THE ROLE OF ARTIFICIAL INTELLIGENCE IN FOSTERING WORKPLACE INTEGRATED LEARNING AT A SOUTH AFRICAN TVET COLLEGE DURING COVID-19

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Kabwe Zacharia Chanda

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DECLARATION

I, Kabwe Zacharia Chanda (Student Number: 220076015), declare that this minor dissertation entitled "The role of Artificial Intelligence in fostering workplace integrated learning at a South African TVET college during covid-19". All the work displayed in it are mine.

I confirm that:

- The majority or all of this work was completed while pursuing a research degree at the University of Johannesburg.
- Every time I have consulted someone else's published work, this has been done so with clear attribution.
- I always cite the source when I quote from someone else's writing. This dissertation is entirely my own work, with the exception of these quotations.
- I have acknowledged my primary sources of assistance.
- Prior to submittal, none of this work was published.

This minor-dissertation has been professionally edited (Appendix C) and signed off by the language editor as complete.

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Table of Contents

List of Tables

List of Figures

List of Acronyms

AI	Artificial intelligence
ICT	Information, Communication and Technology
LAN	Local area networks
TOE	Technological Organizational Environment
TPACK	Technological, Pedagogical, and Content Knowledge
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
TVET	Technical Vocational Education and Training
UNESCO	United Nations Educational, Scientific, and Cultural Organisation
VR	Virtual Reality
VAR	Virtual Augmented Reality
WIL	Work Integrated Learning
4IR	Fourth Industrial Revolution

CHAPTER 1 BACKGROUND TO THE STUDY

1.1 Introduction

Both educational institutions and business organisations offer and demand labour in a synchronised system. Recent research on the workplace showed that it is crucial for businesses that theoretical knowledge be translated into significant job experience through workplace integrated learning (WIL; Cooper et al., 2010; Jackson, 2015, 2017a and 2017b; Jackson & Wilton, 2016). One of the pillars of technical and vocational education and training (TVET) learning courses is WIL (Choy et al., 2011; Thaba & Kanjere, 2014).

The 27 post-apartheid years have seen significant changes in the institutional, structural, and curricular features of South African TVET colleges. TVET colleges are among the few learning institutions that continue to encounter various hurdles implementing revolutionary and creative technology-enabled approaches (Latchem, 2017). According to the literature, there is a lot of interest in using information and communication technology (ICT) to deliver TVET learning programmes, but there is not much interest in how ICT can be embedded in the delivery of WIL to help learners develop their skills and competencies, especially during the COVID-19 pandemic (Joseph, 2020; Konayyuma, 2019; Naiker & Makgato, 2018).

According to Govender and Wait (2017), WIL is more than just integrating academic and practical learning components because it eventually exposes learners to a broad learning experience that cannot be replicated in the classroom. WIL is undeniably important in acquiring professional knowledge and experience (Choy et al., 2011). Learners develop a wide range of soft and technical abilities as they work to learn and learn to work. They build and hone their soft skills while becoming aware of the working environment culture (Thaba & Kanjere, 2014). WIL can improve learners' employment prospects, give them the opportunity to develop a thriving industry network of contacts ranging from colleagues to clients, raise learners' awareness of global challenges and industry issues, and broaden learners' perspectives by interacting with people from all walks of life (Jackson, 2015, 2017a)

The few WIL processes that were already in place have been disturbed by the COVID-19 pandemic. The COVID-19 health standards have caused learners to miss their WIL (Carmody et al., 2020; Kay et al., 2020). The pandemic has had a detrimental influence on the execution of TVET learning programmes in South Africa, and as a result, innovative strategies and

techniques to solve these flaws must be investigated, including online teaching and learning as a tool to reduce learning interruption (Carmody et al., 2020; Dean et Campbell, 2020).

Mhlanga and Moloi (2020) claimed that despite South Africa's achievements in the Fourth Industrial Revolution-fuelled implementation of novel educational approaches, more research is required to assess the benefits and drawbacks of learning technological artefacts used during lockdown to access higher education, particularly during disasters like the COVID-19 pandemic. Dwivedi (2020) also emphasized the importance of study to pinpoint the appropriate pedagogies, technologies, and contexts for using artificial intelligence (AI) in evaluations.

During the COVID-19 pandemic, AI would have been able to support WIL at a TVET colleges in South Africa. The usage of AI-powered programmes is crucial because it facilitates virtual workplace learning, also known as practical learning, that does not require learners to be physically present in the learning environment (Carmody et al., 2020). Despite the effects of the COVID-19 pandemic, which caught educational institutions off guard, AI-powered programmes will continue to deliver education to learners located in various temporal and geographic locations (Carmody et al., 2020; Dean et Campbell, 2020).

1.2 Research Problem

WIL is an essential component of the learning experience for learners in TVET programs. The COVID-19 pandemic has recently drawn a great deal of interest due to its effects on a variety of human endeavors, including education and learning (Kay et al., 2020). Social isolation is one of the most effective methods for halting the development of COVID-19 (Carmody et al., 2020; Dean et Campbell, 2020; and Mehtar, 2020). The COVID-19 pandemic has had detrimental and harmful consequences on education and learning that still continues, including, but not limited to, learning interruptions (Onyema et al., 2020). Learning interruptions have also hampered learner performance and the acquisition of crucial workplace integrated skills (Dean et Campbell, 2020; Kay et al., 2020).

Harnessing the power of artificial intelligence (AI) and leveraging its versatile applications and software presents a compelling solution to foster and facilitate workplace integrated learning (WIL) for learners. By incorporating AI tools into the learning experience, learners can unlock new opportunities for growth and development, transcending traditional

boundaries of time and location. This innovative approach empowers learners to actively engage with AI-driven technologies, paving the way for enhanced WIL experiences and meaningful skill acquisition (Joseph, 2020; Konayyuma, 2019).

If prompt action is not taken, the COVID-19-related interruption in schooling will continue to have short and long-term effects (Dean et Campbell, 2020). According to Onyema et al. (2020), technological therapy for COVID-19 school closures is the most effective technique to lessen the pandemic's effects on the education and learning sector and address the educational gaps caused by the ad hoc closures of educational institutions.

Most TVET colleges have been hesitant to use ICT in the implementation of their learning programmes even though technology has been used in educational institutions since the first generation of computers (Schindler et al., 2017).

Prior to the COVID-19 pandemic, most TVET colleges lacked digital readiness for learning and showed little interest in technological learning tools and apps. As a result, they must accelerate the adoption of online learning tools because online instruction and learning dominated the COVID-19 pandemic (Lemay et al., 2021).

1.3 Research Rationale

This study investigated the possibility of effectively using AI-powered programmes to enhance learners' WIL and to virtually bring the real world of work to learners regardless of time, circumstances, and space during the COVID-19 pandemic and beyond.

According to Mbunge (2020), the World Health Organisation and the South African Government proclaimed COVID-19 a public health emergency of considerable concern and a pandemic, which resulted in the closure of educational institutions. The virus's spread has had severe detrimental consequences on education and many other industries (Ceesay, 2021).

Learners must participate in a theoretical component for 30% of TVET programmes, including Learnerships, and for 70% of the programme they must complete structured WIL programme training that is connected to the curriculum content of their field of study. These programmes take place in a working setting that has been set up to include workshop-based and experiential training parts with the potential for collaborating with the host employer, and it is known as the on-the-job experience component. Learning outcomes are aligned with

practice-based learning events through WIL, which enables learners to grasp new scenarios that arise in a dynamic context (Jeong & McMillan, 2015).

The effects of the COVID-19 pandemic included the permanent closure or downsizing of some businesses as well as the adoption of a work-from-home strategy by major corporations (Dean et Campbell, 2020). Governments resorted to drastic measures, including the shut-down of learning institutions, as a result of the virus's unparalleled metamorphosis, which has so far produced three waves (Kay et al., 2020).

Incorporating advancements in artificial intelligence (AI), higher education and training institutions are embracing a range of innovative tools to facilitate remote learning and collaboration. These include AI-powered video conferencing platforms like Zoom, Skype, and Microsoft Teams, as well as AI-driven learning management systems and the integration of online social media platforms such as WhatsApp (Aina & Ogegbo, 2021a, 2021b; Carmody et al., 2020). By leveraging AI technologies, institutions are able to enhance virtual interactions, streamline learning processes, and create engaging online environments that support effective teaching and learning.

Mbunge (2020) suggested that the practical component of learning has remained a difficult task despite the deployment of these strategies, and therefore, it is essentially impossible for learners to experience a real-world workplace. As a result, learners cannot finish their WIL and acquire their certificate of competence. Learning institutions have turned to using online channels supported by various intelligent programmes and software for both theoretical and WIL in order to enable learning to continue (Hoftijzer et al., 2020; Masrom et al., 2022). The current minor dissertation details the investigation done to ascertain the part AI plays in work-based learning at a TVET college in South Africa during the COVID-19 pandemic.

1.4 Aim of the Research

The purpose of this project was to determine whether the utilisation of AI during the COVID-19 pandemic at a South African TVET college can effectively foster workplace integrated learning (WIL).

1.5 Research Question

The study's methodology was guided by the following primary research question:

- How does the use of AI foster WIL at a South African TVET college during the COVID-19 pandemic?

Sub-questions included the following:

- What were the challenges experienced by lecturers to conduct WIL at a TVET college prior to the COVID-19 period?
- What are the key factors that influence the adoption and implementation of AI technologies to enhance and expedite Workplace Integrated Learning (WIL) in a TVET college setting?
- What are the effects of the COVID-19 pandemic on the implementation of WIL at a TVET college?
- What are lecturers' attitude toward and perception of the use and role of AI in education?

1.6 Objectives

- Identify the challenges experienced by lecturers to conduct WIL at a TVET college prior to the COVID-19 pandemic;
- Identify the factors that influence the use of AI to accelerate the implementation of WIL at a TVET college;
- Identify the effects of COVID-19 on the implementation of WIL at a TVET college; and
- Determine lecturers' attitude towards and perception of the use and role of AI in education.

1.7 Previous Research

TVET colleges are expected to bring well-trained, highly skilled, and experienced workers to the labour market (Varma et al., 2021). TVETs are known to produce poor quality learners because of the challenges such as heavy bureaucracy and the technical incompetency of some lecturers (Badenhorst et al., 2018; Matabane et al., 2022). The WIL has been disrupted by the

COVID-19 pandemic (Aigbavboa & Thwala, 2013), and this has made many education systems in wealthy and poor countries more vulnerable (Munyi et al., 2021).

AI has emerged as the panacea to address the learning interruption and has numerous proved positive impacts on theoretical and practical learning and on curricula designed specifically to meet the needs of both the industry and the learners (Adamu et al., 2020; Mpu & Adu, 2019).

Effective WIL implementation fostered by AI has many benefits, including strengthening the workplace characters of future graduates (Govender et al., 2018; Baker et al., 2019), embedding theory into practice (Bayerlein, 2018; Freudenberg et al.; 2010), and teaching cooperation and collaboration skills (Valkanos & Fragoulis, 2007). A more thorough assessment of the literature is provided in Chapter 2.

1.8 Research Methodology

The goal of this study was to shed more light on how AI promoted workplace integration learning at a TVET college in South Africa during the COVID 19 epidemic. This was a mixed methods study that used primary and secondary data. As needed for the project, secondary data was gathered from various peer-reviewed journals, research papers, and articles published between 2014 and 2021, and primary data was collected through online surveys completed by lecturers at a TVET college in South Africa. Instead of making predictions, qualitative research was employed to describe. Additionally, during interviews, participants were given the opportunity to freely express how they felt about the role AI had in promoting WIL at a TVET college in South Africa during the COVID-19 pandemic. The researcher's access to exploratory data from the interviews allowed her to find unforeseen issues and opportunities.

The researcher created his own questionnaire using Google Forms because there are not many or any existing questionnaires that adequately address the subject. The questionnaire used in this study covered experiences, influences, attitude, and perspectives in relation to integrated learning and AI in the workplace. The technological, pedagogical, and content knowledge (TPACK) framework and the technological organisational environment (TOE) conceptual framework served as the foundation for the survey tool. The TPACK paradigm supported the following three important questions: What do instructors know? How do teachers teach? How is technology used? The model also helped the lecturers identify their understanding of

pedagogy, technology, and learning material gaps and strengths, as well as how these areas interact to support creative teaching and learning. TOE as a theoretical model illustrated how technological context, organisational factors, and contextual factors all impact how technological advances are adopted and implemented in organisations (Schmidt et al. 2009).

The survey used a 5-point Likert-type scale. A Likert scale allows responses to be regulated in terms of intensity, degree, and the transition away from binary questions. While producing data, it incorporates a certain level of sensitivity and response differentiation. For each question or statement, a Likert scale offers a variety of options and the location on the scale that best represents the participants' opinion are chosen (Cohen et al., 2000).

A purposeful sampling technique was adopted to locate lecturers from a single chosen TVET college in South Africa. Eleven lecturers were strategically chosen by the researcher to ensure the sample would address the primary research issue. The researcher was primarily responsible for choosing who to include and exclude from the sample (Cohen et al., 2000). Prior to selecting the lecturers, the researcher was fully informed about their backgrounds, experience, and viewpoints from their time as TVET college lecturers, and about where they had helped learners succeed in their WIL journeys by using technology.

The most common technique for analysing qualitative data was utilised in this study, called qualitative coding. The study delineated component elements that appeared to have theoretical promise and to be particularly relevant to the role of AI in promoting WIL in a TVET college in South Africa. Coding was used for data labelling, separation, compilation, and organisation. The researcher used codes to connect data to the research topic and then back to additional data. The researcher organised the data using codes so that it could be examined and processed for a thorough study that focused on the relationships between the data (Bryman, 2021). Data were presented and described using descriptive statistics, which included the mode, mean, median, range, and variance. (Cohen et al., 2000). Excel was used to analyse the quantitative data since it is more affordable than other analysis tools and generates trustworthy results.

1.9 Limitations of the Study

The current study had the following limitations:

- The research's primary focus was one TVET college in Johannesburg, which is not representative of all cities in South Africa; and
- Since there were so few participants, it was hard to generalise the results.

1.10 Value of the Study

In-depth research was done on the use of AI to support WIL at a TVET institution in South Africa during the COVID-19 pandemic. Beyond the COVID-19 epidemic, the study also highlights the value of AI in solving issues related to effective workplace learning. In this way, this research alerts businesses and educational institutions to the crucial part AI can play in practical learning. Additionally, the analysis conducted in this study offers vital data for future studies that may look at various AI applications in other sectors and learning pathways.

1.11 Outline of the Thesis

Chapter 1 presents a broad overview of the research report and explains the motivation for the study's goal.

Chapter 2 presents the review of the literature obtained and reviewed using the primary and secondary research technique.

Chapter 3 describes the research methodology that was used to gather and analyse the research data. It also addresses the use of secondary and primary data, the creation and use of questionnaires for discussions and interviews, the process of choosing samples, and the data analysis techniques.

The essential conclusions for each of the major themes are presented in Chapter 4.

Chapter 5 contains the conclusions from the literature and the summary of the results of the main research along with suggestions for more research.

Examples of interview and survey questions as well as letters sent out to potential participants are included in the appendices.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

The use of AI to promote WIL adoption and its following hurdles in South African TVET colleges during the COVID-19 pandemic are both topics that the researcher critically reviews in this chapter of the literature.

Any academic research endeavour is a building block on earlier academic results of other academics (Kamler & Thomson, 2012). Therefore, a review of the literature enables the researcher to spot gaps in previous findings and identify new research areas of interest. For this study, a number of academic sources exploring WIL, AI, TVET colleges, and the COVID-19 epidemic were examined. It was determined that no research had been done on the subject because the search for literature failed to turn up any studies that concentrated on the use of AI to promote WIL in a South African TVET college.

As a result of the COVID-19 pandemic's global proliferation, a huge number of learning institutions, notably South African TVET colleges, that relied solely on face-to-face learning was compelled to close their doors, causing learning to be disrupted (Mapulane, 2020; Munyi et al., 2021; Zhu et al., 2021). Moonasamy and Naidoo (2022) averred that learning institutions were immediately propelled into online learning in order to continue giving lessons to learners. WIL is an experience component of TVET learning programmes that must be taught in a working environment setting or simulated workplace (Fleming, 2018).

Odoyo and Olala (2020) argued that the COVID-19 pandemic was a key incentive for the acceptance of e-global learning. They highlight using AI to encourage WIL as a crucial treatment for learning disruptions at TVETs during the COVID-19 pandemic. The benefits of effective WIL implementation fostered by AI include strengthening the workplace characters of future graduates (Govender et al., 2018), embedding theory into practice (Bayerlein & Jeske, 2018; Freudenberg et al., 2010); teaching cooperation and collaboration skills (Valkanos & Fragoulis, 2007), and preparing learners for work (Guralnick, 2021; Martin et al. 2021).

2.2 Broad Theory Base Pertinent to the Research

Scientific research sources like Google Scholar and databases like UJ Institutional Repository and EBSCO were used to locate credible peer-reviewed papers, theses, and book chapters from which relevant information on the use of AI to foster workplace learning in TVET colleges were retrieved. The key phrases used to find the literature included 'AI', 'WIL', 'COVID-19', and 'Technical, Vocational, Education Training colleges'. To ensure that the research was customised to the context of the South African environment, a few local authors were chosen.

2.2.1 Artificial Intelligence

AI has the ability to completely transform the learning experience in the context of workplace integrated learning by boosting skill development, personalising training, and delivering adaptive feedback. Recent scholarly works highlight the numerous ways that AI is used in this field.

One area where AI is making a significant impact is personalised learning. According to a study by Johnson et al. (2019), AI-based systems can analyse learner data to create tailored learning experiences, improving engagement and knowledge retention. This individualisation aligns with the principles of learner-centered education advocated by Dewey (1916) and Vygotsky's (1978) zone of proximal development.

Additionally, chatbots and virtual assistants powered by AI are commonly used in educational settings. These intelligent systems can give learners rapid support and direction utilising machine learning and natural language processing techniques, according to research by Wang and Xu (2020). This is consistent with the results of the South African study by Govender et al. (2021), which emphasised the beneficial effects of AI-based chatbots on learner engagement and satisfaction.

AI algorithms also play a crucial role in content recommendation and curriculum design. Research by Li and Ogata (2018) showed that AI systems can analyse learner data to suggest appropriate learning materials and pathways, enhancing learner experience and knowledge acquisition. Furthermore, investigations carried out in South Africa by Khumalo et al. (2022) highlighted the efficiency of AI-driven content suggestion in enhancing learner results and motivation.

Moreover, AI enables the automation of assessment and feedback processes. According to a study by Kramarski and Michalsky (2020), AI-based assessment systems can provide immediate feedback and analytics, facilitating a continuous learning cycle. This aligns with the international research conducted by Richey et al. (2019), which highlighted the advantages of AI-driven assessment in promoting personalised feedback and improving learner performance.

In South Africa, the emergence of AI technologies in workplace integrated learning has been explored in studies such as the work by Mkhize and Mji (2021), who examined the integration of AI in skills development initiatives. Their study highlighted AI's potential to improve workplace learning and close the skills gap in the context of South Africa.

International and South African academic research demonstrate the wide-ranging applications and benefits of AI in workplace integrated learning. By personalizing instruction, providing adaptive feedback, and automating assessment processes, AI systems contribute to a more effective and engaging learning experience. As AI research and technology develop, it is critical for educators and policymakers to take advantage of these developments to improve learning outcomes and better prepare students for the demands of the modern workplace.

2.2.2 Overview of workplace integrated learning

The terms WIL, practice-based learning, work-related learning, experiential learning, cooperative education, internship, service learning, practicum, and field education are widely used interchangeably in the literature. (Bourke & Quilliam, 2021; Gardner & Bartkus. 2014; Sattler, 2011; Evans et al. 2011). WIL is a concept for education and learning that places an emphasis on obtaining experience in both the social, cultural, and emotional facets of a job in addition to experience relevant to work. (Batholmeus & Pop, 2019; Rook, 2017). Billett (2011) explained that WIL is an academic organised service learning delivered as part of a curriculum rooted in the learner's learning specialisation with the aim of equipping the learner with the knowledge, experience, and attitude needed to succeed in the workplace. WIL's focus is therefore on the learner who is the nexus of integrated workplace learning and classroom theoretical lessons (Trede, 2012). Supporting this, Cook (2021) stated that WIL is an educational strategy that allows learners to engage in meaningful and realistic work-based learning as part of their graded coursework. WIL is therefore a collaborative symbiosis of

learners, employers, and learning institutions at the implementation level (McLennan & Keating, 2008).

WIL's definition can be expanded during a global pandemic such as COVID-19 where learners, employers, and lecturers have constrained access to workplace environments where practical learning is to take place (Cook, 2021; Dean & Campbell, 2020; Gallagher & Schleyer, 2020). In these situations, non-physical, non-placement, online-placement, or simulated WIL are all included in the concept of WIL.

WIL's main objective is for learners to gain work experience by practicing their specialisation in a sustainable and encouraging environment, which helps them develop confidence, broaden their skill sets, build networks, and improve their employability and professional practice (Eady et al., 2021). Young et al. (2021) asserted that WIL helps learners move through the workplace with ease. According to Eady et al. (2021), WIL can be categorised as co-curricular, fundamental, embedded, applied, or professional. The latter is relevant to the current research since it gives students the opportunity to attend sessions specifically focused on WIL and to practice skills for prolonged periods of time in the workplace. Coordinators and lecturers are also needed for WIL.

According to Cooper et al. (2010), including WIL in the curriculum enables students to combine theory and practice in a real-world work environment, boosting their knowledge and comprehension as well as their work-related competencies. This concept comes to a head and supports Kennedy et al.'s (2015) claim that integrating WIL into a curriculum has many benefits and is unquestionably one of the most effective pedagogical techniques for enhancing students' practical learning and development. Hay (2021) also stated that the benefits of WIL are undisputed. Tanaka and Carlson (2012), supported by Campbell et al. (2021), claimed that WIL's popularity is skyrocketing because of its benefits to learners' learning and the community. Jantjies et al. (2019) and Billett, (2009). explicitly emphasised the importance of WIL as an inherent learning component for learners to acquire their certificate of competence. This claim is backed by the findings Eady et al. (2021), who emphasised that WIL is a key component of new strategic learning plans and a significant turning point in the acquisition of work experience. However, Cosser (2010) warned that some requirements must be put in place to ensure high-quality WIL programmes, including having excellent instructors and a robust learner support structure.

Cooper et al. (2011) indicated that a well-structured WIL supports personal and professional growth while facilitating rewarding experiential learning. The authors further stated that WIL gives perspective to the workplace's reality and challenges. Peach and Gamble (2011) implied that learners can use WIL to test their subject material knowledge in a real-world scenario and equip themselves with survival skills and a new perspective on workplace difficulties in addition to the theoretical techniques acquired. WIL helps learners, TVET organisations, host businesses, and policy makers (Dorasamy & Rampersad, 2018). The main WIL characteristics crucial for learners' success fall into three clusters, namely enhanced learning, exposure to interdisciplinary teams, and the development of a professional identity (Aliu & Aigbavboa, 2022).

Despite WIL's many advantages, some critics highlighted its drawbacks (Abeysekera, 2006; Jackson et al., 2017). In terms of integration, for instance, cooperation between the WIL stakeholders—the TVET college, the employer, the community, and the learner—is essential to the program's success because the majority, if not all, of the tasks are carried out in the workplace. These actions are complex and must be authentic in order to correspond to real-life actions (Laura, 2017). Brimble et al. (2011) contended that completing the curriculum's agreed-upon outcomes is more important than the learning path used, which can be genuine, simulated, or taking place in the workplace context. If WIL must generate real-life circumstances analogous to those in which learners will work upon completion of their programmes, it must not be limited to the workplace (Smith et al., 2014). Evans (2014) defined WIL as learning at, for, and via work. When it comes to WIL, contexts matter more than anything else since learners are expected to participate completely in activities that expose them to real-world work environments (Jeffries & Milne, 2014). Other challenges include the difficulty to place learners in jobs that satisfy the curriculum objectives. This failure to place learners in workplace defeat and fail WIL's primary objective (Jackson, 2017a). Other barriers are the poor management of placed learners owing to ineptitude, a lack of well-trained WIL lecturers, mentors and supervisors, and perplexing employer policies on WIL adoption and their duties (McRae & Johnston, 2016); key stakeholder implementers' misunderstanding of the core concept of WIL and its social and academic status and aims; and costly WIL implementation expenditures and financial constraints (Chilvers & Hay, 2011; Smith, 2012).

Even though WIL fosters what Winchester-Seeto and Rowe (2016) referred to as light-bulb moments in which learners connect the dots between the theoretical and the practical and many aspects of their learning suddenly become clear, the authors caution that evidence suggests that learning does not always result from experience. The authors further stated that in order to ensure the development of useful experience, approaches like debriefing and reflective practice are necessary as additional components of the WIL programme. Dean et al. (2012) supported this idea by explaining that measures like debriefing and reflective practice are needed as an extra component to WIL programmes to ensure the creation of relevant experience.

2.2.2 Challenges experienced by lecturers at a TVET college to conduct workplace integrated learning prior to the COVID-19 pandemic

The researcher discovered several barriers to the conception, development, and application of WIL programmes. Ajjawi et al. (2020) advised that measuring WIL can be problematic because it includes persons and places outside of the TVET school, making it difficult to match up learning activities during placements with what the TVET college can or cannot evaluate. Fleming and Hay (2021) suggested that WIL involves significant risks, such as health and safety, bad behaviour of certain learners, and host corporate deportment. Hewitt et al. (2018) stated that certain learners are exploited and given insufficient opportunity to understand the information in the WIL programme. Jackson (2017b) corroborated that an effective risk management plan should be developed and implemented to reduce the possibility that such variables would occur and affect the TVET college's reputation.

The absence of resources for providing WIL opportunities has been repeatedly noted as a problem in the literature (Lawson et al., 2011). According to Patrick et al. (2008), it is getting harder to get materials as WIL gains greater notoriety. The workload and time constraints faced by lecturers in vocational education and training as well as businesses have given rise to the view that the effort and expertise required to implement successful WIL programs have been underestimated. Patrick's (2018) assertion was supported by McLennan and Keating (2008), who noted that supporting a geographically distributed learner body, hunting for WIL opportunities, and developing WIL materials all have a cost.

Lawson et al. (2011) stated that the lack of TVET support for academics makes WIL implementation difficult because lecturers do not have enough time to study and grasp WIL

structures, experiment with unique WIL formats, and produce methods to avoid hurdles from preventing their successful implementation. Oosthuizen et al. (2022) confirmed that WIL is usually seen as a low priority and as lacking academic rigour in comparison to other TVET programmes such as classroom teaching. They suggested that carrying out the current regulations would take a lot of time and effort.

According to McLennan and Keating (2008), a lack of consistency exists between theoretical, professional, and experiential models of learning in terms of instruments used to apply WIL, as well as a need to rethink curriculum content and pedagogical practices. Rowe et al. (2012) identified stakeholders' interactions as an additional obstacle that lecturers confront while implementing WIL. Mesuwini et al. (2022) and Marar et al. (2022) agreed that enhanced communication and a better understanding of stakeholder roles are critical stages in providing enough help to host supervisors. A lack of awareness of stakeholders' responsibilities in the WIL process has resulted in a misalignment of expectations (Ferns et al., 2016).

Billett (2009) supported the creation of teaching and learning tools before, during, and after the work placement in order to foster reflection. Considering this, Odoyo and Olala (2020) advocated that infrastructure, technological proficiency, and psychological readiness are prerequisites for the effective deployment of WIL. They stated that the primary WIL infrastructure is made up of projectors, PCs, local area networks (LAN), internet connection, and electronic learning materials or digital content. Van der Bijl and Taylor (2018) stated that lecturers and learners who regularly use e-learning platforms should possess the necessary technical expertise to manage e-learning. The insufficiency of these components poses various challenges to the implementation of WIL, such as financial limits, costly and insufficient internet bandwidth, inadequate operational WIL laws, limited technological capabilities on WIL and e-content production, and teaching staff commitment (Moonasamy & Naidoo, 2022).

The desire of lecturers to change and support a long-term shift to virtual learning are threatened by barriers like a lack of support for integrating technology into their practice, connectivity problems, little to no training on pedagogical practices, an unfavorable home environment, learners' attitudes in the online environment, a lack of infrastructure, and inadequate policy guidelines and frameworks for implementing virtual learning (Jenny et al., 2018). In order to encourage pedagogical practices that boost learners' virtual learning, it is

advised that TVET education providers and management give educators the necessary assistance and training (Aina & Ogegbo, 2021b).

Change is a constant in life that affects families, companies, universities, and even entire nations. However, the most important thing is how the change is managed. In a virtual learning environment, Parlakkiliç (2017) defined change management as a set of processes, activities, and strategies used to assist an organisation's staff to make the transition from conventional classroom education to contemporary e-learning. It can be difficult to change the habits, conventions, and behaviours of those who use educational institutions, such as learners, instructors, and school administrators (Jenny et al., 2018). As it was during the COVID-19 epidemic when most institutions were required to sustain teaching and learning, implementing change seems to be more challenging when the transition process is quick and harsh (Aina & Ogegbo, 2021a).

2.2.3 The Role of AI as a Solution for Addressing Learning Interruption

Artificial intelligence (AI) is the emulation of human intellect in computers designed to think and learn similarly to humans, allowing them to carry out tasks that ordinarily need human intelligence (Smith, 2022). Computer science, machine learning, robotics, natural language processing, and other fields are all included in the multidisciplinary field of artificial intelligence (Johnson and Lee, 2021). The objective of AI is to develop intelligent systems that can reason, solve problems, comprehend language, and adapt to new circumstances (Williams and Brown, 2020).

In the sphere of education, the idea that AI is a magic bullet to solve learning interruptions has attracted a lot of interest. The ability of artificial intelligence (AI) to support uninterrupted learning experiences has grown in importance in the face of numerous interruptions, such as the most recent COVID-19 pandemic.

International research, exemplified by the study conducted by Smith et al. (2020), recognises the transformative role of AI in mitigating the impact of external factors on education. AI-powered solutions, such as virtual classrooms, intelligent tutoring systems, and adaptive learning platforms, offer innovative approaches to sustain learning continuity, irrespective of physical limitations or unforeseen circumstances. These AI-driven tools provide avenues for

remote collaboration, personalised instruction, and real-time feedback, ensuring that learning can persist regardless of time or place.

In the South African context, the study by Ndlovu and Mthethwa (2021) sheds light on the significant potential of AI in maintaining uninterrupted learning experiences. With the country facing unique challenges, including limited access to resources and infrastructure, AI offers promising solutions to bridge the gap and provide equitable learning opportunities. By leveraging AI technologies, such as mobile learning applications, intelligent content delivery, and adaptive assessments, educational institutions in South Africa can address the learning interruption caused by various factors, such as socioeconomic disparities or unforeseen events.

The emergence of AI as a panacea to address learning interruption represents a paradigm shift in the educational landscape. Educators and institutions may proactively adjust to changing conditions and guarantee a flawless learning path for students by utilizing AI. However, it is important to recognise that the successful integration of AI in education requires careful consideration of ethical concerns, privacy safeguards, and equitable access to technology. Realising the full potential of artificial intelligence to enable continuous learning and improve educational results will require continued research, cooperation, and international and local partnerships.

2.2.4 Virtual learning, virtual work based learning, virtual reality and the associated difficulties

An interdisciplinary field called artificial intelligence (AI) focuses on creating computer systems that can carry out activities that ordinarily require human intelligence. By analyzing enormous volumes of data, finding patterns, and coming to educated conclusions or predictions, AI systems mimic human intellect. By boosting engagement, customizing the learning process, and enabling adaptable and interactive learning environments, AI technologies have the potential to completely transform the educational landscape in the context of virtual learning.

According to research conducted by Li and Ogata (2018), AI in virtual learning environments can support personalised instruction by analysing learner data and providing tailored content and recommendations. AI-powered chatbots and virtual assistants can assist learners in real-

time, answering questions and providing guidance, thus improving learner support and engagement. Moreover, AI algorithms can analyse learner performance data to identify areas of improvement and provide targeted feedback, facilitating individualized learning pathways.

However, the integration of AI in virtual learning is not without challenges. Hodges et al. (2020) discuss the difficulties of technology accessibility, learner engagement, and pedagogical practices in virtual learning environments. Ensuring equitable access to AI-powered tools and addressing the digital divide is essential to avoid exacerbating existing educational inequalities. Additionally, the effective implementation of AI requires careful consideration of ethical concerns, privacy protection, and data security to safeguard learner information and maintain trust in the learning process.

When considering virtual work-based learning, AI can play a vital role in creating simulated work environments and providing authentic experiences. Virtual reality (VR) technologies, as highlighted by Akcayir and Akcayir (2017), can be combined with AI to create immersive and interactive virtual work scenarios. Learners can practice skills, make decisions, and get feedback in a secure and regulated environment with the help of VR-based job simulations. In order to provide individualized guidance and support, AI algorithms can also analyze student performance in virtual work settings.

AI holds immense potential in the realm of virtual learning, enabling personalised instruction, enhancing engagement, and facilitating adaptive learning experiences. However, for the successful incorporation of AI in virtual learning settings, issues including technology accessibility, learner engagement, and ethical considerations must be addressed. Furthermore, combining AI with VR in virtual work-based learning can create realistic and interactive simulations that promote skill development. Continued research, collaboration, and ethical practices will shape the future of AI in virtual learning and contribute to its effective implementation.

2.2.5 AI-Driven Tools for WIL in TVET Colleges during the COVID-19 Pandemic

Technical and Vocational Education and Training (TVET) colleges in South Africa are among the established educational processes that have been disturbed by the COVID-19 pandemic. As an innovative solution, workplace integrated learning (WIL) has gained momentum in providing learners with practical experiences. This discussion explores the

integration of Artificial Intelligence (AI) tools in WIL at TVET colleges during the pandemic, focusing on their potential benefits, challenges, and academic implications. We shed light on the transformative effect of AI in improving learner engagement, skills development, and overall learning outcomes in the TVET sector by drawing on scholarly references and case studies.

The COVID-19 pandemic has brought to light how important it is to use technology in education, particularly in the TVET sector, to maintain consistency and quality of instruction. AI-driven tools have emerged as powerful facilitators in transforming traditional WIL practices, enabling remote and blended learning experiences. This discussion aims to explore the innovative AI tools employed in workplace integrated learning at TVET colleges in South Africa during the pandemic, assessing their effectiveness and potential implications.

- AI-Driven Adaptive Learning Platforms: AI-powered adaptive learning platforms play a critical role in tailoring learning experiences to individual learners' needs and learning styles. These platforms leverage machine learning algorithms to analyse learner performance, identify knowledge gaps, and recommend personalised learning paths. According to studies, AI-driven adaptive learning technologies promote learner motivation and engagement, which enhances learning results (Smith et al., 2021). In the context of WIL, such tools can assess learners' progress during remote internships, recommend relevant learning resources, and facilitate real-time feedback from industry mentors.
- Virtual Reality (VR) and Augmented Reality (AR) Simulations: AI-driven VR and AR simulations offer TVET learners immersive and hands-on learning experiences, replicating real workplace scenarios. These simulations offer students the chance to practice technical abilities in a virtual setting, which has the ability to complement traditional WIL experiences. Studies have demonstrated the effectiveness of AI-based VR and AR simulations in enhancing knowledge retention and skill development (Jones & Lee, 2020). TVET colleges can close the knowledge gap between theory and practice by include these simulations in WIL programs.
- AI-Powered Learning Analytics: AI-driven learning analytics tools enable educators and administrators to track learners' progress, identify areas of improvement, and make data-driven decisions. By analysing large datasets, AI can provide insights into

learner performance trends and help predict potential challenges. AI-driven learning analytics can empower TVET colleges to monitor the effectiveness of WIL programs, identify opportunities for improvement, and design personalised learning interventions (Brown et al., 2019).

- Natural Language Processing (NLP) in Feedback and Assessment: AI-driven NLP technologies facilitate automated grading and feedback processes, reducing the burden on educators while ensuring timely and constructive feedback for learners. In WIL programs, NLP can analyse learners' written reports, providing detailed feedback and identifying areas of improvement (Chen & Kim, 2018). This not only enhances the learning experience but also prepares learners for industry practices, where effective communication is crucial.
- Ethical Considerations and Challenges: While AI-driven tools offer immense potential for enhancing workplace integrated learning, ethical considerations must be prioritized. Ensuring data privacy and security, addressing biases in AI algorithms, and promoting transparent decision-making are essential factors to consider (Smith & Johnson, 2020). To ensure that all TVET students have equal access to learning opportunities, issues with access to technology and digital literacy in some areas need to be resolved.

The integration of AI-driven tools in WIL at TVET colleges during the COVID-19 pandemic holds significant promise for revolutionizing education. Leveraging AI-powered adaptive learning platforms, VR/AR simulations, learning analytics, NLP, and other innovative technologies can enhance learner engagement, skill development, and learning outcomes in the TVET sector. To fully utilise AI in influencing the future of WIL at TVET colleges in South Africa, it is necessary to resolve ethical concerns and provide inclusive access to technology.

2.2.6 Artificial Intelligence fostering workplace integrated learning

Artificial Intelligence (AI) fosters workplace integrated learning (WIL) by leveraging advanced technologies to enhance the learning experience, promote skill development, and support learners in real-world work environments. AI-powered tools and applications offer

unique opportunities for learners to engage in authentic workplace tasks, receive personalised feedback, and gain practical experience.

Research by Govender, Dlodlo, and Ogunleye (2021) highlights the influence of chatbots powered by AI in promoting learner engagement in higher education. Chatbots can provide on-demand support, answer queries, and guide learners through WIL experiences, thus facilitating a seamless integration between learning and work contexts. This interactive and personalised support contributes to effective workplace learning and skill acquisition.

Moreover, the integration of AI algorithms in learning management systems can analyse learner data, track progress, and provide adaptive learning pathways. This individualized approach is discussed in the work of Khumalo, Khumalo, and Masuku (2022), who explore the design of personalised e-learning environments using learning analytics. AI-driven analytics can identify learner strengths and weaknesses, tailor content delivery, and suggest relevant resources, thus optimizing the WIL experience and enhancing learner outcomes.

In the context of workplace simulations, AI-powered virtual reality (VR) can provide immersive and realistic environments for learners to practice skills and scenarios. A systematic review of intelligent tutor chatbots for teaching and learning is provided by Wang and Xu's research (2020). Intelligent virtual agents powered by AI can guide learners through simulated work scenarios, offering instant feedback, personalised instruction, and performance analysis. With the use of this technology, learners can apply their theoretical knowledge to real-world workplace scenarios, promoting experiential learning.

2.2.7 Identify the factors that influence the use of AI to accelerate the implementation of WIL at a TVET college

AI applications in education include anticipating facility upkeep, monitoring targeted learner support, and predicting learner enrolment (Clauberg, 2020; UNESCO-UNEVOC, 2019).

Pedro et al. (2019) stated that there has been much debate about how AI has impacted innovation in a variety of industries and how it could transform the way that learning is incorporated into the workforce. A responsive education system would include AI into its own systems as well as the curriculum and training provided to learners (Holmes et al., 2019). Indeed, the responsiveness of an education system to social and labour market demands is a key component of the Sustainable Development Goal on Quality Education, which aims to

produce individuals who are both socially and economically productive in their society (World Bank Group, 2020).

The World Bank Group's (2020) research found that people who chose remote learning during the COVID-19 pandemic and the slow reopening of training centers encountered hurdles as a result of TVET institutions' emphasis on practical skills. However, there are opportunities to acquire important skills through work-based learning. Even if education and learning have moved to remote platforms supported by television, radio, print materials, and the internet, it is still difficult to impart workplace and practical skills through these channels (Aina & Ogegbo, 2021b; Clauberg, 2020). More resources are needed for hands-on learning than are currently available at TVET colleges. Virtual simulations are one of several effective, efficient, and trustworthy training techniques available (Aina & Ogegbo, 2021b).

The extent to which TVET colleges' focus on practical abilities hinders distance learning varies greatly between nations and programmes. Developing practical skills for a particular vocation is heavily emphasised in TVET, which introduces additional challenges (Van der Bijl, 2021). AI technologies have gained attention recently as a potential answer for practically all issues in formal education (Chounta et al., 2021). Online learning has been shown to be more successful for teaching cognitive content than for teaching vocational hands-on skills, even though switching from face-to-face learning to virtual learning has been heralded as the solution to the disruptions in learning and education (Yasak & Alias, 2015).

In TVET-based workshops and laboratories, or by getting real-world experience in the workplace, practical knowledge is often acquired (Van der Bijl & Taylor, 2016). Unless practical exercises can be remotely reproduced, for example through virtual or augmented reality experiences, remote learning approaches are a poor substitute for practical exercises when these activities require for the use of equipment or materials that are normally not available inside the home. (Bayerlein, 2015). The most difficult programmes are those that primarily rely on experiential learning, which is normally carried out without the use of a computer. Programs that prioritise academic subjects or job-specific skills that don't need manual labor, as well as those that rely mostly on computer use, can transition to remote learning with ease (Mutereko & Wedekind, 2016). For instance, a learning programme in cyber-security will be fairly straightforward to move online since it currently heavily relies on computer use. Because they do not require non-digital technologies, training courses in marketing or financial management could be shifted online (Bilsland et al., 2020; Mutereko &

Wedekind, 2016). However, delivering an auto mechanics programme remotely will be far more difficult as it requires substantial hands-on expertise (World Bank Group, 2020).

Learning techniques can evolve over time to become increasingly specialised, complex, and all-encompassing. To guarantee that these strategies meet the needs of the labor market, employers should preferably be included in their creation (Ugwoke et al., 2016). Lecturer preparation, training program and evaluation process alignment to the new remote delivery mode, and trainee access to remote learning may all improve depending on budgetary resources and TVET system implementation skills (Aina & Ogegbo, 2021b).

There is room for more learners and programmes to participate in virtual work-based learning. With a little creativity and when doing so does not pose safety risks, several practical tasks for TVET programmes, such as in horticulture, cooking, and hospitality, may be carried out in and around the house (Bilsland et al., 2020).

AI is much more than just a content recommendation engine in learning and development as it is in other sectors like gaming and social platform applications (Mpu & Adu, 2019). It would be straightforward to restrict an AI learning platform's potential to nothing more than a suggestion engine in the context of e-learning due to the basic AI functionality of these recommendation engines (Marwan, 2020; Cromton & Song, 2021).

Virtual simulation teaching techniques are becoming more and more significant in professional knowledge education and practical operation training as virtual reality technology advances. (Bilsland et al., 2020). In colleges and universities, virtual reality technology has the potential to enhance one way of professional education, make it easier to maintain instructional materials, and pique learners' interest in learning about a field and putting their learning to use (Zhou, 2021).

Virtual reality technology, which has many invaluable advantages, can make up for many deficiencies in TVET institutions and fulfil the growing demands for high-quality professional staff training as well as learning and teaching (Jantjies et al., 2018). The interactive component of the learning and teaching process between lecturers and students may also be considerably improved by virtual reality technology, which would increase students' enthusiasm in learning (Bilsland et al., 2020). By making it easier for students to practice applying the theoretical knowledge they have learned on a computer and by giving

them plenty of opportunities for verification, the simulation teaching system may lessen the risk of damage to crucial equipment from students' incorrect operation (Zhou, 2021).

According to Aina and Ogegbo (2021b), virtual reality technology could produce three-dimensional visual and aural impacts to foster positive human-computer connection. Zhou (2021) made the case that three-dimensional virtual reality technology may transform the monotonous and passive condition between a human and a computer, which will significantly improve the current state of traditional multimedia learning and teaching. Human-computer interaction is a pleasant, peaceful situation that depends on innate abilities. A setting for multimedia training that looks virtual but is extremely real in three dimensions can be provided using technology for virtual reality (Jantjies et al., 2018).

2.2.8 Effects of the COVID-19 pandemic on the implementation of workplace integrated learning at a TVET college

The COVID-19 emergency had three phases, namely the adapting stage, during which organisations and educational institutions were closed; the middle phase, during which they gradually reopened; and the recovery phase, during which potential opportunities to rethink, reset, and re-try workforce preparation present itself (Dwivedi, 2020; World Bank Group, 2019). This research was primarily concerned with the adapting stage, which was characterised by serious interruptions in both learning and business. Lockdowns impacted more than 1.2 billion learners worldwide as of 30 April 2020, including 73,7 million TVET learners (UNESCO Institute of Statistics, 2018; World Bank Group, 2019). Governments around the world encouraged the creation and adoption of TVET online and digital learning and training solutions (Kelly, 2021).

Soon after learners' were placed, especially in businesses that offered crucial services and commodities, some of them were absorbed to take the position of permanent workers who passed away or were ill (Blom et al., 2022). Since remote learning is a poor substitute for practical experience, practical learning has remained a barrier despite the movement of teaching and learning away from physical classrooms and toward remote learning via the internet, television, radio, or print materials (World Bank Group, 2021).

Many authors (Blom et al., 2022; Hoftijzer et al., 2020) noticed that programmes tied to academic subjects that do not demand labour-intensive work and that heavily rely on the use

of computers can easily adapt to remote learning. On the other hand, practical skills can only be developed in school-based workshops, labs, or workplace settings and are acquired through learning by doing (Kelly, 2021). Using simulations through virtual augmented reality is essential for reducing these restrictions (Irwin et al., 2012; World Bank Group, 2019).

Learners can undertake TVET practicals in and around their homes while taking safety precautions and using some imagination; they can videotape themselves performing these activities and submit the videos for evaluation (Bayerlein, 2015). For most nations, except for a handful that were well prepared, remote learning was probably ad hoc. Countries with well-established remote learning systems needed to implement a few fast initial procedures to get the computers up and running (World Bank Group, 2021).

As greater emphasis is placed on general education topics and less on the conventional vocational curriculum, some stakeholders were concerned that TVET trainees would suffer as a result (Bayerlein & Jeske, 2018). There was a paucity of cutting-edge remote learning options in TVET, and TVET lacks system implementation and financial resources (Aina & Ogegbo, 2022). At TVET colleges, learners have limited access to in situ remote learning and instructors are not sufficiently prepared for remote learning. Additionally, evaluation procedures do not suit the new remote delivery approach (Morgan, 2022). The remote learning method has been most beneficial to communities and nations that have improved digital skills (Morgan, 2020; World Bank Group, 2019). Disadvantaged communities were less likely to benefit from remote learning due to technical limitations with connectivity, equipment, or digital skills as well as other factors like limited learning structures and guidance that can be provided within the household and generally weaker mechanisms to cope with the pandemic's socioeconomic impact (Kelly, 2021; Morgan, 2022).

In certain cases, theoretical and practical tests related to the certification of acquired abilities were postponed during the COVID-19 pandemic, and in other cases, educational institutions, especially TVET colleges, relied on previous performance or formative assessment data to determine grades (Aina & Ogegbo, 2022; Hondonga et al., 2022).

2.2.9 Lecturers' perceptions of the use of AI-support WIL during Covid

Chounta et al. (2021) conducted a survey and questioned lecturers about their understanding and worries about the use of AI in WILL as well as the problems they face in order to better

understand lecturers' attitudes about and perceptions of the use and function of AI in education. According to their findings, instructors are not aware of AI and how it may help them in the classroom. Nonetheless, they view it as an opportunity to learn. Instructors require assistance in order to work successfully and efficiently, and Torres and Giddie (2020) believed that AI could provide this assistance. Chounta et al. (2021) and Cheok et al. (2017) also discovered challenges relating to the sociocultural milieu, such as lecturers' conceptions of AI as a tool to help obtain, change, and use multilingual information.

The employment of intelligent teaching aids in the classroom is rare, according to a thorough analysis of the instructional platforms used by TVET institutions (Ferguson et al., 2016). There are two potential causes for this, according to the 2017 Horizon Report from the New Media Consortium: Either TVET does not invest the necessary funds into incorporating cutting-edge technologies into its curricula, or teachers lack the necessary training to implement AI-enhanced technologies in the classroom. Another factor would be that the needs of TVET teachers are not being met by current AI-enhanced technology (Freeman et al., 2016). According to studies (Van der Bijl, 2021; Van der Bijl et al., 2019), developing tools for instructors that are enhanced by AI necessitates participatory methodologies.

Situating the relationship between AI in education within the context of FATE research highlighted significant issues surrounding the use of AI technology in the classroom and the need for ethical and regulatory procedures to recognize and take into account the effects of AI systems (Luckin, 2018). These effects could harm stakeholders' privacy, including that of teachers and students, as well as learning effectiveness and interpersonal interactions and relationships. Usually, AI in education is portrayed as a tool for individualized learning. The advantages of customization, particularly when combined with bias reinforcement, are, however, hardly ever demonstrated (Bulger, 2016). According to some (Bulger, 2016; Torres & Giddie, 2020), AI has been criticized for ignoring social interaction and social learning components, emphasizing individual skill development at the expense of learners' welfare and relatedness, and questionably prioritizing goals and objectives.

AI algorithms may simultaneously exacerbate societal inequities, unfairness, and negative stereotypes (Holstein et al., 2019; Cromton & Song, 2021). One could argue that eliminating data instances that might spread prejudice is the obvious solution to creating fair systems. However, when our goal is to support students by recognizing their needs in educational settings, especially when these requirements are a result of racial or systemic injustice, this is

not a solution (Ogbonnya-Ogburu et al., 2020). In order to address ethical issues for the development of AI systems for education, Aiken and Epstein (2000) offered a set of design principles based on six fundamental human traits: ethical, aesthetic, social, intellectual, physical, and psychological. The ten guiding principles that emerged placed an emphasis on fundamental human needs like the requirement for social interaction and overall wellbeing as well as the necessity of fostering positive attitudes like creativity and curiosity (World Bank Group, 2019). In addition, other ideas emphasise the lecturer's role as the orchestrator and facilitator of learning while incorporating individuality, distinction, and diversity (Van der Bijl et Taylor, 2019). The AI system is meant to support rather than replace the human.

Younger lecturers typically place a high importance on the use of technology in teaching and learning, yet for a number of reasons, many lecturers do not routinely use educational technologies. For instance, nearly half of the study participants who used mobile devices for learning less than once a month fell into the category of non-users, according to Pedaste et al. (2017). Additionally, they discovered that just 5% of students regularly used mobile devices for schoolwork and assignments given to them by teachers. This shows that students do not regard their mobile devices as learning tools, which may be due to the fact that teachers do not employ technology—in this case, mobile devices—when they design learning assignments.

2.3 Theoretical Framework

During the COVID-19 pandemic, frequent and protracted WIL interruptions at South African TVET institutions inspired the current study. A intriguing starting point for the study's analysis was the COVID-19 pandemic and its effects on WIL and the education and training industry. Additionally, these effects have sparked innovative changes in South African society and around the world.

Any research effort requires a theory since it gives unambiguous guidance and results in the acceptance or rejection of identified occurrences. A theoretical or conceptual framework’s significant responsibilities include simplifying the research topic and justifying the exploration of the issue (Punch, 2014). A theoretical framework helps the researcher generalise the many qualities of an observed event rather than merely describing it, and it also shows their limits in scientific inquiry (Gray, 2014). It emphasises the essential elements that

impact an existing event and the need to examine them to understand how they change in different circumstances.

A theoretical framework, according to Grant and Osanloo (2014), aids the researcher in understanding concepts and variables as they are described by definitions and in producing new information by validating and testing theoretical premises. The description of a study's theoretical presumptions aids in providing answers to the "how" and "why" issues. The current researcher used the deductive approach, which begins with an existing theoretical or conceptual framework and leads to the formulation of results. In the current study, the TPACK and TOE frameworks were combined into one conceptual framework.

A conceptual framework, according to Tonette and Maria (2009), grounds a study in pertinent knowledge bases that establish the significance of the issue statement and research questions. Shulman's original pedagogical content knowledge structure serves as the foundation for TPACK, which also incorporates technology (Lye, 2013). Kelley and Kallem (2009) adopt a balanced approach to this problem by teaching technology education to all learners in order to create technical literacy while also meeting the demands of a workforce striving to compete in a global market (Tseng et al., 2022). The goals of employing technology in the classroom are explained and understood using the TPACK framework. The TPACK framework's components include technical knowledge, content knowledge, pedagogical knowledge, pedagogical content knowledge, technological content knowledge, and technological pedagogical knowledge.

The framework focuses on building and assessing teacher competence in a wide range of curriculum areas to guarantee that children receive the best education possible (AACTE Committee on Innovation and Technology, 2008). As a result, TPACK is an essential framework when considering which knowledge instructors require to integrate technology into their lectures and how they might obtain it (Cheng et al., 2022). The types of preservice and in-service lecturer training and professional development options available may be affected by the use of TPACK as a framework for assessing teaching knowledge (Celik et al., 2023). In order to properly educate lecturers to integrate technology into their classrooms, it is ongoing necessary to review current lecturer preparation methods and recommend new ways (Tseng et al., 2022). A framework in research is a symbolically formed framework that supports in the development of various study aspects. It is as important to scientific research

as a skeleton is to the human body. A well-structured theoretical framework is used to accomplish the needed outcomes (Lye, 2013).

The TPACK paradigm is based on the following key questions: What do teachers know? How do teachers know? How do learners know? How do instructors teach? How is technology used? In order to promote innovative teaching and learning, teachers can use the technique to pinpoint knowledge gaps and areas of strength in learning materials, pedagogy, and technology (Celik et al., 2023; Cheng et al., 2022). The different parts of the TPACK framework are depicted in Figure 2.1.

The TOE framework, created by Louis Tornatzky and Mitchell Fleischer in 1990, is a firm-level theory that examines the effects of three key organisational setting characteristics on decisions to accept technological innovations. The theory of reasoned action, the theory of planned behavior, and the technology acceptance model are three technological frameworks that focus on individuals within organisations, but they were not taken into account for this research because high level attribute information is provided by individuals, allowing the research to cover both individual and organisational levels. (Li, 2020). According to Baker (2012), TOE is concerned with how the corporate setting effects the adoption and execution of innovations. The components of the TOE framework are shown in Figure 2.2.

The three components of the TOE framework—the technology context, the organisational context, and the environmental context—were emphasised by Baker (2012) as having an impact on technological innovation. This was also brought up by Li (2020), who went on to say that because TOE has not changed since its inception, it is too closely aligned with other theories of technology adoption and is not competitive with them. The TOE framework describes how the adoption and implementation of technical advances are impacted by the technological context, organisational context, and environmental context (Baker, 2012; Li, 2020).

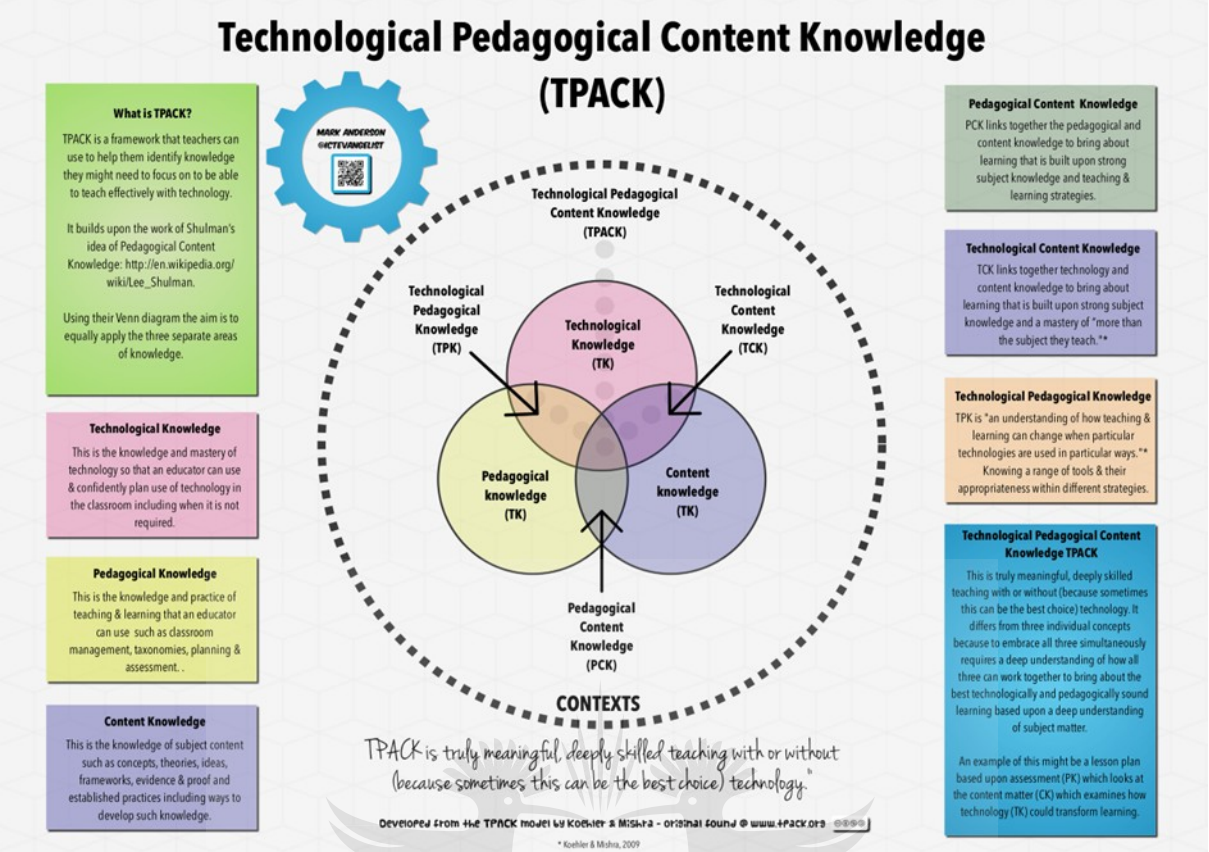

Figure 2.1: The TPACK framework and its components (Koehler & Mishra, 2009)

The technological context comprises technologies that are used inside the organisation and those that are available on the market but have not yet been purchased by the organisation (Li, 2020). The adoption of new technologies is thought to be significantly influenced by current technologies. By defining the limits of what is feasible and showing businesses how technology may assist them in changing and adapting, already existing inventions that are not yet being used by a company can have an impact on innovation (Baker, 2012).

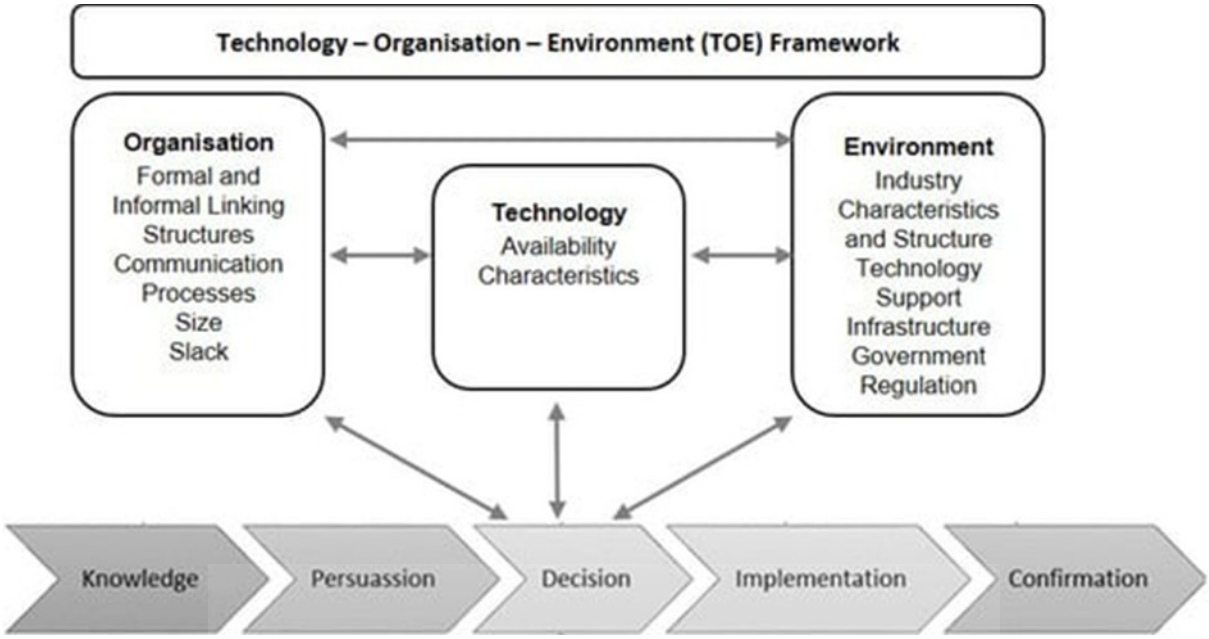

Figure 2.2: The original TOE framework by Tornatzky et al. (1990).

The current research covered both teachers and learners as well as the TVET college as an organisation. The TOE framework covered the learners' side of the equation, and the TPACK framework effectively addressed the lecturers' side.

2.4 Summary of Chapter

To provide pertinent data to support the current study, the researcher conducted a review of the literature in this chapter. An overview of WIL, the development of AI, the difficulties faced by lecturers at TVET institutions in conducting WIL prior to the COVID-19 epidemic, and the variables influencing the use of AI to speed the implementation of WIL at a TVET college in the South African setting were all topics covered in the conversation. The researcher thoroughly covered the advantages and difficulties of implementing AI to promote learning at TVET colleges in South Africa during the presentation. An overview of the research techniques employed in the current study is provided in the following chapter. Mixed methods research, which balances the strengths and disadvantages of qualitative and quantitative techniques, is known as this (Bryman, 2012; Leko et al., 2022). The quantitative survey was created during the COVID-19 pandemic with ideas like experiences, influences, attitudes, and perceptions of integrated learning in the workplace and AI in mind. The highest

level of mixed techniques allowed for the integration of hypotheses, the discovery of conflicts, and the trustworthiness of the findings while also increasing the validity of triangulation (Johnson & Christensen, 2004; Leko et al., 2022).

CHAPTER 3 RESEARCH DESIGN

3.1 Introduction

This chapter's goal is to go over the research technique and study plan that were employed to investigate how AI contributed to the development of WIL at a TVET college in South Africa during the COVID-19 epidemic. This chapter discusses the study's research strategy by elaborating on data sampling and collection procedures. It also introduces the data administration and analysis, and it closes by emphasising ethical considerations in mixed methods research.

Despite substantial academic study and philosophical position arguments among researchers, there is still no agreement on the final meaning, categorisation, and classification of paradigms. Saunders' paradigm approach was thus employed in this investigation. The Saunders et al. (2016) research onion concept, which outlines the several research components used in the current investigation, is depicted in Figure 3.3. Research philosophy, theory development approach, methodological choice, research strategy, time horizon, and methodologies and procedures are the six layers of the research onion. According to Raithatha (2017), the research onion provides a thorough review of the six key layers that must be addressed in order to create a successful research technique.

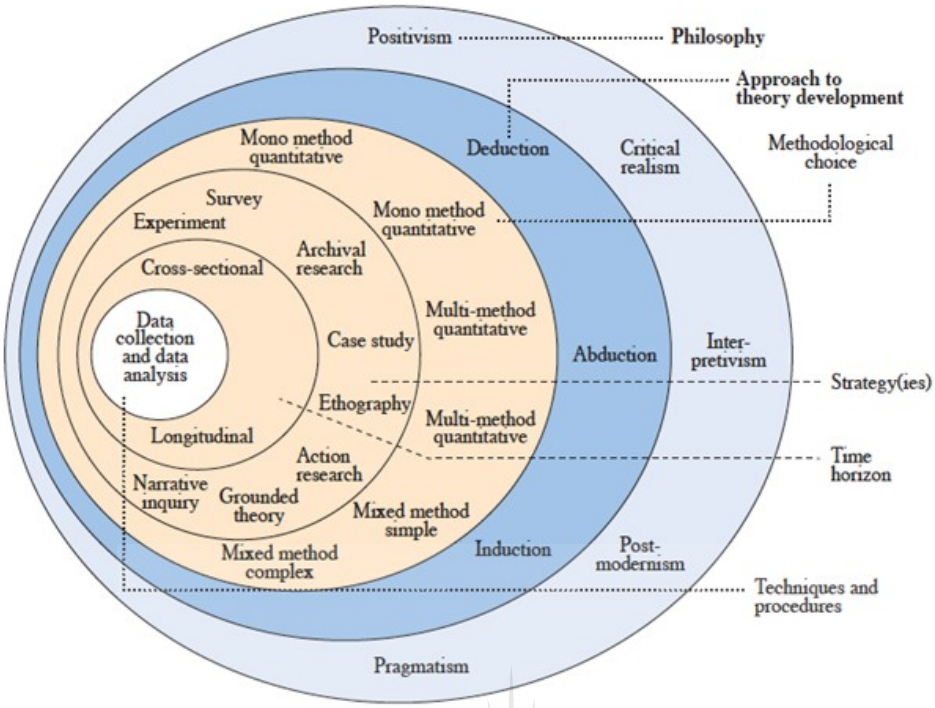

Figure 3.3: Research onion

3.2 Research Paradigm

Research is defined as a logical process that ascertains issues by following a sequence of chronological processes, rigorous research methodologies, data collection and analysis, and drawing conclusions with the goal of increasing current knowledge and gaining new information (Creswell, 2013; Sekaran, 2003; Redman & Mory, 1933). Research is similarly described by Bassey (1990) as a rigorous, critical, and self-critical examination that aims to further knowledge. Thus, research must be purposeful and rigorous rather than based on intuition or experience (Creswell & Plano Clark, 2011; Shat & Al-Bargi, 2013).

It is critical that every study investigation be led by a paradigm (Makombe, 2017). The term paradigm was originally used by Kuhn in 1970, who defined it as an integrated group of conceptual ideas, variables, and problems connected to suitable methodological approaches and tools. According to Chalmers (1982), a paradigm is a set of general theoretical precepts, guidelines, and methods for their application that adhere to a certain scientific community. Guba and Lincoln (1994) described paradigm as a fundamental framework that drives the investigator, whereas Creswell (2009) defined it as a world perspective. Worldview, a

synonym for paradigm, is described by Patton (2002) as a means of considering and comprehending the intricacies of the actual world.

While various paradigms, such as constructivism, post-positivism, participatory action frameworks, or pragmatism, aid in structuring and organizing contemporary social work research, they are all fundamentally philosophical in nature and share components like axiology, ontology, and epistemology (Creswell, 2009; Lincoln et al., 2011). Makombe (2017) asserts that the ontological inquiry takes into account the reality that the researcher wants to investigate and understand. The epistemological inquiry takes into account what (ontology) is available for investigation and how to get there. The methodological investigation evaluates the approaches and procedures that will enable the investigation to be conducted. The study paradigm, method, and design choices are influenced by the responses to these questions (Creswell & Plano Clark, 2011). As a result, each paradigm has a unique perspective on the axiology, ontology, epistemology, methodology, and rhetoric of research. Both epistemology and ontology are essential to one another and cannot exist apart (Creswell, 2009). Ontology is the reality of what is already known, whereas epistemology is the methodological pursuit of reality. Epistemology is necessary to access reality (Makombe, 2017).

The research approach can be classified as quantitative, qualitative, or hybrid. Each of these strategies employs a variety of research techniques. In the social sciences, qualitative research methodology is frequently used while quantitative research techniques are typically used in the pure sciences (Creswell, 2013). However, both the pure and social sciences use a hybrid strategy known as the mixed methods technique (Leko et al., 2022).

The pragmatism paradigm, which features relativism as an ontological approach, was applied for this research. This strategy allowed for mixed methodologies where the research issues and their effects are highlighted rather than the research techniques themselves (Biesta, 2010; Johnson & Onwuegbusie, 2004; Leko et al., 2022). Maxcy (2003) claimed that pragmatic scholars unequivocally rejected the notion that social science inquiries may only approach reality by utilizing a single scientific technique. In order to address research questions that cannot be addressed by a single methodology, both approaches are combined (Makombe, 2017). The pragmatic paradigm helped to highlight the key tools needed to carry out the current investigation on the employment of AI in a South African TVET institution during the COVID-19 epidemic. The goal of employing the pragmatism concept was to guarantee that

information is constantly questioned and clarified from a practical standpoint within the education and training space (Creswell & Plano Clark, 2011). As a result, there was some researcher engagement and subjectivity in forming results based on participant replies and judgements (Creswell, 2013). To address the impacts of learning disruptions during the COVID-19 pandemic, lecturers had to identify whether AI usage would be a preponderant solution (Dwivedi, 2020).

The pragmatism paradigm was also used since, in order to understand the core of the research, it was important to challenge the presumptions of past approaches that were ingrained in the philosophy of knowledge (Creswell & Plano Clark, 2011). In accordance with Biesta (2010), pragmatism and mixed methods research are related in some ways and that link has increased awareness of pragmatism. In order to ascertain if the use of AI may promote WIL at a South African TVET institution during the COVID-19 epidemic, this paradigm's application in the context of this study tried to go beyond what works and focused on beliefs that connect to actions (Morgan, 2018).

3.3 Research Design

The parameters used to gauge the quality of social research are referred to as research design (Flick, 2022). This makes it a framework for gathering data that is appropriate for a particular set of requirements as well as the research issue in which the investigator is interested (Baran, 2022). The research design is the method the researcher employs to carry out their investigation (Creswell & Creswell, 2003; Melnikovas, 2019; Mouton & Marais, 1990). According to Johnson and Christensen (2004), there are three different sorts of research designs: mixed methods research, qualitative research, and quantitative research. According to Berman et al. (2000), qualitative research focuses on understanding social settings, their causes, and participants' perceptions of them. It also emphasizes understanding of individuals in their social contexts. According to Gay et al. (2006), quantitative research is any method that enables the collecting of data in a numerical format for the purpose of testing theories and hypotheses. According to Johnson & Christensen (2004), mixed methods research blends quantitative and qualitative methodologies and employs each to address a separate stage of the investigation. This study's goal was to look into how AI might promote WIL in a South African TVET institution during the COVID-19 pandemic, hence the research design had to use both qualitative and quantitative methods.

The advantages of qualitative research were emphasised by Guest et al. (2005). These advantages include the use of open-ended questionnaires, which give the participating population the chance to respond in their own words as opposed to the limited responses available in quantitative research; and the opportunity given to the researcher to ask "how" and "why" questions in order to understand the social scenario. For these reasons, the researcher used "how" and "why" questions in surveys and one-on-one interviews (Baran, 2022).

Exploratory, descriptive, and explanatory qualitative research are the three subtypes that exist (Flick, 2022). Exploratory research describes a study's variables in depth, descriptive research describes the current situation, and explanatory research explores ideas that explain how and why a phenomenon behaves in a particular manner (De Vaus, 2001; Johnson & Christensen, 2004). Because it can spark ideas for understanding how AI is used to promote WIL, the exploratory research technique was used for this study.

The researcher used emails to distribute a survey questionnaire, and he used telephonic one-on-one interviews where participants were able to voice their opinions about the study (De Vaus, 2001). Even though the researcher wanted to conduct face-to-face interviews with the participants, COVID-19 restrictions prevented him from doing so because many educational institutions severely restricted access to their locations for outsiders. The researcher followed a procedural flow to organise, code, and analyse the data as topics came up in the data (Leavy, 2022).

The researcher's 15 years of experience as an adult educator and project manager of learning programs in a private institution, as well as his knowledge of the use of AI in education, had a significant impact on the research design. As a result, during the COVID-19 epidemic, essential concepts such as AI programs and artifacts, WIL and assessment, and evaluation were employed as launching pads for the application of AI can encourage WIL.

A qualitative survey was used to describe rather than forecast anything. Additionally, it offered the responders the freedom to express their thoughts and feelings regarding the subject (Johnson & Christensen, 2004). In turn, the replies gave the researcher possible exploratory data that exposed unanticipated problems and opportunities. In order to evaluate the central tendency spread, including the mean, median, and mode, quantitative descriptive statistics using a survey were used to gather quantifiable data for statistical analysis of

lecturers representing the population sample participating in the study. According to summary frequencies such as the mode, mean, median, range, and variance, descriptive statistics were utilised to describe and present participant demographic data (Cohen et al., 2000).

The mixed method study was carried out in stages, with the first stage entailing giving the 11 participants a questionnaire. The questionnaire had both qualitative and quantitative components, enabling a thorough approach to data collecting. The qualitative component of the questionnaire involved open-ended questions or survey questionnaire that enabled participants to provide detailed responses and insights (Johnson & Onwuegbuzie, 2004). The quantitative component included structured items to gather numerical data on various variables.

After analysing the questionnaire data, the study proceeded to the second phase, which involved conducting interviews with the participants. The interviews aimed to further explore and elaborate on the themes and patterns identified in the questionnaire responses. Based on the preliminary findings, a semi-structured interview guide was created to maintain consistency between interviews and to delve deeper into the experiences, viewpoints, and opinions of the participants.

The study was able to collect rich qualitative data with the questionnaire, support it with quantitative analysis, and then obtain a deeper understanding through the interviews by using this sequential mixed method approach. The validity and reliability of the study's findings were improved by the comprehensive approach's capacity to triangulate data (Creswell & Plano Clark, 2018).

The interviews in this study served as a crucial component to further explore and interrogate the themes that emerged from the questionnaire responses. They provided an opportunity to delve deeper into participants' experiences, perspectives, and opinions, allowing for a more comprehensive understanding of the research topic (Johnson & Onwuegbuzie, 2004). This method promoted in-depth discussions and allowed participants to elaborate on their answers, offering insightful information and giving the research findings more depth. Thematic analysis methods were used to analyze the interview data, revealing additional sub-themes and patterns that improved knowledge of the broader research issue (Braun & Clarke, 2006). The combination of survey and interview data ensured a thorough examination of the study's objectives and added to its overall rigor and validity.

3.4 Research Method

This study used qualitative and quantitative methodologies that foster inductive and deductive reasoning to produce a solid understanding of the AI phenomena in WIL and results that can be trusted (Thurloway, 2014). By combining qualitative and quantitative methods, the researcher was able to maximize their benefits and minimize their disadvantages (Anguera et al., 2018; Bryman, 2012; Wan, 2022). The quantitative survey was built around concepts like WIL, AI, experiences, impact, attitude, and perception. The qualitative questionnaire was built around concepts like WIL, AI, events, impact, attitude, and perception.

Using mixed approaches at the highest level helped ensure higher validity or triangulation and allowed for the discovery of discrepancies, the integration of hypotheses, and trust in the results. According to Green et al. (1989), using mixed methods has additional advantages such as clarifying the findings from one method with findings from the other method, extending the scope of inquiry by employing various methodologies, stumbling upon paradoxes that may require rewriting the research question, and using findings from one method to help inform the findings from the other method.

This study used deductive reasoning and a mix of qualitative and quantitative methodologies to create a comprehensive understanding of the AI phenomena in WIL and results that inspire trust (Thurloway, 2014). Melnikovas (2019) suggested that deduction implies research that begins with an existing theory that prompts a query and/or hypothesis, which leads to the acquisition of evidence, which is then analysed to corroborate or reject the hypothesis. Melnikovas further stated that induction refers to commencing the research with data gathering and analysis, which leads to the development of a hypothesis. The deductive technique is used to develop existing theories or concepts, whereas the inductive approach is used to build new theories or concepts. As the TPACK and TOE theoretical frameworks were employed to develop the main research issue, the deductive technique was used for this study.

3.5 Research Setting

Johnson and Christensen (2004) assert that because it is impossible to investigate the entire population, researchers instead focus on a sample of that population in order to draw generalizations about the entire population. There are numerous sampling techniques, including random and non-random. The researcher used a non-probability sampling technique

to select participants who agreed to take part in the study and met the requirements. It is a sampling strategy, according to Zikmund (2003), in which sample units are selected depending on discretion or practicality.

Eleven lecturers from a single selected TVET college in Johannesburg, Gauteng Province, South Africa, were chosen as study participants using purposeful sampling, and they participated in the interviews and completed the questionnaires. The 11 lecturers were chosen strategically to ensure that the sample was significantly enough to address the primary research issue. The researcher was primarily responsible for choosing who to include and exclude from the sample (Cohen et al., 2000). The researcher had full information of the potential participants' experiences and perspectives prior to recruiting them based on their numerous years of working as lecturers at the TVET college and assisting learners in succeeding in their workplace learning journey by means of technology use.

3.6 Research Instruments

The researcher must collect empirical evidence, also known as data, in accordance with the rules of research design in order to respond to the research questions (Neuman, 2011). Data is expressed in numbers in quantitative research while it is expressed in words in qualitative research (Johnson & Christensen, 2004).

The researcher employed triangulation (Bryman, 2012) for this study, including individual interviews and open-ended questionnaires. To cross-check the data and findings of the research of the same phenomenon, mixed approaches were combined and used throughout data collection (Berg, 2004; Johnson & Christensen, 2004). It enabled the researcher to have a more nuanced understanding of the event under study. Email was used to contact participants and request their participation in the study (Appendix A).

Emails containing a questionnaire and a full explanation of the study's goals, parameters, and guidelines were sent out. Telephone interviews that lasted between 25 and 30 minutes were conducted after the questionnaire. The same researcher gathered all of the data. Confidentiality was guaranteed to participants, and each interview was videotaped and verbatim recorded. The researcher believed that by choosing the 11 participating lecturers, the research topic would be accurately reflected.

An email including an open-ended survey (Appendices D) was sent to each participant. The questionnaire's questions were created using straightforward language in accordance with the objectives of the study. The 11 participants received an email with the questionnaire.

Kvale (cited in Cohen et al., 2000) defined an interview as a discussion between two or more individuals on a topic of mutual interest, and believed that human interaction is essential for knowledge production, and emphasised the social situatedness of research data. Knowledge is therefore established between participants who generate data rather than participants who capture data (Johnson & Christensen, 2004). As a result, interviews are viewed as intersubjective rather than simply subjective or objective. Interview sessions allow both interviewees and interviewers to explore their opinions and interpretations of the society in which they live and explain how they perceive circumstances from their own point of view. In these ways, interviews are more than just collecting data about life; it is part of life itself, and its human embeddedness is unavoidable (Johnson & Christensen, 2004). Interviews give the interviewer the opportunity to not only urge for comprehensive answers but also for replies to complicated and profound issues that may arise as a consequence of in-depth verbal and non-verbal exchanges.

In this study the researcher predetermined the topics and themes discussed in the interviews by creating an outline. The sequencing and execution of questions during the interview were determined by the researcher.

Due to limitations brought on by the COVID-19 outbreak, the researcher conducted one-on-one phone interviews with participants to gather information on the research topic (Guest et al., 2005; Mehtar, 2020). According to Denzin and Lincoln (2000), one of the best methods for qualitative research is interviews. The researcher took the role of the "learner" and the interviewee played the part of the "expert" in this two-way conversation. The entire process was guided by a predefined interview schedule or guide.

The involvement with participants enabled for additional non-verbal communication information to be acquired through the participants' reactions in addition to the information that was gathered verbally (Johnson & Christensen, 2004). The interviews were recorded, and transcription started immediately after that. To make sure the researcher followed ethical guidelines, the participants were told about the nature and goal of the study. In addition, the participant was continuously reminded that they might leave the study at any time.

The interviews were semi-structured in that certain questions were prepared in advance, but the researcher was flexible and willing to explore novel and intriguing themes. Between 25 and 30 minutes were allotted for the interviews.

3.7 Research Process

Data management and data analysis occur continuously during the research process, making it difficult to distinguish between them (Miles & Huberman, 1994). Data management affects data analysis, therefore keeping data safe, organized, and methodical is essential for productive research, according to Guest et al. (2005). While conducting this study, the researcher did not use any qualitative software tools; instead, he handled the data directly himself.

The researcher taped and transcribed the data acquired for individual telephone interviews. The recordings were kept in a locked filing cabinet for the duration of the study, and only the researcher had access to the cabinet. The transcripts of the interviews were then stored on the researcher's personal laptop, which is password-protected and has a unique numbering system for easy identification. The secured file cabinet also included all participant consent forms and completed questionnaires. All raw data will be erased six months after the study is over due to confidentiality considerations.

Because there are few or no questionnaires adequately addressing the current problem, the researcher created his own. He used Google Forms and asked questions about workplace experiences, impact, attitude, and perception, as well as integrated learning and AI. The TPACK and TOE frameworks were combined into one conceptual framework and served as the foundation for the instrument. The ratings were given on a Likert scale, with a midpoint of 3 and a range of 1 to 5. Degrees of response, intensity of reaction, and the move away from binary questions have all been addressed using Likert scales (Cohen et al., 2000). The scale was created to produce numbers while still being responsive and differentiating in response. Different responses to a certain topic or phrase are provided on a Likert scale. Participants can communicate their emotions by circling the mark on the scale that best describes them (Cohen et al., 2000).

The data analysis step is critical because it condenses the vast amount of information gathered in order to make sense of it (Leavy, 2022). Only by categorising textual content into groups

such as themes is it feasible to comprehend the collected material (Bryman, 2012). Both primary and secondary data were gathered by the researcher. Primary data was acquired through a questionnaire and semi-structured interviews, while secondary data was gained by reviewing recent literature on the application of WIL in TVET colleges.

Qualitative coding, the most common technique of qualitative data analysis, was used in this study. The researcher discovered component pieces that appeared to be of significant theoretical relevance and particularly relevant in the use of AI to implement WIL at a South African TVET college. Coding was used for data labelling, separation, compilation, and organisation. Using coding, the researcher related data to the research hypothesis and back to additional data. The use of codes enabled the researcher to organise data in order to examine it and process a detailed analysis focused on data relationships (Bryman, 2021). According to Cohen et al. (2000), descriptive statistics were used to describe and show data in terms of summary frequencies, such as the mode, mean, median, range, and variance.

3.8 Research Ethics

The researcher gave a lot of consideration to ethical considerations during the phases of data collecting and analysis. Informed consent, privacy invasion, fraud, and participant injury were among these problems (Bryman, 2006; Rhodes, 2010). According to consensus, most participants provide information to the researcher during the interview process that they had not intended to (Barrow et al., 2022; Patton, 2002), hence maintaining confidentiality and securing participants' informed agreement are essential. The purpose of the study was explained to each participant in the study.

Ethical issues revolve around how the researcher should treat the people who participate in their research and the activities that they should or should not engage in while interacting with participants (Israel & Hay, 2006; Roth & Von Unger, 2018). Many researchers (Hesse-Biber, 2010; Roth & Von Unger, 2018) indicated that the main goal of ethics in research is to make sure that no harm is done to anyone involved in the study or that no one suffers unfavourable consequences from the research activities. Therefore, during the current research, ethical and professional standards were strictly adhered to and followed. There was no harm done to participants, all participants were fully informed of the scope of the research, and their consent was sought There was no invasion of their privacy and no deception. The

researcher ensured that the research and their conduct conformed to the University of Johannesburg's ethical code of practice in research. The researcher requested formal ethics approval from the University of University prior to beginning data collection, and was subsequently granted this approval (Appendix B). The opportunity to opt out of the study at any point was given to participants.

3.9 Trustworthiness

This study on the use of artificial intelligence (AI) in work-integrated learning (WIL) at TVET institutions during COVID-19 in South Africa utilised a mixed-methods research methodology to ensure the validity and dependability of the research findings. A thorough examination of the subject from various angles was made possible by the mix of qualitative and quantitative methodologies. Based on its feasibility for comprehending the challenges of integrating AI in the TVET industry during a worldwide pandemic, the research design was chosen.

Surveys and semi-structured interviews were the two main approaches used for this study's data collecting. To ensure representation from a TVET college, participants were chosen using a stratified random sampling technique. 11 lecturers in total took part in the survey and interview. Prioritising ethical concerns, all participants' informed consent was obtained before data collection started. Throughout the research procedure, confidentiality and data protection policies were rigorously followed.

Descriptive statistics were used to analyze the survey data and assess lecturers' impressions of AI-driven learning platforms and their influence on WIL experiences. Thematic analysis of the qualitative interview data allowed for the identification of significant themes on the difficulties, advantages, and best practices of integrating AI into TVET WIL programs. The combination of quantitative and qualitative data improved the reliability of the study's conclusions and allowed for a thorough grasp of the research issue.

By comparing survey results with insights from interviews, data triangulation was used to increase the reliability of the research. The convergence of information from various sources improved the study's conclusions' reliability and validity.

Throughout the research process, reflexivity was maintained by the researcher. Acknowledging the potential biases and preconceptions that could influence the study, the researcher took measures to remain impartial and open-minded.

In conclusion, this study used a thorough and open methodology to explore how AI was incorporated into work-integrated learning at TVET colleges in South Africa during the COVID-19 epidemic. The research's mixed-methods methodology, data triangulation, and reflexivity all worked together to make the findings more credible, assuring the study's contributions to workforce development and educational technology are reliable and legitimate.

3.10 Research Limitations

According to Theofanidis and Fountouki (2018), any research endeavor will inevitably have restrictions and limitations in terms of its underlying theories, study design, replication potential, flaws in data collection and questionnaire design, insufficient subgroups or data for robust statistical analysis, short time frame for data collection, disregard for seasonal differences and missing data, causal relationships, measurement errors, study setting, population or sample, ethological considerations, and ethological considerations. Limitations necessitate arguing against the researchers' presumptions and outright pointing out flaws that could have been fixed. The researcher was well aware of the numerous restrictions and constraints in the current research and addressed them early in the study process (Price & Murnan, 2004Wang et al., 2015).

In order to increase the quality of their study findings and the interpretation of the data, researchers should freely and thoroughly disclose their research limits, delimitations, and assumptions. A study's reputation suffers when any of these crucial components is omitted, disregarded, or kept quiet (Theofanidis & Fountouki, 2018). The following are the limitations that the current study faced:

- The focus of the research was on one TVET college, which cannot be regarded as representative of all colleges within South Africa; and
- The size of the sample of selected lecturers who participated in the study was small and the research outcomes can therefore not be generalised.

In recognising these limitations, this research attempted to investigate the importance of the use of AI as a panacea to learning hindrances resulting from the COVID-19 pandemic to ensure the continuity of WIL which may otherwise not be highlighted.

3.11 Summary of Chapter

This study used a standard scientific technique and methodical methods to collect, analyse, and evaluate the data to shed more light on the usage of AI to develop WIL in a South African TVET institution during the COVID-19 pandemic. Throughout the study, the reliability and validity of the research methods and comments were prioritised. This chapter looked at the research technique and study design. The chapter's introduction focused on the definition of research as well as the philosophical elements of epistemology, ontology, and methodology. A unique discussion expanded on key research components such as induction and deduction and quantitative and qualitative methodologies. This was followed by a section that looked at the tools used to gather, analyse, and interpret the data. Questionnaires were provided to participating lecturers, and telephonic interviews were conducted with the selected participants.

11 lecturers from a South African TVET college were questioned during the COVID-19 epidemic. To achieve findings, the acquired data was scrutinised, and categories were identified and aligned with the data. Several research approaches were applied to improve the validity and reliability of the study. Chapter 4 presents and analyses the outcomes of the quantitative and qualitative data collecting methodologies.

CHAPTER 4 FINDINGS AND ANALYSIS

4.1 Introduction

This chapter presents the findings and discussion in the following sections: (1) Challenges TVET lecturers faced conducting WIL prior to the COVID-19 pandemic; (2) factors that influence the use of AI to accelerate the implementation of WIL at a TVET college; (3) the effects of the COVID-19 pandemic on the implementation of WIL at a TVET college; and (4) lecturers' attitude towards and perceptions of the role of AI in training and education.

Two different types of data generated were for this research. The first type was quantitative data, which was gathered via an online survey and used to create a biographical profile of the participants as well as a profile of the implementation of WIL in TVET colleges. The second type of data was qualitative data, which was gathered during interviews conducted using the Zoom platform and transcribed by the researcher. Qualitative coding was used to examine the transcribed data.

4.2 Biographical Description

The first phase of data collection involved gathering demographic information from participants, which was used to create a biographical description of the participants. The following key subsections are discussed: Participants' education level, age, gender, and time spent at the TVET college.

4.2.1 Participants' education level

Figure 4.4 shows that 03 of the participants have honours degrees, 06 have master's degrees, and 02 have bachelor's degrees. This shows that the selected participants have a good enough education.

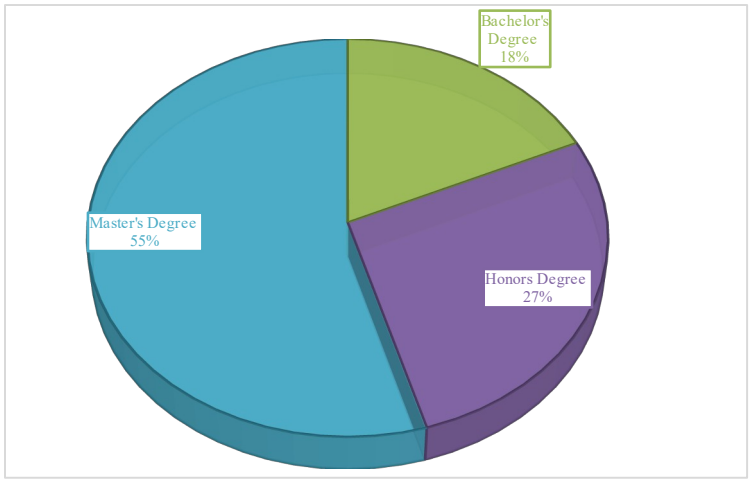

Figure 4.4: Participants' education level

4.2.2 Participants' age

Figure 4.5 shows that 06 of the participants were between the ages of 30 and 40; 01 respondent was between the ages of 41 and 50; 02 respondents were between the ages of 51 and 60; and 02 were older than 61 years.

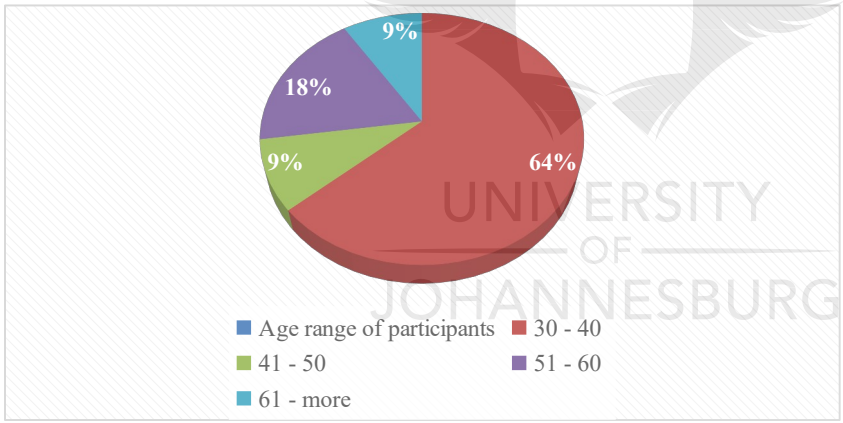

Figure 4.5: Participants' age

4.2.3 Participants' gender

Figure 4.6 shows that 09 participants of the sample were male, while 02 participants were.

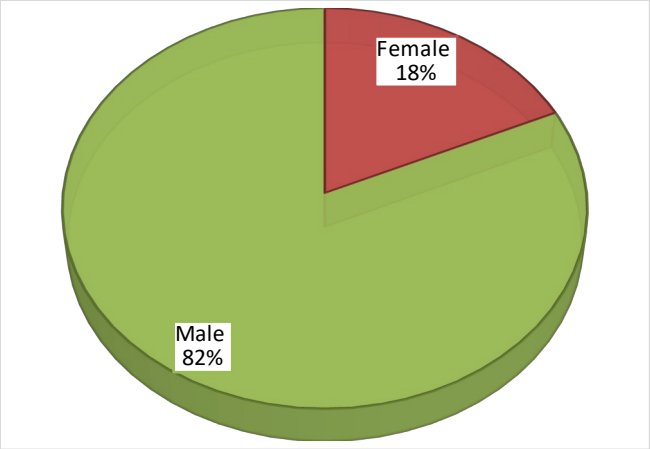

Figure 4.6: Gender of participants

4.2.4 Participants' years spent at a TVET college

Figure 4.7 shows the participants' experience of working at a TVET college. One participant has spent more than 20 years at a TVET college, two have spent between 16 and 20 years, one has spent between 11 and 15 years, 05 participants have spent between 6 and 10 years, and 02 participants have spent 5 years or less.

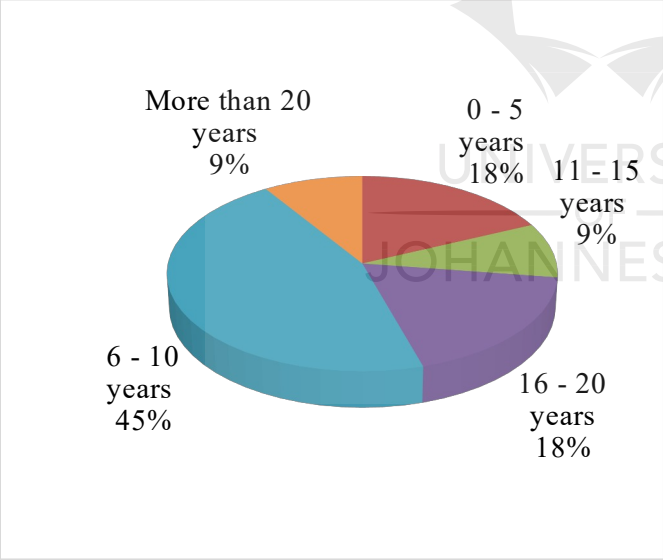

Figure 4.7: Participants' experience working at a TVET college

4.3 Findings

The findings presented here are based on the data from the interviews and online survey. The triangulation of data, made possible by the integrated findings from the two data sets, adds

weight to the conclusions and gives them a rich, detailed narrative description. The descriptive data is first presented followed by the interview findings. Both sets of date are presented under the following sections: (1) Challenges TVET lecturers faced conducting WIL prior to the COVID-19 pandemic; (2) key factors that influence the adoption and implementation of AI technologies to enhance and expedite Workplace Integrated Learning (WIL) in a TVET college setting; (3) the effects of the COVID-19 pandemic on the implementation of WIL at a TVET college; and (4) lecturers' attitude towards and perceptions of the role of AI in training and education.

4.3.1 Descriptive data presentation

4.3.1.1 Section 1: Challenges TVET lecturers faced conducting workplace integrated learning prior to the COVID-19 pandemic

The findings in this section looks at the challenges lecturers at a TVET college experienced while implementing WIL before the COVID-19 pandemic. In order to achieve this goal, the following questions were asked:

- What, in your opinion, were the principal impediments you as a TVET lecturer encountered while implementing WIL prior to the COVID-19 pandemic?
- What significant obstacles did your TVET institution experience in putting WIL into practise before the COVID-19 pandemic?

Table 4.1 shows that 04 participants said that adding WIL for learners to the already onerous workload that the TVET institution assigned them was an additional heavy task; 02 participants indicated that there were many grey areas in terms of WIL's scope, functions, and objectives that still had to be addressed for the stakeholders, including employers, learners, and TVET colleges, to ensure WIL can be effective; 02 participants responded that there was a mismatch between the TVET programmes' objectives and workplace sites' scope of work; 02 participants acknowledged that the TVET college provided no resources to ensure WIL is effectively implemented; and 01 participant mentioned that learners were not well prepared to go to the workplace and that they believe that some kind of workplace readiness programme should have be provided to both lecturers and learners prior to starting WIL.

Table 4.1: Challenges experienced by lecturers in implementing WIL prior to the COVID-19 pandemic

Challenges in implementation experienced by lecturers	**Number of respondents**
There are no resources the TVET college provides to ensure that WIL is effectively implemented	02
There are many grey areas (in terms of WIL's scope, functions and objectives/aims) that still need to be addressed for all the stakeholders in order for WIL to be effective	02
Mismatch of the TVET programmes' objectives and workplace sites scope of work	02
Learners are not well prepared to go to the workplace	01
Conducting WIL for learners is an additional task on the heavy loads that are already allocated to the lecturers by the TVET college.	04
Total	**11**

Table 4.2 shows the responses to the second question: 05 participants highlighted the lack of necessary resources as one of the major challenges they experienced when implementing WIL prior to the COVID-19 pandemic; one participant emphasised that lack of assistance led to the subpar implementation of WIL; another participant noted that the poor implementation of WIL was in large part due to the lack of support from potential employers who believed that TVET colleges do not meet the industry training level requirements; and four participants reiterated that the competency of the lecturers and the lack of adequate infrastructure resources were the main problems encountered when implementing WIL prior to the COVID-19 pandemic.

Table 4.2: Challenges experienced at the TVET college in implementing WIL prior to the COVID-19 pandemic

Challenges in implementation at the TVET college	Number of participants
Insufficient/lack of support from the Department of Education	01
Lack of suitable resources to successfully	05
Lack of support from potential employers who believe that TVET colleges do not meet the industry training level requirements	01
Lecturer's competency and inadequacies of infrastructure resources	04
Total	**11**

4.3.1.2 Section 2: Factors that influence the use of artificial intelligence to accelerate the implementation of workplace integrated learning at a TVET college

The purpose of the question "What do you think is the most important factor that influences the use of AI in accelerating the implementation of WIL at a TVET College?" was to gather opinions, information, and evidence on the variables impacting the use of AI to accelerate the implementation of WIL at a TVET college. Table 4.3 summarises the responses to the key question and shows that one participant of those surveyed said that AI helps shifting work from lecturers who are already swamped with instructional duties; four participants said that AI helps implement a customised WIL curriculum to ensure learners successfully finish the WIL programme; one participant reported that AI lessens the burdens of businesses who have trouble recovering economically and have to cut costs; 3 participants mentioned that AI assists in the use of monitoring, evaluation, and assessment tools; and two participants mentioned that AI provides fast feedback and recommendations.

In the interview, the participants stated that some employers had developed an innovative workplace integrated learning program aimed at equipping Technical and Vocational Education and Training (TVET) learners with advanced techniques. The program's objective is to nurture skilled learners who can meet the specific needs of these employers. To achieve this goal, the company begins by conducting a comprehensive pre-assessment of TVET learners interested in the WIL. This assessment evaluates their current skills and knowledge,

providing valuable insights into individual strengths and areas for improvement, which form the basis for personalised learning plans. Based on the pre-assessment results, each TVET learner is assigned a customized learning plan tailored to their specific needs and proficiency level. Through this customised and comprehensive curriculum, employers successfully nurture a talented pool of skilled learners, ready to make valuable contributions to the companies and excel in their careers beyond the workplace.

The participants revealed during the interview that AI revolutionises workplace integrated learning through various applications in monitoring, evaluation, and assessment tools. Automated grading streamlines assessment processes, for example, while adaptive learning platforms dynamically adjust content to cater to individual learners. They highlighted the power of Natural Language Processing which evaluates open-ended responses, while AI-driven analytics extract valuable insights from learning data. Intelligent tutoring systems act as virtual tutors, and automated content recommendations deliver personalised learning materials. They also pointed at continuous feedback that is provided by AI-powered chatbots, and predictive analytics which identify at-risk learners for early intervention. They concluded by saying that AI enhances the learning experience by providing data-driven support, personalised content, and efficient assessment tools, empowering both learners and instructors for better outcomes.

Two participants mentioned that AI provides fast feedback and recommendations; The participants further provided clarity of their statements in the interview by saying that Through advanced algorithms and data processing capabilities, AI systems can rapidly evaluate learners' performance and provide instant feedback on assessments, quizzes, and assignments. This eliminates the need for manual grading, saving valuable time for instructors and allowing learners to receive timely feedback to improve their understanding and performance. Moreover, AI-driven adaptive learning platforms use machine learning to continuously analyse learners' progress, preferences, and learning styles. Based on this data, the system can generate personalised recommendations for each learner, suggesting relevant and engaging content tailored to their specific needs. This not only enhances the learning experience but also ensures that learners receive the most appropriate resources to advance their skills efficiently. AI's ability to quickly process vast amounts of data and adapt to individual learners' requirements makes it a powerful tool in delivering fast, targeted feedback and recommendations in workplace integrated learning settings.

Table 4.3: Important factors affecting the decision to use AI in TVET colleges

Important factors affecting the decision to use AI	Number of participants
With companies struggling to recover economically, there may be fewer workplace spaces available. Therefore the perfect ersatz will be AI.	01
Use of monitoring, evaluation and assessment tools	03
Provision of prompt feedback and recommendations	02
Offloading tasks (i.e. admin, assessments, tracking of learning progress, etc.) from lecturers who are already loaded with teaching tasks	01
Personalised WIL programme to ensure that all learners complete the WIL programme	04
Total	**11**

4.3.1.3 Section 3: Effects of the COVID-19 pandemic on the implementation of workplace integrated learning at a TVET college

This section addresses the following issues: The effect of the COVID-19 pandemic on TVET colleges, and the steps taken to mitigate the effects of the pandemic on WIL programme implementation. The inquiry sought to provide specific information about how the pandemic affected the rollout of WIL at the TVET college. Table 4.4shows that the inability to perform face-to-face on-the-job training was cited as the primary impact of the pandemic on the implementation of WIL by one of the participants, and learning disruption was cited as the main impact by 04 of participants. Additional 03 participant said that the greatest impact of the pandemic on the implementation of WIL was the loss of instructional time; one participant said that the greatest impact was lecturers' lack of readiness to support digital learning; and one participant said the redeployment of learners to different workplaces was the greatest impact of the pandemic.

Table 4.4: Effects of the COVID-19 pandemic on the implementation of WIL at a TVET college

Effects of the COVID-19 pandemic on the implementation of WIL at a TVET college	**Number of participants**
Learning interruption delaying the completion of WIL	04
Inability to conduct face-to-face on-the-job training	01
Redeployment of learners in different workplaces as some companies have since been forced to indefinitely close their operations	01
Teachers' preparedness to support digital learning	02
Loss of instructional time	03
Total	**11**

Identifying the steps TVET institutions took to mitigate the impact of the COVID-19 pandemic on the implementation of WIL was the goal of the second question. Table 4.5 shows that one of participants said that learners' homes were used as simulation sites for practical exams; 04 participants said that no action was taken in this respect; one participant said that TVET colleges had to conduct theoretical off-the-job training courses or curricula because of their inability to conduct face-to-face on-the-job training; and 05 participants claimed that TVET colleges chose to quickly transition from in-person instruction to online learning.

Table 4.5: Measures taken by TVET colleges to mitigate the impact of the COVID-19 pandemic on the implementation of WIL

Measures taken by TVET colleges to mitigate the impact of the COVID-19 pandemic on the implementation of WIL	**Number of participants**
Rapid shift from face-to-face teaching to online learning	05
Only conducting theoretical off-the-job training courses/curriculum and inability to conduct face-to-face on-the-job training	01
No measure was taken in this regard	04
Simulation of practicals at learners' individual home	01
Total	**11**

4.3.1.4 Section 4: Lecturers' attitude towards and perceptions of the role of artificial intelligence in training and education

This question's goal was to learn more about how lecturers felt about the application of AI in WIL, and therefore, they were asked to establish whether the deployment of AI as key to improved instructional application at the TVET college was a good move. Table 4.6 shows that two sets of participants with equal representation reported that they very frequently used AI and that they used AI occasionally, respectively. However, two other groups of participants with equal representation reported that they rarely used AI and extremely rarely used AI, respectively. Only of the participants said they use AI often. The reasoning for this query was two-fold. Firstly, it was used to gauge lecturers' knowledge of AI (TKOE), and secondly, the researcher suggests that openness at this level may facilitate the implementation of a system or tool (TOE).

Table 4.6: AI use frequency in TVET colleges

AI use frequency in TVET colleges	Number of respondents
Very frequently	1
Frequently	1
Occasionally	3
Rarely	2
Very rarely	3
Never	1
Total	**11**

4.3.2 Interview findings

The present study delves into the transformative impact of Artificial Intelligence (AI) in facilitating workplace integrated learning within the context of a South African Technical and Vocational Education and Training (TVET) college during the challenging times of the COVID-19 pandemic. With the sudden shift to remote and online learning, the TVET college explored innovative approaches to bridge the gap between theory and practice. Through a series of in-depth interviews conducted with lecturers valuable insights were gathered on the practical implementation and potential of AI-driven solutions in enhancing workplace integrated learning experiences. The interview findings shed light on the diverse perspectives

and experiences, uncovering both the opportunities and challenges associated with the integration of AI in the learning environment. By examining these findings, this dissertation seeks to contribute to the discourse surrounding AI's role in fostering effective and sustainable educational practices amid unprecedented global disruptions.

4.3.2.1 Section 1: Challenges TVET lecturers faced conducting workplace integrated learning prior to the COVID-19 pandemic

Many lecturers indicated during the interview that while the benefits of WIL for the stakeholders, including learners, industry, lecturers, and the TVET college, are extensive and well acknowledged, WIL has inherent risks distinct from those associated with on-campus learning. Both experienced and less experienced TVET lecturers stated that these risks may have substantial reputational and legal repercussions for WIL stakeholders. They claimed that the learning environment on campus can be controlled and monitored since it is predictable but that WIL programmes take place in a variety of community and corporate contexts and have various organisational structures based on the curriculum guide. In line with this assertion, Lecturer 2 explained that variable contracts exist between the parties associated with WIL, and that WIL assignments can be either full or part time, paid or unpaid, and last from a few weeks to several years. Participant 4 agreed and added that organisations are often not compensated for sponsoring a learner. He further stated that given the vast variation within WIL, it is crucial to recognise that the risks associated with it are similarly diverse and may vary between fields, companies, and institutions.

Other lecturers noted that lecturers involved in WIL implementation consider health and safety, learners' behaviour, and host employer behaviour, including the exploitation and physical safety of learners, as high-risk areas. These aspects are all connected to the TVET college's reputational risk. Lecturer 1 revealed that "the risks must be clearly understood by lecturers for them to develop risk management procedures to lessen them for TVET colleges, learner, host organisations, as well as themselves".

The lecturers mentioned the Occupational Health and Safety Act 85 of 1993 that mandates that the host organisation employer must take reasonable precautions to prevent damage to a learner as it does with any other worker it employs. Participant 5 agreed and added that "in order to maintain efficient health and safety management, the TVET college is obligated to

seek advice, interact, and synchronise operations with the host employer. This is arguably part of its overlapping obligation to the learner".

The foregoing makes it clear that the capacity of an institution to accomplish its WIL objectives may be impacted by strategic risk. Lecturer 9 said the following about it:

> Even if a suitable location is identified, it might be logistically difficult to coordinate the schedules of learners, lecturers, and workplace mentors. Stakeholders seem to operate independently, each with its own set of reality. The quantity and calibre of learners produced by TVET institutions are unlikely to satisfy the needs of the labour market. Government policies should be synchronised and updated often since things change so quickly in the modern world. It appears that the government is wasting money on programmes that are no longer required.

Lecturer 4 made the following statement:

> Prior to the COVID-19 epidemic, lecturers at a TVET institution may have had a few difficulties while attempting to undertake WIL. These difficulties might include finding organisations that can host learners for WIL; organising the lecturers' workload, which include overseeing WIL placements in addition to their usual teaching responsibilities. This takes time and increase the lecturers' burden.

The interviews revealed that it can be challenging to guarantee learners are receiving a high-quality education during WIL placements because each organisation have a different learning environment and resources. Lecturer 2 expanded on it as follows:

> For TVET institutions, forming relationships with industry partners and locating appropriate job placements for learners can be difficult, particularly in sectors with a constrained ability to accept learner placements. And WIL can take a lot of time because it frequently requires negotiating with business partners and scheduling placements around class timetables. This can be particularly difficult for lecturers who have a plethora of classes to teach.

Lecturer 5 highlighted that insufficient resources is one of the challenges lecturers face and emphasised that "it's possible that TVET institutions lack the tools required to help learners during occupational learning experiences, such as transportation or safety gear". Lecturer 7 pointed to safety and health issues as part of the challenges and said, "Ensuring the health and

safety of learners when they are participating in occupational learning experiences can be difficult, particularly in fields where the job is physically demanding or dangerous". Lecturer 07 stressed inexperience and unwillingness to change and said, "Some lecturers could lack the necessary expertise to properly help learners in this kind of setting; and perceived WIL as a deviation from conventional forms of education; thus, they were reluctant to engage"

The interviews showed that lecturers face different challenges prior of the COVID-19 pandemic and they were all aware of them. Some of these challenges were as a result of the shortcomings of the lecturers themselves.

4.3.2.2 Section 2: Factors that influence the use of artificial intelligence to accelerate the implementation of workplace integrated learning at a TVET college

The participants provided further grounds for the use of AI in WIL, including improved pedagogy, more access to pertinent knowledge, flexibility in terms of learning schedules, and cost effectiveness. Nearly all the lecturers indicated more effective instructional methods, which makes sense given that when humans are engaged in WIL, the transmissive approach —a one-way information transmission method—dominates the interactive strategy, but this is not the case when AI is used.

Lecturer 6 claimed that a TVET college's ability to raise the necessary funds is essential to the successful application of AI in WIL. He further noted that the successful integration of AI in WIL depends on the availability of the necessary infrastructure, including hardware, software, and networking.

The availability of teaching materials that are pertinent to AI and WIL, and according to Lecturer 3, it is crucial for the successful deployment of resources because "this covers textbooks, internet sources, and other tools that can help learners acquire and expand their AI abilities". Moreover, according to Lecturer 7, the training and skills of lecturers and staff at a TVET plays a major role in successfully implementing WIL through AI. Participant 10 agreed and added that "TVET lecturers and staff must be well-versed in the technology and know how to use it in the classroom if they are to employ AI effectively". Lecturer 8 stated the following:

> For the adoption of AI in WIL at a TVET institution, cooperation with industry partners, such as companies and organisations that are currently using AI, can give

> invaluable insights and resources; and again, the effectiveness of AI adoption in WIL at a TVET institution can also be influenced by how keen learners and staff are to embrace and employ AI in their learning and teaching.

Resources prerequisites were clearly stressed as having a major influence on the use of AI. The interviews clearly showed that TVET colleges require more resources to assist with the introduction and integration of AI into their curricula since AI technology can be costly to buy and maintain.

4.3.2.3 Section 3: Effects of the COVID-19 pandemic on the implementation of workplace integrated learning at a TVET college

Some lecturers explained that the COVID-19 pandemic hampered the academic development of many learners by interfering with the continuity of TVET programmes and WIL evaluations. Lecturer 10 explained that due to the amount of time invested, assessments had to be changed and the methods used in assessments had to be amended because "even by itself, this practice has financial repercussions".

Other lecturers noticed that TVET colleges, among other education and training institutions, have been significantly impacted by the COVID-19 pandemic. The transition by many institutions to online or hybrid learning models may have impacted how WIL programmes are implemented. Lecturer 3 made the following comment:

> For instance, due to limits on travel and in-person contacts, I have seen some WIL programmes being delayed or disrupted, while others had to change how they provide WIL experiences online.

The interviews gave a clear picture of the critical effects the COVID-19 pandemic had on the implementation of WIL.

4.3.2.4 Section 4: Lecturers' attitude towards and perceptions of the role of artificial intelligence in training and education

In the interviews, the participants described the good and bad aspects of AI. Positive aspects included the development of lecturers', mentors', and learners' inventiveness in assessments, including personalisation of feedback and workplace tasks, which led to a growth in knowledge and knowledge sharing using various AI educational artefacts. On the other hand,

the drawbacks included the possibility of less human contact and conversation, which may result in a degree of loneliness and seclusion. Only a few participants did not have strong opinions on the use of AI in education, but even though they did not have strong opinions or a lot of expertise in AI, some lecturers were amenable to using it in the classroom. They were prepared to weigh the advantages and disadvantages of AI and make case-by-case decisions about whether and how to use it in their instruction.

When discussing the potential for AI to replace mentors or lecturers in the workplace, participants brought up the ethical concerns that are still a contentious topic in the AI community. Lecturer 9 said the following:

> In a constantly changing world where the pandemic has stretched the reality of education outside the physical classroom, I strongly believe that lecturers have no choice but to adapt to the new way of life. We have just one option for teaching and educating learners using digitally integrated AI artefacts, whether in theory or in practicals.

The interviews provided clear insight into lecturers' attitude towards and perceptions of the use of AI. It showed that there are a few variables that can affect lecturers' attitude toward and perception of AI in WIL, including their familiarity with the technology, their personal views on the place of technology in education, and their professional experiences using AI in the classroom.

4.4 Discussion

This study used the TOE and TPACK frameworks to explore the role of AI in fostering integrated learning at a South African TVET college during the COVID-19 pandemic. The discussion is structured around the themes that complemented the conceptual framework used for content analysis.

4.4.1 Section 1: Challenges TVET lecturers faced conducting workplace integrated learning prior to the COVID-19 pandemic

Before the COVID-19 pandemic, lecturers at a TVET college faced a variety of difficulties when facilitating WIL. The findings showed that 02 of the participants highlighted a mismatch between the curriculum content and the business scope of work where learners are

often placed as part of the challenges encountered when conducting WIL prior to the pandemic. This aligns with McLennan and Keating's (2008) findings that there is a lack of consistency between theoretical, professional, and experiential learning models used to implement WIL and that curricular material and pedagogical approaches must be reconsidered. In addition, the interviews also showed that finding and securing appropriate placements for learners to fulfil their WIL may be challenging for lecturers. This finding is consistent with the advice given by Ajjawi et al. (2020) that measuring WIL may be challenging because it involves people and locations outside the TVET college, and therefore, it can be challenging to match learning activities during WIL with what the TVET college can or cannot assess.

Furthermore, lack of resources was selected by 02 of the participants as being one of the major challenges they faced. This survey outcome is in line with the claims by Lawson et al. (2011) and Oosthuizen et al. (2022) that lecturers lack the time to thoroughly understand WIL structures, experiment with novel WIL formats, and devise strategies to overcome obstacles that can limit their successful implementation. Organising transportation for learners to and from placements, coordinating schedules with employers and learners, and handling any additional paperwork or documentation are just a few of the logistical obstacles that come with planning WIL activities. A key responsibility of lecturers is to guarantee learners are safe while participating in WIL placements. This backs up Fleming and Hay's (2021) assertion that WIL entails significant risks, including risks to health and safety, the behaviour of some learners, and host corporate behaviour, if not addressed early. Risk assessments and safety procedures may be necessary to reduce potential risks (Jackson, 2017b).

In the survey, one participant indicated that the preparation of learners prior to starting their WIL is often not done according to high standards. This finding is consistent with that of Jenny et al. (2018), Aina and Ogegbo (2021a), and Billett (2009), who emphasised the difficulties, such as little to no training on pedagogical approaches for lecturers, that contribute to learners' poor WIL preparation. Making sure that learners are adequately prepared for their WIL placements may be difficult for lecturers because it entails giving learners the knowledge and abilities they need as well as assisting them with forming corporate behaviour and attitudes.

Finally, during their WIL placements, learners need support and supervision from lecturers. In order to do this, it may be necessary to regularly check in with learners, offer advice and

comments, and make sure they are reaching the learning objectives of their WIL. Lecturers are therefore expected to visit workplaces where learners are placed. Lawson et al. (2011) noted the lack of TVET support to lecturers during WIL implementation. This is supported by the survey outcome confirming that 04 of the participants complained about WIL being an additional workload. Maintaining assessment quality and integrity may be difficult for lecturers when it comes to WIL assessment procedures, which can entail creating and putting into practice efficient assessment criteria and making sure that tests are administered in a fair and uniform manner.

4.4.2 Section 2: Key factors that influence the adoption and implementation of AI technologies to enhance and expedite Workplace Integrated Learning (WIL) in a TVET college setting

There are several factors that can influence the adoption of AI in WIL at a TVET college. The survey revealed that one participant claimed that using AI helps transfer work away from lecturers who are already overburdened with instructional tasks. Clauberg (2020) stressed this aspect in their study. Without adding to the workload of lecturers, AI can help TVET colleges expand the number of learners to whom they can provide their educational programmes. This finding supports the claim made by Pedro et al. (2019) that cutting-edge methods and AI can be used in education to expand teaching and learning opportunities and to improve administrative tasks.

The results showed that 04 of participants stated that AI helps implement a customised WIL curriculum to ensure learners successfully complete the WIL programme. A more individualised and efficient learning experience can be achieved using AI to customise the educational process to the unique needs and preferences of each learner. With the aid of AI, learners can advance at their own pace, taking as long or as little time as necessary to completely comprehend the content.

Three participants stated that AI aids in the use of monitoring, evaluation, and assessment tools. Certain responsibilities, like assigning grades or providing feedback, can be automated by AI, freeing up lecturers to concentrate on other duties and enhancing their productivity.

The survey showed that one of the participants stated that AI gives quick feedback, recommendations, and incentives. Learners who might not otherwise have access to high-

quality TVET training, such as those in rural or underserved locations, can benefit from educational resources and support provided by AI.

One of the interviewed lectures stated that AI alleviates the pressure on firms that are struggling to recover economically by decreasing costs and making data-driven decision. By automating specific operations and enabling scalable material delivery, AI can help lower the equipment maintenance cost and mentors' cost of training and development. This finding supports Zhou's (2021) assertion that a simulation teaching system may lessen the risk of damage to crucial equipment from learners' mistakes. AI can assist businesses in collecting and analysing data on learner performance and learning, enabling them to make better decisions about future WIL implementation.

4.4.3 Section 3: Effects of the COVID-19 pandemic on the implementation of workplace integrated learning at a TVET college

The COVID-19 pandemic has had a substantial effect on how educational institutions, particularly TVET colleges, operate around the world (World Bank Group, 2019). In order to comply with health and safety regulations related to the pandemic, many educational institutions had to make significant changes to the way they conduct business. Some of these changes included switching to online or hybrid learning models and putting social distancing strategies into place. Given that many workplaces also had to modify their operations or close temporarily because of the pandemic, these adjustments also had an impact on the implementation of WIL initiatives. Some educational institutions had to postpone or discontinue WIL assignments, and others had to modify their WIL programmes to address the obstacles posed by the pandemic, for example, by including virtual or remote learning experiences. The results of the study showed that the pandemic had a significant impact on TVET colleges' implementation of WIL. The survey results indicated that COVID-19 pandemic effects on WIL included learning interruption delaying the completion of WIL interruptions caused (04 participants, lost instructional time (03 of the participants), redeployment of learners to new jobs (01 participant), lecturers not being prepared to accommodate digital learning (02 participants); and inability to conduct face to face On-the-job training (OJT) (01 participant).

The difficulties of planning and arranging work placements in a remote or virtual environment during the pandemic affected or delayed the implementation of many WIL

programmes. However, some TVET colleges adapted and discovered strategies for maintaining WIL possibilities through online or virtual platforms. This supports the arguments made by Bayerlein (2015) that TVET colleges should follow the example of WIL learners and have them complete their practical work at home and record themselves performing the tasks. The World Bank Group (2019) and Irwin et al. (2012) supported the use of virtual augmented reality when there are restrictions on people's freedom of movement.

In order to reduce the risk of virus transmission, it was crucial for TVET colleges to ensure the health and safety of learners and lecturers come first and to abide by the directives and suggestions of the appropriate authorities. In addition, it was critical that institutions continue to assist learners in their learning and development, particularly through WIL programmes in ways that are safe and practical.

4.4.4 Section 4: Lecturers' attitude towards and perceptions of the role of artificial intelligence in training and education

Most study participants were experienced lecturers who complement their instructional strategies with contemporary learning technology, including learning management systems for scheduling classes and communicating with learners, and virtual learning libraries for retrieving course materials. Overall, TVET lecturers are at ease using digital learning technologies. The results of this poll showed that 04 of the surveyed lecturers believe they had little AI knowledge, whereas 07 of lecturers said they had in-depth knowledge. This finding conflicts with earlier claims by Ferguson et al. (2016) that the use of intelligent teaching aids in the classroom is uncommon and those of Chounta et al. (2021) that lecturers are unaware of AI and how it could help them in the classroom and their job.

The findings of the current research revealed that most lecturers demonstrated a positive cognitive, emotional, and behavioural attitude toward the use of AI to mitigate the impact of the COVID-19 pandemic during WIL adoption (Dwivedi, 2020). This contradicts Chounta et al.'s (2021) findings that lecturers are not aware of AI and its impact on their environment. Lecturers' opinions and perceptions regarding the usage and function of AI in WIL differed. Some lecturers were excited about the potential of AI to improve and supplement the learning experience, while others were dubious or unwilling to employ it (Cromton & Song, 2021).. This is in line with Chounta et al.'s (2021) and Cheok et al.'s (2017) findings about the sociocultural milieu. Some lecturers see AI as a useful tool that can help learners learn more

personally and effectively, but others are be concerned that AI could eventually replace human lecturers or reinforce prejudices in the educational system.

It is crucial for educational institutions to consider how their faculty members feel about using AI in the classroom and to make sure that any implementation of technology is done in a way that is open, moral, and considerate of the needs and concerns of all parties involved.

In conclusion, although TVET lecturers have implied and overt attitudes toward the use of AI to overcome the effects of the COVID-19 pandemic in the implementation of WIL, they appear to have a generally accepted desire and readiness to use the virtual world to help learners successfully complete their WIL programmes. The results also showed that lack of resources and strategic, pedagogical, technical, and structural support influence attitudes and perceptions towards the use of AI, which confirms the findings of the New Media Consortium's Horizon Report for 2017.

4.5 Summary of Chapter

According to Silverman (2011), content analysis results in a comparatively methodical and thorough assessment of the entire data collection. The study's direction and guidance were aided by the research objectives. Research goal one looked into the difficulties lecturers at TVET college encountered when attempting to undertake WIL prior to the COVID-19 pandemic. Responses related to this objective cited a lack of resources for TVET colleges, inadequate learner preparation for WIL programmes, a lack of learner support and supervision during WIL implementation, and a mismatch between the curriculum's content and the business's scope of work. Another goal of the research was to determine the key factors that influence the adoption and implementation of AI technologies to enhance and expedite Workplace Integrated Learning (WIL) in a TVET college setting. Responses to this goal included reducing the workload of lecturers, tailoring the curriculum to the needs of each learner, helping with monitoring, evaluation, and assessment, providing useful feedback and recommendations, and lowering mentoring costs and equipment maintenance expenses. In order to achieve aim three, the researcher concentrated on determining the impact of the pandemic on the implementation of WIL at a TVET college. The interruption of WIL, lost instructional time, learners being transferred to different employment, and lecturers not being ready to accept digital learning were all mentioned by participants as consequences of the

pandemic. The fourth research goal was to ascertain lecturers' attitudes towards and perceptions of the application and function of AI in education, and the results showed that most participants emphasised their understanding of AI and that only a minority said they knew little about AI.

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS FOR FURTHER STUDY

5.1 Introduction

This chapter is a summary of the findings, the conclusions, which emphasise the research's key findings and lessons learned, and recommendations for policy-makers, practitioners, and future research.

5.2 Summary of Findings

The purpose of the study was to highlight how AI can support WIL at a TVET college in South Africa during the COVID-19 pandemic. Based on the literature and TOE and TPACK conceptual frameworks, an assumption was formed and elaborated on in the research problem (section 1.2), the background (section 1.1), the research rationale (section 1.3), and the research goal (section 1.4). In an attempt to address this assumption, the objectives (section 1.6) helped keep the study on track. The following question guided the study: How does the use of AI foster WIL at a South African TVET college during the COVID-19 pandemic?

Empirical evidence, including the results of the survey and interviews, and the literature review, was used to examine the various possibilities of using AI to encourage WIL at a TVET college during the COVID-19 pandemic. In response to the main research question, the following topics emerged and were explored in detail:

- Challenges TVET lecturers faced conducting workplace integrated learning prior to the COVID-19 pandemic;
- Factors that influence the use of AI to accelerate the implementation of WIL at a TVET college;
- Effects of the COVID-19 pandemic on the implementation of workplace integrated learning at a TVET college; and
- Lecturers' attitude towards and perceptions of the role of artificial intelligence in training and education.

The findings under these themes are summarised in the following subsections.

5.2.1 Challenges TVET lecturers faced conducting workplace integrated learning prior to the COVID-19 pandemic

In this section, the researcher tried to uncover the difficulties TVET college lecturers and TVET college as institutions encountered when conducting WIL prior to the COVID-19 pandemic. Both empirical and extant scholarly evidence provided insight into the question.

For TVET college lecturers, empirical evidence showed that TVET colleges were overloading lecturers with WIL on top of the heavy teaching tasks that they already had (04 participants), stakeholders' roles and functions were unclear (02 participants), there was a mismatch between the curriculum material and the business scope of work in which learners were frequently placed (02 participants), there was a lack of resources to smoothly run the implementation of WIL (02 participants), and there was inadequate learner preparation prior to beginning the WIL programme (01 participant).

For the TVET college, the survey showed that one of the primary problems that 46% of participants encountered when applying WIL prior to the pandemic was a lack of required resources. The Department of Education's inadequacy and lack of assistance, according to one participant, contributed to the WIL's poor implementation, and one participant stated that the poor implementation of WIL was due in large part to a lack of support from potential employers who believed that TVET colleges did not meet industry training level requirements. Finally, 04 participants of participants stated that the main problems encountered in implementing WIL prior to the pandemic were the competency of the lecturers and a lack of adequate infrastructure resources.

5.2.2 Key factors that influence the adoption and implementation of AI technologies to enhance and expedite Workplace Integrated Learning (WIL) in a TVET college setting

In an attempt to answer the question associated with this topic, 04 participants affirmed that the key findings show that AI helps transfer work away from lecturers who are already overburdened with instructional tasks, 02 participants stated that the implementation of a customised WIL curriculum to ensure that learners successfully completion of the WIL programme, 03 participants made reference to the use of monitoring, evaluation, and

assessment tools, and 02 participants made reference to the provision of quick feedback, recommendations, and incentives

5.2.3 Effects of the COVID-19 pandemic on the implementation of workplace integrated learning at a TVET college

Among these effects of the pandemic were WIL disruptions (04 participants), missed instructional time (03 participants), learners being moved to new employment (01 participant), and lecturers who were not prepared to accept digital learning (02 participants).

This section also tried to identify the efforts TVET institutions took to offset the impact of the COVID-19 pandemic on WIL implementation. One participant stated learners' homes were used as simulation venues for practical exams, and four participants indicated that nothing had been done in this regard. Because of their inability to conduct face-to-face on-the-job training, TVET colleges were forced to conduct theoretical off-the-job training courses or curriculum (one participant) or to quickly transition from in-person instruction to online learning (five participants).

5.2.4 Lecturers' attitude towards and perceptions of the role of artificial intelligence in training and education

According to the survey findings, 04 of polled lecturers considered they had little AI expertise, and 07 claimed they had in-depth knowledge. The findings of the interviews revealed that participants described both the positive and negative elements of AI. The rise of lecturers', mentors', and learners' inventiveness in evaluations, including the customisation of feedback and workplace assignments, led to an increase in knowledge and knowledge sharing using various AI educational artefacts. On the other hand, the disadvantages include the likelihood of less human contact and dialogue, which could lead to loneliness and seclusion. Communication between people is essential during the learning process. The participants raised ethical concerns about the potential of AI to replace mentors or lecturers in the workplace, which is still a sensitive topic in the AI community.

5.3 Conclusions

The use of AI to implement WIL during the COVID-19 pandemic at a South African TVET college yielded good outcomes. It allows TVET college learners to receive assistance and resources for their WIL experiences online, even during pandemic-related disruptions, through the adoption of AI-powered virtual assistants and chatbots. These tools have been proven to be helpful in improving communication among learners, coordinators, lecturers, and employers, as well as in creating a sense of community and connection despite physical distance.

The use of AI in WIL has the potential to significantly improve learner outcomes and experiences and meet or even exceed stakeholders' expectations. However, it is critical to continue evaluating and assessing the use of these technologies to ensure they are used efficiently and ethically. As the use of AI in education grows, it will be critical to address the possible consequences on equality and inclusivity and work to ensure all learners have access to these great resources.

AI (Artificial Intelligence) plays a crucial role in supporting workplace integrated learning (WIL) at TVET (Technical and Vocational Education and Training) colleges in South Africa during the COVID-19 pandemic. Firstly, AI-powered adaptive learning platforms have been instrumental in addressing the challenges of remote learning. By analysing learners' performance data and preferences, AI algorithms can provide personalised learning pathways and content, ensuring that learners receive tailored instruction based on their individual needs and pace of learning. This personalised approach fosters better engagement and comprehension, enabling TVET learners to continue their learning journey effectively despite the disruptions caused by the pandemic.

Secondly, AI-driven virtual reality (VR) and augmented reality (AR) simulations have been valuable in providing hands-on learning experiences even when physical access to workplaces is restricted. These simulations enable learners to practice technical skills in a virtual environment that replicates real workplace scenarios. By immersing learners in simulated work environments, AI-powered VR and AR technologies allow them to gain practical experience and develop essential skills, making them better prepared for future work placements and actual job roles.

Lastly, AI-supported learning analytics and automated feedback systems have played a crucial role in monitoring learners' progress and providing timely support. Learning analytics powered by AI can track learners' learning patterns, identify areas of improvement, and predict potential challenges. This data-driven approach empowers educators and mentors at TVET colleges in South Africa to intervene proactively and offer targeted assistance to learners facing difficulties in their studies. Additionally, AI-driven feedback and assessment tools using natural language processing (NLP) automate the grading process and provide personalised feedback on assignments, ensuring continuous learning and development for the learners even in the absence of in-person interactions.

In conclusion, AI has been a transformative force in supporting workplace integrated learning at TVET colleges in South Africa during the COVID-19 pandemic. Through adaptive learning platforms, AI-driven VR/AR simulations, and learning analytics with automated feedback, AI has enabled personalised and immersive learning experiences for TVET learners. As the pandemic continues to reshape the educational landscape, the integration of AI technologies in workplace integrated learning holds great promise for enhancing learner engagement, skills development, and overall learning outcomes in the TVET sector.

5.4 Recommendations

WIL is a useful approach for equipping learners with the skills and experiences they need to be successful in the workplace. The integration of AI in WIL has the potential to improve the experiential learning and help learners gain experience that are in short supply in the labour market. However, the use of AI in WIL involves a variety of ethical, practical, and logistical concerns that must be addressed. This section gives recommendations for further policy and practice and research and development work in AI in WIL in South African TVET colleges during the COVID-19 pandemic or similar pandemics that might limit the movement of learners and restrain employers from accepting learners. These recommendations are based on a survey of the literature and the results of this study. These guidelines will be helpful to people who are interested in investigating the use of AI in WIL and will help guarantee that the technology is used responsibly and effectively.

5.4.1 For policy and practice

The following essential considerations should be kept in mind by policy-makers and practitioners as they explore the role of AI in fostering WIL during the COVID-19 pandemic and beyond:

- It is important to establish guidelines and best practices for the use of AI in WIL to ensure the technology is used in an ethical, transparent, and fair manner.
- Secondly, it is crucial to consider leveraging AI to facilitate virtual or remote WIL opportunities, such as virtual workplace training, to provide learners with beneficial experiences and skill development even during a pandemic or other periods when physical participation in WIL is unfeasible.
- Thirdly, it is imperative to consider making an investment in learning management systems with embedded AI capabilities or other educational technology tools that can enable learning that is integrated into the workplace. Many of the administrative and logistical processes involved in WIL can be automated and streamlined with the aid of these tools, freeing lecturers' time to allow them to concentrate on teaching and learner support.
- It is vital to explore potential collaboration avenues with local businesses and organisations for increased WIL opportunities.
- Fifthly, it is essential to monitor and assess learner progress and performance using data analytics and other AI-powered tools and identify areas where more support, such as mental health support during the pandemic, is required. This will help ensure learners get the most out of their workplace integration learning experiences.
- It is necessary to promote continuing professional development for faculty and staff that focusses on how to effectively employ AI and other digital tools in the classroom and WIL programmes. This will help ensure lecturers and staff are well-equipped to reap the many benefits of AI in education.

Policy-makers and practitioners can help guarantee that these technologies are employed in a way that helps learners and supports the broader mission of the TVET colleges by staying informed and proactive in their approach to AI in education.

5.4.2 For further research

It is advised in the future scholars look at the following in the area of AI in education:

- Work together with decision-makers, employers, communities, and other interested parties specialising in the use of AI in training and education to make sure research is pertinent and useful in practical contexts.
- Investigate how AI can be used to connect learners with business partners and future employers and examine the impact of these relationships on learner career success.
- Investigate the efficacy of using AI to support virtual or remote WIL opportunities. This can include gathering information on learner learning and performance and evaluating the impact of these programmes on learner career outcomes.
- Investigate the potential ethical concerns of employing AI in WIL, including aspects of privacy, data security, and fairness.
- Examine best practices for using AI in WIL, such as techniques for making AI technologies accessible and user-friendly for learners.
- Explore the possibilities for employing AI to tailor WIL programmes and support learners' individualised learning paths.

By implementing these suggestions, further research will add to the body of knowledge in this rapidly growing subject area and provide guidance for the creation of efficient and moral procedures for the use of AI in education.

5.4.3 For further development work

As technology advances at a rapid pace, the application of AI in education has garnered and continues to gain traction as a possible tool for enhancing workplace learning outcomes and increasing efficiency. While AI has the potential to improve and supplement traditional teaching techniques, it is vital to acknowledge its limitations and approach its usage in education with a critical and scientific mindset. The researcher proposes that future studies investigate the following:

- How has the use of AI in WIL since the beginning of the COVID-19 pandemic changed?
- How educators and learners responded to the use of AI in WIL during the pandemic?

- How the deployment of AI in WIL during the pandemic influenced the efficiency and efficacy of the learning process?
- How the use of AI in WIL during the pandemic affected the labour market and learner job chances?
- How AI will be used in WIL after the pandemic?
- How could AI be implemented in WIL in an ethical and responsible manner, particularly in light of privacy and fairness concerns?
- How the best strategies for using AI in WIL programmes during the pandemic and beyond can be scaled and replicated?
- What effects using AI in WIL programmes may have on learners' educational outcomes and employment during the pandemic?
- What the long-term impact of using AI in WIL programmes during the pandemic will be education and employment?

By answering these research concerns, future studies can contribute to a deeper understanding of the function of AI in education and contribute to the establishment of best practices for its implementation in WIL implementation in South African TVET institutions during the COVID-19 pandemic.

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Appendix A: Request to participate in the research

Dear Participant,

My name is Kabwe Zacharia Chanda and I am currently working on my Master Thesis in the field of Education [specialising in Information, Communication and Technology (ICT)] at the University of Johannesburg (UJ). This study will attempt to analyse the role of artificial intelligence in fostering workplace integrated learning (WIL) at a South African TVET college during Covid-19.

The research is conducted subject to the rules and stipulations of the Faculty of Education Ethics Committee of the University of Johannesburg (UJ), and includes the following:
- Your participation in the research is entirely voluntary;
- No harm will befall you by either participating or not participating, nor will you benefit financially by participating;
- You may withdraw from the research at any point, and request that your responses be withdrawn from the data set; and
- Your anonymity is guaranteed, and you will not be identified in any way in research reports that may emanate from the research.

Please note:
-The data will be digitally stored for posterity, and may be used in other research projects,
- You may request a digital copy of research reports post-publication at no cost to you, and
- The raw data set cannot be made available to you as it will violate the anonymity principle.

The questionnaire collects quantitative and qualitative data. Quantitative data will be coded and entered into an Excel spreadsheet for analysis, which will include measures of central tendency, correlational analysis, factor analyses and other appropriate statistical analyses. Excel will be used for the analysis of the qualitative data. Qualitative data will be subject to text analyses using procedures like content analysis, the constant comparative method, thematic analysis, or other appropriate analysis techniques. This may in include quantifying the qualitative data.

Your familiarity and expertise in using ICT to implement learning programs in a TVET college are some of the reasons you have been selected to assist in providing sine qua none answers to the questionnaire.

Please select a time when it is convenient for you to complete the questionnaire fully, and remain fully engaged for the duration of the questionnaire. The filling of the questionnaire will take you no longer than 15 minutes. Questionnaire responses typically suffer from respondent fatigue in later sections, and it becomes a serious threat to the reliability of the data.

I would like to thank you in advance for your contribution to the research by completing the questionnaire.

Appendix D: Survey questionnaire

Kindly indicate your age

- Less than 30
- 30 - 40
- 41 - 50
- 51 - 60
- 61 – more

Kindly indicate your gender

- Male
- Female
- Prefer not to say
- Other

How long have you been working at the TVET college (implementing WIL)?

- 0 - 5 years
- 6 - 10 years
- 11 - 15 years
- 16 - 20 years
- More than 20 years
- Other

For purposes of transformation reporting, kindly indicate which population group you fall under

- Asian
- Black
- Colored
- Indian
- White

What is your educational attainment?

- National Diploma
- Bachelor's Degree
- Honors Degree
- Master's Degree
- Doctoral degree
- Post Doctoral degree

What role do think you can play in using AI to accelerate the implementation of WIL at your TVET College?

How often have you used ICT artifacts in facilitating both theoretical and workplace integrated learning (WIL) during your employment at the TVET college?

What do you think are the major challenges you as a TVET lecturer faced in conducting workplace integrated learning (WIL) prior to COVID-19?

- Conducting workplace integrated learning for learners is an additional work on the heavy load(s) that is / are already allocated to me by the TVET college
- I have no clear understanding of what WIL is and I have never received any special training to implement it
- There are no resources the TVET college provides to ensure that WIL is effectively implemented
- There are many grey areas (in terms of WIL's scope, functions and objectives / aims) that still need to be addressed for all the stakeholders in order for WIL to be effective
- Learners are not well prepared to go to the workplace. I still believe that some kind of workplace readiness program should be provided to them prior to starting WIL
- Difficulties to work with incompetent managers / supervisors to whom learners are reporting
- Mismatch of the TVET programs' objectives and workplace sites scope of work

What major challenges did your institution (TVET) face to implement workplace integrated learning prior to COVID-19?

- Lack of suitable resources to successfully
- The TVET does not believe WIL play a critical role in the learners' learning
- Lecturer's competency and inadequacies of infrastructure resources
- Lack of support from potential employers who believe that TVET colleges do not meet the industry training level requirements
- Insufficient / lack of support from the Department of education
- TVET is of the view that a dedicated management structure should be put in place to place learners in appropriate work sites
- Other

What do you think can be the factors that influence the use of AI in accelerating the implementation of WIL at a TVET College?

- Use of monitoring, evaluation and assessment tools
- Tracking of daily tasks performed by the learners
- Provision of prompt feedback and recommendations / motivation
- Personalised WIL programme to ensure that all learners complete the WIL
- Offloading tasks (i.e. admin, assessments, tracking of learning progress, etc) from lecturers who are already loaded with teaching tasks
- With companies struggling to recover economically, there may be fewer there may be fewer workplace available. Therefore the perfect ersatz will be AI.
- Uninterrupted (continuous) learning

What have been the effect of Covid-19 on the implementation of WIL at your TVET College?

- Learning interruption delaying the completion of WIL
- Redeployment of learners in different workplaces as some companies have since been forced to indefinitely close their businesses
- Loss of instructional time
- Teachers' preparedness to support digital learning
- Other

What measures did the TVET college take to subside the effect of Covid-19 on the implementation of WIL at your TVET College?

- Rapid shift from face-to-face teaching to online learning
- WIL was still being implemented as usual needing the physical presence of candidates

- Simulation of practicals at learners' individual home
- No measure was taken in this regard
- Other

What is your position on the use of AI in implementing WIL in your TVET college?

- Strongly agree
- Agree
- Undecided
- Disagree
- Strongly disagree

Appendix E: Interview protocol

Introduction:

- Greet the participant and introduce yourself as the researcher.
- Explain the purpose of the interview, which is to explore the use of AI in work-integrated learning at TVET colleges during COVID-19.
- Ensure the participant's informed consent for the interview and clarify that their participation is voluntary.
- Assure confidentiality and explain that their responses will be used for research purposes only.

Background Information:

- Confirm with the participant about their role in the TVET college (e.g., lecturer) and their experience with work-integrated learning programs.
- Inquire about their familiarity with AI technologies and their usage in training and education or workplace settings.

AI Integration in WIL:

- Explore the participant's perception of the use of AI in work-integrated learning. Ask about any experiences or interactions with AI-driven learning platforms, simulations, or automated assessment tools during the WIL program.
- Inquire about the advantages and challenges they see in incorporating AI in WIL, particularly during the COVID-19 pandemic.

Impact on Learning Experience:

- Probe the participant's thoughts on how AI has impacted their learning experience during WIL. Ask about the level of engagement, personalisation, and interactivity they perceive with AI-powered learning tools.

- Investigate whether AI has facilitated the development of relevant skills and competencies for their future careers.

Educator and Industry Perspectives:

- If the participant is an educator or industry partner, inquire about their observations of how AI has influenced the learning outcomes of TVET learners during WIL.
- Discuss any changes in teaching methods or workplace training practices due to the integration of AI in WIL.

Challenges and Ethical Considerations:

- Ask the participant about any challenges or limitations they have encountered with the use of AI in WIL. Explore issues related to data privacy, AI bias, or access to technology, particularly in the context of South Africa.
- Discuss ethical considerations in AI usage, and how TVET colleges can address these concerns to ensure an ethical and equitable learning environment.

Future Implications and Recommendations:

- Inquire about the participant's perspective on the future of AI integration in WIL at TVET colleges. Ask about potential areas of improvement or enhancement in using AI to support WIL programs.
- Seek their recommendations for TVET colleges to optimise the benefits of AI-driven learning while addressing its challenges.

Conclusion:

- Thank the participant for their valuable insights and time.
- Provide an opportunity for the participant to ask any questions or share additional thoughts.
- Reiterate the confidentiality and anonymity of their responses.
- Conclude the interview and express appreciation for their contribution to the research.