ali and Phil (2016) argue that a mix of instructional approaches, familial backgrounds, and sociocultural elements are responsible for decreased attendance in math classes. Kelly (2012), and Letsoalo and Makgakga (2022) point out that factors under the university's influence, like housing conditions, timetable arrangements, and transportation issues, also play a significant role. In instances where ViCon tools were utilised to support students, a substantial number still did not engage fully in the ViCon classes (Santibañez & Guarino, 2021). Given these circumstances, including changes in policies regarding multi-modal teaching and learning at institutions like Unisa, there is a growing impetus to delve deeper into the reasons behind lower attendance rates, especially in ViCon sessions.

The motivation behind this research is rooted in the transformative changes experienced in educational methodologies, accelerated by global events that have underscored the necessity for remote learning technologies. ViCon has become crucial in maintaining the flow of education, especially for subjects like mathematics that demand ongoing interaction and comprehension. However, the observed variance in participation rates among undergraduate students in mathematics courses conducted via ViCon has sparked debates about the remote learning model's effectiveness and capability to meet educational needs adequately.

The objective of this study is to investigate the root causes behind the observed low participation rates in mathematics classes held through ViCon. By pinpointing and understanding these contributing factors, this research aims to provide insights into student experiences and the challenges they face. Unraveling these issues is vital for crafting strategies that boost student engagement, enhance attendance rates, and, ultimately, improve the quality of educational outcomes. Furthermore, this study is crucial and timely for guiding the evolution of educational strategies and policies, making them more responsive, inclusive, and efficient in addressing the varied needs of the student body.

At its core, this research seeks to proactively tackle the deficiencies present in contemporary educational frameworks by focusing on ViCon participation. This effort is aimed at refining the remote learning experience for students pursuing undergraduate mathematics, contributing towards the larger objective of promoting educational fairness and superiority in a world that is increasingly reliant on digital platforms. The anticipated outcome is to generate

insights that will bolster online support mechanisms for ODeL students, particularly within the field of mathematics. Moreover, the study sought to explore the technical, logistical, and educational challenges faced by pre-service mathematics students during videoconferencing sessions, while also identifying the potential benefits of this communication method. Additionally, it sought to explore students' perceptions and attitudes towards videoconferencing, including their satisfaction and how they perceive its effectiveness in facilitating their mathematics learning. Overall, this study aims to provide valuable insights into how ViCon can be leveraged to improve mathematics teacher training within the ODeL framework in South Africa, contributing to the broader discourse on the role of technology in education.

Scope and delimitation

The study focused exclusively on first-year Bachelor of Education (BEd) students at Unisa's Pretoria Campus who were registered for the mathematics course, Measurement in Intermediate and Senior Phases (MAE103L), during the first semester of the 2019 academic year. The course aims to equip students with the ability to understand the measurement concept, length, perimeter and area, surface area, volume and mass, temperature, time measurement, and angle measurement. The research specifically examined the ViCon sessions associated with this module.

Theoretical framework

This study was buttressed by transactional distance theory [TDT] (Moore, 1973). This theoretical framework provides a comprehensive lens through which to examine the dynamics of distance learning environments, particularly those mediated by technology such as videoconferencing. Developed by Moore (1973), this theory explores the pedagogical relationship between lecturers and students in terms of the psychological and communication space that exists between them, emphasising the importance of dialogue, structure, and learner autonomy in minimising transactional distance. In other words, Moore (1983) describes transactional distance theory as the gap in communication resulting from the physical separation between teacher and student, which affects their interaction with the educational content. Giossos, Koutsouba, Lionarakis, and Skavantzos (2009:2) extend this definition to emphasise that transactional distance involves more than just the spatial separation between educators and learners; it also encompasses the dynamics of the transaction, or the extent of interaction between them, influenced by their geographical locations. In the context of the current study, the focus on videoconferencing goes beyond bridging the transactional distance between teacher and student; it aims to facilitate social interactions among students themselves. Moreover, transactional distance theory takes into account the socio-cultural dimensions of distance education, acknowledging the crucial role of social interaction in the academic environment today (Kang & Gyorke, 2008).

Therefore, a student is a social being and their developmental learning is based on interaction with peers and the teacher (Kang & Gyorke, 2008). As highlighted in Moore and Kearsly (2005), the developmental learning of a student concentrates on the transactional gap between the teacher and student "through distinctive procedures in instructional design and the facilitation of interaction". In the context of this study, the theory can offer valuable insights into how the perceived distance in videoconferencing sessions might influence students' attendance and engagement levels. By understanding the factors that contribute to transactional distance, such as the quality of interactions, the design of the course content, and the extent to which students feel supported and autonomous, lecturers can develop strategies to enhance the effectiveness of online mathematics instruction and support, thereby potentially improving attendance rates and educational outcomes in videoconferenced sessions.

Literature review

Higher education systems, especially OdeLs, are confronted with the task of addressing the differing needs of students. They address this task by, among other ways, using learning technology that allows students to learn more openly and flexibly (Letsoalo & Makgakga, 2022),

and share common goals relating to access, retention, flexibility, and employability (Zuhairi, Karthikeyan, & Priyadarshana, 2020). The use of ViCon in the teaching and learning of mathematics has introduced a dynamic and interactive dimension to an otherwise traditionally challenging subject. This technological advancement allows educators and lecturers to transcend geographical barriers, providing an accessible platform for students from diverse backgrounds to engage in mathematical discourse. Through ViCon, mathematics teachers can demonstrate complex concepts in real-time, employing digital tools and resources that enhance visual understanding and retention. The ability to share screens, use digital whiteboards, and present simulations brings abstract mathematical theories to life, making them more comprehensible for students. Furthermore, this method supports the differentiation of instruction, enabling teachers to tailor their teaching strategies to meet the varied learning needs of their students, and offering personalised feedback and guidance during live sessions.

ViCon has emerged as a key instrument for fostering collaborative learning, with its importance notably increasing within the realm of mathematics education. It creates a communal and cooperative environment essential for the study of mathematics. Studies have shown that ViCon can significantly enhance communication and collaborative learning endeavours, particularly when students are supported with additional conceptual and socio-cognitive frameworks (Nsamba, 2019; Borko, Jacobs, Eiteljorg, & Pittman, 2008). Techniques such as structural visualisation and scripting further enrich the learning process by offering a structured approach for students to engage more thoroughly with the content (Nsamba, 2019; Borko et al., 2008; Tomadaki, Quick, & Scott, 2008).

Moreover, ViCon promotes interactions among peers and encourages the creation of study groups, where students can collaboratively tackle problem-solving tasks, discuss mathematical concepts, and exchange strategies. The interaction between students or participants in the ViCon platform fosters a sense of community and can be equated with better learning (Wu, Sun, & Bellisario, 2022; Giesbers et al, 2014). As supported by Correia, Liu, and Xu (2020), the use of ViCon encourages students' interaction with instructors and the environment, and this expands their learning experience.

The application of video [as a means] to stimulate effective discussions in mathematics professional development has been investigated, highlighting the value of building a learning community where participants comfortably exchange insights through video and mutual interactions (Wu, Sun, & Bellisario, 2022; Reiserer, Ertl, & Mandl, 2002). This method is supported by evidence that cooperative learning within ViCon settings, bolstered by content outlines and cooperation scripts, leads to the creation of collaborative external representations, thereby enhancing learning results (Giesbers, Rienties, Gijselaers, Segers, & Tempelaar, 2009; Ertl, Reiserer, & Mandl, 2005). This collaborative framework not only deepens mathematical comprehension but also fosters the development of critical thinking and communication skills. The adaptability of ViCon also meets diverse learning speeds, enabling students to review recorded materials and practice independently. Thus, the adoption of ViCon in mathematics education marks a progressive shift towards a more inclusive, stimulating, and effective learning experience, heralding new frontiers in educational methodologies for the digital era (Reiserer, Ertl, & Mandl, 2002).

It follows that ViCon can foster a sense of community and collaboration among students, which is crucial for learning mathematics, provided that it is accompanied by appropriate conceptual and socio-cognitive support mechanisms. The success of such collaborative efforts, however, depends on the thoughtful implementation of these tools within the learning environment (Ertl, Fischer, & Mandl, 2006).

In a study investigating the sudden and enforced challenges posed by COVID-19, as well as the technological tools used by knowledge workers to achieve team collaboration objectives, Waizenegger, McKenna, Cai, and Bendz (2020) found that videoconferencing (ViCon) promotes social interaction, improves communication

among peers, and facilitates the exchange of ideas. Similarly, Hacker, von Brocke, Handali, Otto, and Schneider (2020) highlighted that ViCon platforms enhance group communication and enable participation in collective social activities. In their research aimed at identifying factors influencing attendance at Health Services Management's video conference sessions at UNISA, Matlakala, Nkosi, Modiba, Dolamo, and Maboe (2013) found that engaging in ViCon sessions helps to clarify content for students and provides valuable feedback on assignments. According to Roberts (2009), ViCon usage has contributed to higher student retention rates, increased motivation, improved social interaction, and made learning more positive and engaging. Rod and Bett (2014) reported savings in time and money, with students achieving a better grasp of subjects through immersive learning experiences. Tamadaki, Quick, and Scott (2008) found that students could grasp course material better through new vocabulary, sharing personal experiences, and developing oral communication skills. Fushikida, Oura, Yamamoto, and Yamauchi (2018) highlighted a positive shift in students' attitudes and a deeper comprehension of course content with ViCon.

Integrating ViCon into educational settings, especially for mathematics, introduces a range of hurdles that impact both the delivery and reception of teaching. Al-Samarraie (2019) and Joseph, Plonczakand Stemn (2009) uncovered that utilising ViCon for teaching mathematics brings to light the necessity for proficient questioning techniques and a solid grasp of the subject matter, alongside the critical role played by prompt feedback from instructors and fellow students. Consequently, the absence of swift reactions can demotivate students from participating in ViCon classes. In the same vein, students might be inclined to skip ViCon sessions if they perceive that the lecturer lacks a thorough understanding of the mathematical concepts being taught.

Also, Al-Samarraie (2019) and Ertl, Fischer, and Mandl (2006) pointed out that merely incorporating web-based ViCon into educational settings does not inherently enhance learners' satisfaction. This observation suggests that the simple inclusion of technological tools does not ensure the development of a community feeling or the enhancement of educational results. It underscores the necessity for a thoughtful amalgamation of ViCon technologies with educational methodologies to fully realise their advantages.

Not all students have access to the necessary technology, or a stable internet connection required for effective videoconferencing, leading to inequalities in learning opportunities and outcomes. For instance, students residing in rural regions without access to electricity are compelled to travel to wealthier areas to utilise computers, facing expenses related to transportation, computer access, and possibly lodging and meals. Gu (2021) and Matlakala et al. (2013) highlight the economic burden of such travel and the necessity for some students to arrange for overnight stays to ensure punctual attendance in class. Additionally, students who do have access to electricity and computers are not immune to obstacles, including technophobia and interruptions due to loadshedding. Hacker et al. (2020) observed that certain students find it challenging to set up a Virtual Conference (ViCon) system due to a lack of technical skills. Dumford and Miller (2018) further indicated that some educators and students lack proficiency with technology, which hinders their ability to engage with modern educational trends.

Virtual teaching and learning environments also introduce complications related to classroom management and dynamics. Maintaining student engagement in a virtual environment can be challenging, especially in a subject that demands high concentration and effort like mathematics. Students may feel more isolated and less motivated to participate actively in the absence of a physical classroom setting (Rone et al., 2023). For instance, Standaert et al. (2016) discovered that teachers or lecturers often struggle to maintain control over students since they cannot see all participants simultaneously during online sessions. The ability to observe students' body language and gestures is crucial for lecturers to respond or intervene appropriately, underscoring the challenges of replicating traditional classroom interactions in a virtual setting.Similarly, conducting assessments and understanding students' thought processes in solving

mathematical problems can be challenging through videoconferencing (Goos & Kaya, 2020). It is not easy to gauge students' comprehension and provide personalised feedback without the direct observation possible in a traditional classroom. Therefore, assessment methods are likely to be adversely impacted in ViCon sessions. It follows that lecturers may need to adapt their teaching strategies. Effective online mathematics teaching requires innovative approaches and tools that might not be readily available or familiar to all educators (Livy et al., 2021).

Technical challenges can greatly impair the efficacy of ViCon sessions, particularly for lecturers inexperienced with ViCon software and unfamiliar with online distance education (Hodges et al., 2020). This inexperience can lead to significant stress and anxiety for them. While well-crafted online learning can achieve the same level of quality as traditional classroom learning (Hodges et al., 2020; Milman, 2020), the time required to design, develop, and execute quality online teaching and learning experiences often is not available. Students familiar with the platforms might feel deterred from participating in sessions where the lecturer faces challenges with the basic operations and smooth running of the sessions.

Lecturers and students alike may face issues such as unstable internet connectivity, software glitches, or a limited understanding of how to use ViCon platforms. Such difficulties can interrupt the continuity of the session and result in the loss of crucial teaching and learning time (Rone et al., 2023).

ViCon, along with other online platforms, aims to close the gap between students and lecturers by offering a virtual space where students can access guidance similar to that of face-to-face meetings. Nonetheless, certain students, particularly those who have previously received a high-quality education, may not perceive ViCon sessions to be as advantageous. In essence, students at ODeL institutions like Unisa might decide against participating in ViCon sessions if they feel confident in their academic abilities. Unisa's student body is varied, including individuals who have benefited from a strong secondary education or have gained experience in tertiary education at some sister universities or colleges, thereby enhancing their self-assurance and ability to thrive in an ODeL environment. Such students often possess the skills needed to meet course demands independently, resulting in their academic background influencing their decision to skip these sessions. This situation is exacerbated by the traditional approach of student support services, which mainly target students facing academic difficulties, with engagement in these services being voluntary, as noted in Letsoalo (2021). However, the danger lies in some students overestimating their academic proficiency, which could lead to struggles during formal evaluations like final examinations, and potentially, to their failing.

Another significant factor influencing student participation in ViCon sessions may be their orientation toward learning methods. Students accustomed to traditional, face-to-face instruction might perceive ViCon sessions as less engaging or unsuitable for their learning needs. Online learning can be a lonely experience with no lecturers, co-learners, or students physically present. Mokoena (2011) reported that students tend to favour conventional classroom settings over ViCon for instructional support, indicating a preference for in-person interactions with peers on campus rather than through a screen. Mathematics learning is highly interactive, requiring discussions, problem-solving in real-time, and immediate feedback. ViCon can limit these interactive opportunities due to technological constraints, such as delays, audio issues, or limitations in sharing screens and documents effectively.

Access to electricity is crucial for technology-driven activities, yet loadshedding significantly disrupts this, especially impacting education and ViCon sessions vital for distance learning (Kgarose, Makhubela & Setaise, 2023.). The intentional power outages interrupt daily activities, severely affecting students' ability to participate in online classes, leading to missed sessions, disrupted learning, and diminished motivation. The unpredictability of loadshedding schedules complicates study planning, disproportionately affecting students with limited access to alternative power sources (Malik,

Memon, Ali, Mallah, Bux, & Haq, 2022). This issue not only hinders academic progress but also deepens the digital divide, placing students in less privileged or rural areas at a greater disadvantage and exacerbating educational inequalities.

In essence, loadshedding's impact on videoconferencing represents a significant barrier to equitable and uninterrupted education. To safeguard the educational rights of all students and ensure a level playing field, educational institutions and policymakers should devise strategies that minimise the educational disruptions caused by loadshedding. These strategies could include investing in alternative energy sources for educational institutions, providing students with resources to access recorded lectures, or developing more flexible scheduling systems that can accommodate the unpredictability of power outages.

Methods

Study design

The study employed a qualitative (Creswell & Creswell, 2018), phenomenological approach (Alase, 2017; Creswell & Creswell, 2018), The research investigated the technical, logistical, and educational challenges encountered by pre-service mathematics students during videoconferencing sessions, while also identifying the potential advantages of this communication method. Moreover, it aimed to examine students' perceptions and attitudes towards videoconferencing, including their satisfaction and how they view its effectiveness in supporting their mathematics learning. In essence, this cross-sectional qualitative study was designed to explore and gain insight into the experiences of undergraduate mathematics students with videoconferencing during their pre-service education, specifically focusing on their perceptions of the challenges associated with videoconferencing. Utilising a phenomenological approach (Alase, 2017), the study aimed to capture the depth and nuance of students' perceptions, challenges, and suggestions for improving videoconferencing as an educational tool.

Sample size realisation

The study focused on the 2019 cohort of 755 first-year Bachelor of Education (BEd) students specialising in Mathematics Education, with 30 purposively chosen participants who had incomplete attendance at the ViCon sessions. That is, purposive sampling scheme was used for students' selection (Letsoalo & Rankhumise, 2024; Andrade, 2021). Data collection involved a structured questionnaire, based on Gillies (2008), with open-ended items to capture participants' perspectives and experiences with ViCon in mathematics education, emphasising a qualitative analysis of their responses. The study addressed credibility concerns by following TDT and adopting a phenomenological approach, focusing on students' thoughts, feelings, and experiences. To ensure the findings were credible and trustworthy (Ahmed, 2024; Tracy, 2024), the authors piloted the questionnaire and ensured the alignment of the TDT with the purposive sampling strategy (Creswell & Creswell, 2018)) and data analysis methods. The research is replicable in similar conditions (Tracy, 2024), as it provides sufficient detail about the methodology (dependability), and the connection between the primary data and the findings is evident (Ahmed, 2024). Consequently, the study meets the required quality criteria.

Data analysis

The process of analysing qualitative data, as described by McMillan and Schumacher (2014), primarily involves an inductive method where data is organised into categories, with the identification of patterns and relationships within these categories. This approach was utilised in the data analysis of this study. In qualitative research, the act of making sense of the data begins with the raw data and culminates in the discovery of categories and patterns. To deeply understand the data, which includes significant phrases, expressions, and sentiments shared by participants about their experiences with videoconferencing, the researchers engaged in a thorough examination of the interview and focus group discussion transcripts. This involved repeated readings to achieve intimate familiarity with the content. Following this, a systematic coding of the data was

carried out, where transcripts were annotated with labels that encapsulate the main points or concepts shared by participants, as per Creswell and Creswell (2018). After coding, the researchers analysed the codes to find recurring patterns throughout the dataset. These patterns indicated themes, which are overarching concepts that group similar codes together. This phase required extensive interpretation by the researchers to determine which patterns were significant enough to be considered themes and which were more appropriately categorised as sub-themes or specific elements of larger themes. Each identified theme provided a perspective for understanding the complex experiences of students using videoconferencing for their education.

Ethical issues

This research adheres to all applicable ethical principles, including ensuring participant anonymity. Participants were assured that their involvement in the study would be kept confidential, their participation was entirely voluntary, and they had the option to withdraw at any point without facing any consequences. Furthermore, it was emphasised that all personal information would be handled with strict confidentiality. Participants were also informed that data collected from their participation would be exclusively utilised for this study and no other. Ethical approval for the study was obtained from the Turfloop Research Ethics Committee (TREC) under the reference number TREC-0310111-031. learning

Findings

This section reveals the pre-service educators' experiences with ODeL learning. Although these two ideas are closely linked, the presentation intentionally lays out the participants' viewpoints in a straightforward manner. Specifically, it outlines the reasons or factors identified by participants for the reduced participation rates in ViCon sessions of the MAE103L module at Unisa.

The analysis of the study's data led to the identification of themes, which were grouped into three main categories. The first theme, concerning students' overall perceptions of ODeL courses, delved into their viewpoints regarding the learning of ODeL courses and their personal experiences within the ODeL framework. The second theme explored the students' broad perspectives on the implementation of ViCon as a support mechanism in tertiary education settings. Lastly, the theme addressed ViCon as a tool for boosting class interaction and discussed how students perceive and engage with ViCon as an educational resource aimed at improving the effectiveness of teaching and learning processes.

Students' views on ODeL learning

Open Distance e-Learning (ODeL) methodology enables learning that is both flexible and accessible, regardless of a student's physical location. This approach allows learners to engage with their studies at their convenience and preferred pace. ODeL takes into account the transactional distance, or the educational gap, that arises from the physical separation between instructors and students during the planning and interaction with course content (Moore & Kearsley, 2005). In this research, 11 first-year pre-service student teachers, denoted by S_ij,i=0,1;j=0,1,⋯,9, recognised the advantage of being able to study from any location, thanks to the off-campus learning model. Typically, in ODeL environments, there is a physical disconnect between the educator and the learner (Perraton, 1988), yet students are allowed to balance work and study commitments effectively. This study further revealed that ODeL students can access educational materials universally, anytime, and anywhere. Despite the physical distance from their instructors, some students noted that the availability of learning resources was not impeded. It has been observed that as the interaction between the lecturer and ODeL students intensifies, the perceived transactional distance diminishes (Moore, 1983). Participants in this study appreciated the flexibility of studying at their own pace and in their own space, underscoring the boundless nature of learning through ODeL.Table 1 presents some of the students' comments or views relating to [their] ODeL learning.

Table 1: Pre-service educators' comments on ODeL learning

Student	Comment
S_{09}	*Studying at a distance institution allows us to study on our own time. We can work and study at the same time, though it is demanding.*
S_{11}	*I am a parent and have to do some chores. And studying off-campus provides me with the opportunity to study anytime when I am free after work. It reduces stress for class attendance and regular class discussions. But the university should give us tutors for all the modules.*
S_{13}	*This is a chance to improve our qualifications to study at a distance institution. You can plan your own study time, either at home or visiting libraries in the neighbourhood. But it is difficult to meet with the lecturers.*
S_{15}	*As ODeL students, we can study anytime anywhere. I can go to work and study late in the afternoon after work. Just that it is a lonely journey.*
S_{16}	*As parents,* ***ga re na nako ya go ya diklaseng/diphaphušing tša go ithutela*** *(as parents, we do not have time to attend classroom-based lessons), so we can further our studies at distance universities. The problem is meeting with the lecturers. Some of the contents need to clarify by the lecturers.*

The study's participants shared the difficulties they encountered while pursuing education through an ODeL institution. They noted that balancing work and study commitments significantly limited their available time for learning, even though ODeL's flexibility alleviated the pressure of having to attend classes physically. This aligns with the idea that ViCon technologies can transcend the constraints of traditional, in-person lessons, eliminating the need for conventional classroom settings (Yang, Zhu & MacLeod, 2018; Wiesemes & Wang, 2010). Despite their busy schedules, students can engage with their course materials via ViCon, which allows them to fulfill their various obligations. However, the participants also expressed feelings of isolation resulting from studying in solitude, highlighting the loneliness that can accompany preparing for assignments and exams in their personal spaces. Some of these sentiments are captured in Table 2, illustrating the participants' experiences.

Table 2: ODeL students' frustrations

Student	Comment
S_{02}	*Studying at a distance is frustrating as most of the time you do schoolwork alone, with no one helping you*
S_{15}	*I can work and study late in the afternoon after work. Just that it is a lonely journey*
S_{12}	*You cannot meet lecturers and other students who registered for the same module because of the distance.*

Table 3: Effect of transactional distance

Student	Comment
S_{03}	*Because we cannot attend videoconferencing lessons, it would be better if they could arrange e-tutors for us to assist with the content of the module.*
S_{08}	*The lecturer can arrange an e-tutor for those who cannot attend thevideoconferencing lesson and this can assist us in understanding the content of the module*
S_{15}	*It is difficult to attend the sessions and maybe the lecturer can get an e-tutor to assist us with the module content*

As noted in Correia et al. (2020), the use of ViCon may increase students' instructional interaction with their lecturers, and with their peers, and enhance the environment to expand their learning experience. However, participants in this study noted that the transactional distance inherent in ODeL could potentially hinder their learning experience. They suggested that incorporating e-tutors, who could aid in clarifying and elucidating the module content, might be beneficial, as indicated in Table 3.

It is important to highlight that while some students were open to incorporating ViCon sessions into their ODeL studies, their attendance at these sessions was sporadic, potentially due to constraints like work commitments that limit their time. Kang and Gyorke (2008) emphasise the importance of dialogue in fostering meaningful interactions between lecturers and students. Furthermore, participants expressed a desire for chances to engage in person with their peers and lecturers to discuss the content of their modules. As presented in Table 4, time and money are significant factors in the ODeL studies, particularly for the students who do not have relevant gadgets to access ViCon.

Table 4: Effect of socioeconomic status

Student	Comment
S_{01}	*Some of us do not have money to travel to the videoconferencing venue as we are unemployed*
S_{04}	*The problem is time as we are working and do not have money to go to the venue to attend videoconferencing lessons*
S_{09}	*The videoconferencing venue is far from us and needs us to travel for one and a half hours and transport also is expensive*

Table 5: Time and money as significant factors, and overall advantages of ViCon

Student	Comment
S_{09}	*Videoconferencing encourages group discussion of the module. I did not attend the sessions because I am working and cannot attend. Videoconferencing sessions can be conducted on weekends to accommodate all of us.*
S_{07}	*These videoconferencing sessions can enable us to meet virtually with lecturers and other students to learn the module. The problem is that we are working and also the distance from our place to attend the video lessons. But we have WhatsApp where we discuss the content of this module.*
S_{09}	*Videoconferencing* ***e re thuša ka go re tliša felo go tee and re tla kwišiša di-learning*** *(It aids in bringing us in a single location, thereby enhancing our comprehension of the material) outcomes and content of the module. But we can also watch videos on YouTube and have group discussions to understand the content.*
S_{10}	*The video lessons are good, as we can discuss the content of the module with our lecturer. But the problem is the money to travel to the venue.We download videos and have WhatsApp groups to discuss the content of the module.*
S_{14}	*Videoconferencing assists us to discuss and understand the course content with our fellow students. We can ask questions for clarity where we have challenges. It also helps because the lecturer is unpacking the content and can share ideas.*
S_{03}	*We feel that we understand the course as we have group discussions and WhatsApp groups where we discuss the content of the course and mathematical problems.* ***Go ya ka nna, ke bona ke šoma gabotse*** *(in my opinion, I am doing well), so that's why I did not have an interest in attending the VC sessions. However, videoconferencing is cost-effective in terms of travelling costs or money for overnight accommodation to avoid being late.*

These results align with the observations made by Matlakala et al. (2013), who noted that the costs associated with commuting, as well as the need for some students to arrange overnight stays to participate in ViCon, can burden students. Conversely, these findings contrast with the conclusions of Rob and Bett (2014), who argued that ODeL models offer savings in both time and money since students are not required to commute between their homes and the university.

Students' Views on Videoconferencing

Students highlighted that both time and financial considerations are crucial factors when participating in ViCon sessions, noting that these sessions offer savings in terms of both time and travel expenses. Some students pointed out that ViCon sessions minimise the time and money spent on commuting to Unisa centers for in-person meetings, as they can simply connect to the internet from anywhere. Yet, some students faced financial challenges, lacking the resources to either travel to these centres for ViCon sessions or afford the necessary internet access. Moreover, the students observed that ViCon has the potential to connect individuals across different locations, whether they are in urban or rural and remote areas, effectively reducing the transactional distance between lecturers and students and making education more accessible. Table 5 presents some of the students' comments regarding ViCon.

Participants recognised that interactions facilitated by ViCon effectively bridge the gap between lecturers and students, making it easier to clarify course materials. The use of ViCon was seen to narrow both communication and psychological distances. This supports Klenke's (2014) observation that ViCon fosters beneficial social interactions and collaborative learning opportunities. The study also revealed that ViCon allows students to engage more deeply with their coursework. Several benefits of utilising ViCon for learning mathematics were identified by the students, including increased opportunities for discussions between lecturers and students or among the students themselves, elimination of travel time, and reduction in travel expenses. However, while this proved beneficial for students who could afford internet access for ViCon participation, it posed a challenge for those lacking financial resources.

Participants indicated that ViCon sessions could enhance their comprehension of the learning material, suggesting that such sessions support the coursework's structure, making it more accessible and understandable. According to Moore (1993), less structured course material correlates with reduced transactional distance. This research demonstrates that ViCon sessions contribute to making the course structure more adaptable, aiding students in developing their understanding. Despite recognising the advantages of participating in ViCon sessions, these students often missed the sessions organised by their lecturer, with some preferring to view the sessions on YouTube and subsequently discuss them in group chats.

The study also pointed out that challenges like low participation rates during ViCon sessions were prevalent. Economic constraints were a significant barrier, especially for unemployed students who couldn't afford to access ViCon sessions. Additionally, the lack of face-to-face interactions led some students to rely on YouTube videos followed by discussions in WhatsApp groups for their learning. This finding aligns with Matlakala et al. (2013), who noted that one of the disadvantages of ViCon sessions is the associated costs, as students may need to incur expenses traveling to and from their homes to participate effectively.

Some students found that ViCon sessions did not meet their needs, as they preferred other online learning platforms for accessing and comprehending the course materials. For instance, platforms like Moodle, Blackboard, and Google Classroom, which facilitate the distribution of course materials, assignments, and assessments, allowing students to participate in self-paced learning, served as alternatives to videoconferencing. These platforms are commonly referred to as Learning Management Systems (cf. Akhmedova & Rahmatova, 2024). These alternatives also facilitated interpersonal connections among the students. They suggested that methods other than lecturer-led ViCon

interactions could help minimise the transactional distance, proposing that the lecturer should promote group discussions and the use of WhatsApp groups to prevent feelings of isolation within the course. These suggestions stem from the students' keen interest in actively solving mathematical problems, indicating a preference for deep engagement with the lessons beyond mere content explanation. This approach underscores a desire for conceptual understanding rather than just the passive reception of information. The findings suggest that even with a focus on learning outcomes and content by the lecturer, attendance might not improve unless the sessions cater to active problem-solving. This study highlights the potential for stakeholders, including lecturers, to reconsider or adapt the ViCon programme to better address student needs in a multi-modal teaching and learning environment.

Discussion and Recommendations

The research found that ViCon sessions not only enhance learning but also foster a sense of unity, facilitating communication between the lecturer and students about the course material, thereby diminishing transactional distance i.e., the four ViCon sessions effectively narrowed the communication gap between the lecturer and the students. Additionally, as in Dung (2020), ViCon sessions are likely to bolster interactions among the lecturer and students, between students and the content, and among the students themselves. Essentially, this implies that the discussions aimed at enriching the module's content are likely to be more frequent (Cavus & Sekyere-Asiedu, 2021). Kang and Gyorke (2008) have emphasised that the nature of communication between students and their lecturers impacts the dialogue. This aligns with the views of Aslam (2017) and Talman (1999), who argue that human developmental learning deeply involves interactions within one's socio-cultural environment, facilitated by various signs and tools.

In the framework of TDT, the discussion of ViCon alongside newer platforms such as Moodle, Canvas, Google Classroom (LMS), and Virtual/Augmented Reality tools like Google Expeditions, zSpace, and AltspaceVR underscores key elements of structure, dialogue, and learner autonomy. ViCon, being synchronous, reduces transactional distance by facilitating real-time interaction and immediate feedback, thereby enhancing the relationship between instructor and learner. Conversely, Learning Management Systems such as Moodle and Canvas introduce more structured, asynchronous learning, which can increase transactional distance unless complemented by interactive tools. Although ViCon is based on older and less accessible technology, modern platforms provide more flexible frameworks that shape dialogue and learner autonomy, influencing transactional distance in various ways.

TDT offers insight into participants' behaviour concerning their engagement with Videoconferencing (ViCon) sessions. While some students acknowledged the value of ViCon, their decision to opt out of these sessions aligns with Mokoena's (2011) observation that learners often seek flexibility by exploring alternative ways of studying course materials. This suggests a preference for greater learner autonomy, as the structured nature of ViCon sessions may not fully meet their needs, thereby increasing the transactional distance. The students' creation of online discussion and WhatsApp groups for peer-supported learning reflects their desire for social interaction and dialogue, which ViCon may not always adequately provide. Tolman (1999) underscores the significance of considering cultural-historical psychological development and the inherently social nature of students in the educational process. Ignoring these social aspects could result in students bypassing structured learning environments like ViCon in favour of more informal, collaborative spaces, thus impacting the balance between structure, dialogue, and autonomy. The use of ICT tools like WhatsApp highlights students' need for more socially integrated and flexible learning environments, where they can engage beyond the traditional teacher-learner model, further shaping the transactional distance.

In addition to its stated objectives, the research findings revealed that some students resorted to alternative technological resources, such as YouTube videos, and participated in group discussions via WhatsApp, which have

increasingly become preferred methods for enhancing the learning experience. According to Nehls et al. (2015), computer-based technologies are widely recognised for their ability to overcome barriers to direct communication. This suggests that for some students, the necessity for ViCon sessions to diminish the transactional distance is mitigated by their proactive measures and interventions.

Challenges related to time and socio-economic status are intimately connected to TDT, as they significantly affect students' engagement and autonomy. Employed students, for example, faced difficulties attending videoconferencing (ViCon) sessions scheduled during working hours, which led to an increased transactional distance due to restricted access to structured learning opportunities. Financial limitations were also identified as major obstacles, with some students unable to participate in ViCon sessions because of the costs associated with internet data or the inability to afford smartphones. This corresponds with Rob and Bett's (2014) findings that time and financial constraints impede the effective use of ViCon in education. Additionally, socio-economic factors contributed to widening the transactional distance, as students from disadvantaged backgrounds—such as those who were unemployed—struggled to access the necessary technology or afford travel to Unisa centres for ViCon sessions. These issues exacerbated the psychological and communication gaps between students and lecturers. To address this, the study recommends providing recorded ViCon sessions, enabling students to engage with the material offline and thus overcoming the barriers imposed by financial constraints and reducing transactional distance.

Conclusion

Guided by the TDT, which emphasises the dynamic interaction between students and their environment in the learning process, this study explored the experiences of pre-service educators engaging with ViCon for the MAE103L module at Unisa. It revealed both the promising opportunities and significant challenges presented by this educational approach. Participants valued the flexibility of ODeL and the ability to study from various locations. However, the implementation of ViCon sessions exposed notable difficulties such as conflicts with work schedules and feelings of isolation among students. Despite these challenges, students demonstrated resilience by developing innovative learning strategies, indicating that the obstacles posed by ViCon could inspire creative adjustments and solutions. The study highlighted the importance of incorporating a variety of digital tools, like Microsoft Teams and Zoom, to enhance ODeL environments, suggesting that a wider range of technological options could make remote learning more accessible while reducing costs and logistical challenges.

Furthermore, while not an explicit objective of the study, the research highlighted socio-economic and logistical barriers that hindered some students from participating in ViCon sessions. These barriers included the need for travel and accommodation, financial burdens, and limited internet access. While ViCon holds promise for narrowing the educational divide, ensuring broad accessibility remains a challenge. Nonetheless, the willingness of students to seek out alternative collaborative platforms and their preference for an interactive, hands-on learning experience signal a path forward. This preference underlines a broader desire for learning experiences that are not only more engaging and interactive but also practical, indicating an evolving need for ODeL to shift towards more inclusive and engaging educational settings.

Informed by these findings and the principles of the TDT, this study recommended that educational institutions, especially Unisa, broaden their toolkit of online resources to cater to the varied needs and circumstances of their students, thereby enhancing the inclusivity and effectiveness of ODeL. Promoting the creation of virtual study groups and offering asynchronous materials, such as recorded ViCon sessions, could alleviate the impact of time and financial constraints faced by students. Moreover, focusing on collaborative problem-solving and active engagement over mere content delivery could align more closely with students' educational preferences. By implementing these strategies, lecturers, mathematics educators, and institutions can narrow the transactional distance, enriching

the educational experience and ensuring that the benefits of ODeL are accessible to all students, regardless of their economic status and/or geographical location.

Conflict of interest

The authors declare that they have no conflicts of interest related to this research or its publication, nor do they have any financial, personal, or professional interests that might affect the results or interpretations of the study.

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References

Ahmed, S. K. (2024). The pillars of trustworthiness in qualitative research. Journal of Medicine, Surgery, and Public Health, 2, 100051.

Akhmedova, Z., & Rahmatova, N. (2024). LMS (Learning Management System) Learning Management System Features. Science and innovation in the education system, 3(1), 85-94.

Alase, A., 2017. The interpretative phenomenological analysis (IPA): A guide to a good qualitative research approach. *International Journal of Education and Literacy studies*, 5(2), 9-19.

Alqahtam, A. Y.,&Rajkhan, A. A. (2020).E-learning critical success factors during the covid-19 pandemic: A comprehensive analysis of e-learning managerial perspectives. *Education Sciences*, 10(9), 1 – 16.doi.org/10.3390/educsci10090216

Al-Samarraie, H. (2019). A Scoping review of videoconferencing systems in higher education: Learning paradigms, opportunities, and challenges. *International Review of Research in Open and Distributed Learning*, 20(3). https://doi.org/10.19173/irrodl.v20i4.4037

Andrade, C. (2021). The inconvenient truth about convenience and purposive samples. *Indian Journal of Psychological Medicine*, 43(1), 86-88.

Archibald M., Ambagtsheer R., Casey, M. G., & Lawless, M. (2019). Using Zoom Videoconferencing for Qualitative Data Collection: Perceptions and Experiences of Researchers and Participants. *International Journal of Qualitative Methods*, 18, 1–8.

Borko, H., Jacobs, J., Eiteljorg, E.,& Pittman, M.E. (2008). Video as a tool for fostering productive discussions in mathematics professional development. *Teaching and Teacher Education*, 24(2),417-436.

Candarli, D., & Yuksel, H. G. (2012). Students' perceptions of video-conferencing in the classrooms in higher education. *Procedia - Social and Behavioral Sciences, 47*, 357–361. https://doi.org/10.1016/j.sbspro.2012.06.663

Cartis, A. (2022). Zoom fatigue" in higher education: videoconferencing impact on students' fatigue. EDU WORLD 2022 Edu World International Conference Education Facing Contemporary World Issues*European Proceedings of Educational Sciences,* 1356 – 1364. DOI: 10.15405/epes.23045.138

Cavus, N., & Sekyere-Asiedu, D. (2021). A comparison of online video conference platforms: Their contributions to education during COVID-19 pandemic. *World Journal on Educational Technology: Current Issues*, 13(4), 1162-1173.

Correia, A. P., Liu, C., & Xu, F. (2020). Evaluating videoconferencing systems for the quality

of the educational experience. *Distance Education*, 41(4), 429-452. https://doi.org/10.1080/01587919.2020.1821607.

Crewell, J. W. & Creswell, D. (2018), *Research Design: Qualitative, Quantitative and mixed Approaches*. Los Angeles: Sage.

Dulebohn J. J., Hoch J. E. (2018). Virtual teams in organizations. *Human Resource Management Review*, 27(4), 569–574. https://doi.org/10.1016/j.hrmr.2016.12.004

Dung, D. T. H. (2020). The Advantages and Disadvantages of Virtual Learning. *IOSR-Journal of Research and Method in Education*, 10, 45-48. https://doi.org/10.9790/7388-1003054548

Ertl, B., Fischer, F. & Mandl, H., 2006. Conceptual and socio-cognitive support for collaborative learning in videoconferencing environments. *Computers & Education*, 47(3), 298-315.https://doi.org/10.1016/j.compedu.2004.11.001.

Ertl, B., Reiserer, M. & Mandl, H., 2005. Fostering collaborative learning in videoconferencing: The influence of content schemes and collaboration scripts on collaboration outcomes and individual learning outcomes. *Education, Communication & Information*, 5(2), 147-166.

Fatani, T. H. (2020). Student satisfaction with videoconferencing teaching quality during the COVID-19 pandemic. *BMC Medical Education, 20*(1), 396. https://doi.org/10.1186/s12909-020-02310-2

Fushikida, W., Oura, H., Yamamoto, R. & Yamauchi, Y. (2018). Role of video lectures in a flipped classroom: How is knowledge applied in collaborative learning? *EdMedia + Innovative Learning.* Amsterdam, Netherlands, June 25-29, 2018, 985-997.

Giesbers, B., Rienties, B., Gijselaers, W.H., Segers, M.&Tempelaar, D.T. (2009). Social presence, web videoconferencing and learning in virtual teams. *Industry and Higher Education*, 23(4), 301-309.

Giesbers, B., Rienties, B., Tempelaar, D., &Gijselaers, W. (2014). Investigating the relations between motivation, tool use, participation, and performance in an e-learning course using web-videoconferencing. *Computers in Human Behavior, 29*(1), 285–292. https://doi.org/10.1016/j.chb.2012.09.005

Gillies, D. (2008). Student Perspectives on Videoconferencing in Teacher Education at a Distance. *Distance Education*, 29 (1), 107 – 118.

Giossos, I.; Koutsouba, M.; Lionarakis, A. and Skavantzos, K. (2009). Reconsidering Moore's transactional distance Theory. *In European Journal of Open Distance and ELearning*, 2009(2), (pp. 1-6).

Gladović, P., Deretić, N.,& Drašković, D. (2020). Video Conferencing and its Application in Education. *Journal of Traffic and Transport Theory and Practice*, 5(1), 45-48. DOI: 10.7251/JTTTP2001045G

Goos, M. & Kaya, S. (2020). Understanding and promoting students' mathematical thinking: a review of research published in ESM. *Educational Studies in Mathematics*, 103(1), 7-25.

Gu, J. (2021). Family Conditions and the Accessibility of Online Education: The Digital Divide and Mediating Factors. Sustainability, 13 (15), 8590. https://doi.org/10.3390/su13158590.

Hacker J., vom Brocke J., Handali J., Otto M., &Schneider J. (2020). Virtually in this together: How web-conferencing systems enabled a new virtual togetherness during the COVID-19 crisis. *European Journal of Information Systems*, 29(5), 563–584. https://doi.10.1080/0960085X.2020.1814680

Hodges, C., Moore, S., Lockee, B., Trust, T.,& Bond, M. A. (2020). The difference between emergency remote teaching and online learning. *Educause Review*. https://er.educause.edu/ articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning

Jameel, H.T., Ali, H.H. & Phil, M., 2016. Causes of poor performance in mathematics from teachers, parents and student's perspective. *American Scientific Research Journal for Engineering, Technology, and Sciences*, 15(1), 122-136.

Joseph, R., Plonczak, I., &Stemn, B. (2008). Providing Field Experiences through Videoconferencing for PreserviceTeachers: Linking Mathematics, Science and Technology in Education Methods Courses. Paper presented at AERAconference. New York *(19) (PDF) Videoconferencing in Math and Science Preservice Elementary Teachers' Field Placements*. Available from: https://www.researchgate.net/publication/226454756_Videoconferencing_in_Math_and_Science_Preservice_Elementary_Teachers'_Field_Placements [accessed Mar 18 2024].

Kang, H.,& Gyorke, A.S., (2008). Rethinking distance learning activities: A comparison of transactional distance theory and activity theory. *Open Learning: The Journal of Open, Distance and e-Learning*, 23(3), 203-214.

Kelly, G.E. (2012). Lecture attendance rates at university and related factors. *Journal of Further and Higher Education*, 36(1), 17-40.

Kgarose, M.F., Makhubela, D.K.&Setaise, L.C. (2023). Is load shedding another pandemic, post COVID-19 at institution of higher learning in South Africa?. *Perspectives of Law and Public Administration*, 12(3), 447-456.

Klenke, H. A. (2014). The effects of interactive videoconferencing on elementary literacy: collaborative learning environment. *Graduate Research Papers,* 192, 1-30.

Krutka, D. G., & Carano, K. T. (2016). Videoconferencing for global citizenship education: Wise practices for social studies educators. *Journal of Social Studies Education Research*, 7(2), 109 - 136.

Letsoalo, M.E. (2021). Mentees' perspective of effectiveness of mentoring programme on students adjustment to university life: a pilot study at the University of Limpopo, South Africa. *African Journal of Development Studies*, 2021(si1), 163-182.

Letsoalo, M. E., & Makgakga, T. P. (2022). The effect of discussion classes on students' overall performance at an institute for open and distance learning in South Africa: Analysis using mixed-effects models. *African Perspectives of Research in Teaching & Learning*, 6(2), 14-28.

Letsoalo, M. E., & Rankhumise, E. M. (2024). Critical factors impeding the performances of small and medium-sized enterprises in South Africa: Owner-managers perspectives. *African Journal of Innovation and Entrepreneurship*, 3(2), 53-70.

Livy, S., Muir, T., Murphy, C. & Trimble, A. (2022). Creative approaches to teaching mathematics education with online tools during COVID-19.*International Journal of Mathematical Education in Science and Technology*, 53 (3), 573-581, DOI: 10.1080/0020739X.2021.1988742

Malik, A.A., Memon, P.A., Ali, H., Mallah, M.A., Bux, K.,& Haq, M.U. (2022). Impacts of Coping Strategies for Electricity Load Shedding among University Students. Pakistan Journal of Medical & Health Sciences, 16(05), 1165-1165.

Matlakala, M. C., Nkosi, Z. Z., Modiba, L. M., Dolamo, B. L. & Maboe, K. A. (2013). Video conference teaching at an Open Distance Learning (ODL) university in South Africa, Analysis of benefits and drawbacks. *African Journal for Physical, Health Education, Recreation and Dance (AJPHERD),* 1, 22-31.

McMillan, J. H., & Schumacher, S. (2014). *Research in Education: Evidence-based inquiry* (7th ed.). Pearson.

Milman, N. B. (2020). This is emergency remote teaching, not just online teaching. Education Week. https://www.edweek.org/ew/articles/2020/03/30/this-is-emergency-remoteteaching-not-just.htm

Mokoena, S. (2011). Students' perceptions of videoconferencing in teacher education at a distance. *Progressio,* 33(2), 136-150.

Moore, M. G. (1973). Towards a theory of independent learning and teaching. *Journal of Higher Education, 44*, 661–679. https://doi.org/10.1080/00221546.1973.11776906

Moore, M.G. (1983). *The individual adult learner*. In M. Tight (Ed.), *Education for Adults* (pp. 153–168). London, Croom Helm.

Moore, M. G., & Kearsley, G. (2005). *Distance education: A systems view*. Belmont, CA: Thomson Wadsworth.

Mucktar, K., Javed, K., Arooj, M., & Sethi, A. (2020). Advantages, Limitations and Recommendations for online learning during COVID-19 pandemic era. *Pakistan Journal of Medical Sciences*, 36, 27 – 31.doi: 10.12669/pjms.36.COVID19-S4.2785

Nehls, K., Smith, B. D., & Schneider, H. A. (2015). *Video-conferencing interviews in qualitative research*. In *Enhancing qualitative and mixed methods research with technology* (140-157). Igi Global.

Nguyen, T. K., & Nguyen, T. H. T. (2021). The acceptance and use of video conferencing for teaching in Covid-19 pandemic: An empirical study in Vietnam. *AsiaCALL Online Journal, 12*(5), 1–16.

Nsamba, A. (2019). Maturity levels of student support e-services within an open distance e-learning University. The International Review of Research in Open and Distributed Learning. https://doi.org/10.19173/irrodl.v20i4.4113.

Ntuli, C. H. S., & Gumbo, M. T. (2019). Tutors' views on the integrated tutor model in open distance learning. *Perspectives in Education*, 37(2), 53–66.Perraton, H. (1988). A theory for distance education. In D. Stewart, D. Keegan, & B. Holmberg (Ed.), Distance education: International perspectives (34-45). New York: Routledge.

Peters P. (2020. April 28). Google's Meet teleconferencing service now adding about 3 million users per day. *The Verge*. https://www.theverge.com/2020/4/28/21240434/google-meet-three-million-users-per-day-pichai-earnings

Pedroso, J. E. P., Oducado, R. M. F., Ocampo, A. R. S., Tan, V. S., & Tamdang, K. A. (2023). Factors influencing intention to use videoconferencing tools in online distance education among students in Philippine maritime schools. *Australian Journal of Maritime & Ocean Affairs*, 15(2), 142-153.

Reiserer, M., Ertl, B., & Mandl, H. (2002). Fostering collaborative knowledge construction in desktop video-conferencing: effects of content schemes and cooperation scripts in peer teaching settings. , 379-388. https://doi.org/10.5282/UBM/EPUB.251.

Rennar-Potacco, D., & Orellana, A. (2018). Academically Supporting STEM Students From a Distance Through Videoconferencing: Lessons Learned.

American Journal of Distance Education, 32, 131 - 149. https://doi.org/10.1080/08923647.2018.1446121.

Roberts, R. (2009). Video conferencing in distance learning: A New Zealand schools' perspective. *Journal of Open, Flexible, and Distance Learning*, 13(1), 91-107.

Rob, K. V.,& Bett, N. K. (2014). Video-conferencing and its application in distance learning. Conference paper-June 2012.

Rone, N. A., Guao, N. A. A., Jariol, M. S., Acedillo. N. B., Balinton, K. R., Francisco, J. O. (2023). Students' lack of interest, motivation in learning, and classroom participation: How to motivate them? *Psychology and Education: A Multidiciplinary Journal*, 7, 636 – 645.

Santibañez, L.,& Guarino, C. M. (2021). The Effects of Absenteeism on Academic and Social-Emotional Outcomes: Lessons for COVID-19. *Educational Researcher*, 50 (6), 392 – 400.

Sondak, N. E.,&Sondak, E. M. (1995). Videoconferencing: The next wave for international business communication.*In Proceedings of the Annual Conference on Languages and Communication for the World Business and the Professions* (1-10).https://www.learntechlib.org/p/80886/

Standaert W., Muylle S., &Basu A. (2021). How shall we meet? Understanding the importance of meeting mode capabilities for different meeting objectives. *Information & Management*, 58(1), 103393. https://doi.org/10.1016/j.im.2020.103393

Thorp-Lancaster, D. (2020). Microsoft Teams hits 75 million daily active users, up from 44 million in March. *Windows Central*. https://www.windowscentral.com/microsoft-teams-hits-75-million-daily-active-users

Tomadaki, E., Quick, K., & Scott, P. (2008). Videoconferencing in Open Learning. *Journal of Interactive Media in Education*, 2008, pp. 8. https://doi.org/10.5334/2008-8.

Tracy, S. J. (2024). Qualitative research methods: Collecting evidence, crafting analysis, communicating impact. John Wiley & Sons.

Unisa. (2008). *Open distance learning policy*. Pretoria, South Africa: University of South Africa Press.Retrieved from http://www.unisa.ac.za/cm/contents/departments/tuition_policies/docs/OpenDistanceLearning_Council3Oct08.pdf

Waizenegger L., McKenna B., Cai W., &Bendz T. (2020). An affordance perspective of team collaboration and enforced working from home during COVID-19. *European Journal of Information Systems*, 29(4), 429–442. https://doi.org/10.1080/0960085X.2020.1800417

Van Zyl, J.M., Spamer, E.J.,& Els, C.J., 2012. Effect of contact class attendance on the academic success of open distance learning students in advanced certificate in education programs. *Contemporary Educational Technology*, 3(3), 166-183.

Verma, N., Getenet, S., Dann, C., & Shaik, T. (2023). Characteristics of engaging teaching videos in higher education: a systematic literature review of teachers' behaviours and movements in video conferencing. Research and Practice in Technology Enhanced Learning, 18.

Vygotsky, L.S. (1978). *Mind and society: The Development of Higher Mental Processes*. Cambridge, MA: Harvard University Press.

Winzenburg, S. (2011). How skype is changing the interview process. *The Chronicle of Higher Education.* Retrieved April 15, 2012, from http://chronicle.com/article/How-Skype-Is-Changing-the/126523/

Wu, Y., Sun, Y., & Bellisario, D. (2022). What do you get from turning on your video? Effects of videoconferencing affordances on remote class experience during COVID-19. *Proceedings of the ACM on Human-Computer Interaction*, 6, 1 - 21. https://doi.org/10.1145/3555773.

Yang, H. H., Zhu, S., & MacLeod, J. (2018). Promoting education equity in rural and underdeveloped areas: Cases on computer-supported collaborative teaching in China. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(6), 2393-2405. https://doi.org/10.29333/ejmste/89841

Zuhairi, A., Karthikeyan, N., & Priyadarshana, S. T. (2020). Supporting students to succeed in open and distance learning in the Open University of Sri Lanka and Universitas Terbuka Indonesia. *Asian Association of Open Universities Journal*, 15(1), 13 – 35.