

The viability of Virtual Reality Head-Mounted Displays in the teaching and learning of pre-service History teachers

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DECLARATION

I, the undersigned, hereby declare that the work contained in this dissertation is my own original work and that I have not previously submitted it, in whole or in part, to any university for a degree.

A handwritten signature in black ink, appearing to be 'G. M. D.', written over a horizontal line.

06/03/2024

Signature

Date

DEDICATION

Psalm 119:105: “Your word is a lamp to guide my feet and a light for my path.” First and foremost, I want to dedicate this study to the Lord of lords, my Saviour Father God. In times when my strength said no but the path I chose demanded a yes, You, Lord, provided the way.

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ABSTRACT

Due to the Fourth Industrial Revolution (4IR) and the necessary required 21st century skills, the present educational system is undergoing a process of methodological and pedagogical reform. Information and Communication Technologies (ICT's) such as Virtual Reality (VR) and its accompanying technologies for instance the Head - Mounted Displays (HMDs) could aid the enrichment of the teaching and learning of pre-service History teachers in virtual learning environments (VLEs). This research study was aimed at discerning the viability of Virtual Reality Head-Mounted Displays (VR-HMDs) as an ICT pedagogical tool (or instructional technology) to support the teaching and learning of pre-service History teachers in VLEs. This study further aimed to determine if VLEs could foster students' self-directed learning (SDL) skills. The research study was conducted in a classroom environment of a tertiary education institution where the pre-service History teachers were engaged with VR to reach certain History lesson objectives. Anchored in constructive and interpretive paradigms, a single exploratory qualitative case study design with a non-probability purposive sampling and discourse analysis was followed. To a limited extent, and complementary and in support of the predominantly qualitative design, some quantitative data was also reported, necessary to better understand the phenomena under investigation. Different instruments were used to gather the research data from the 15 participants which included questionnaires, worksheets, focus group interviews and field notes. The findings of this study showed that VR-HMDs and VLEs are viable for the teaching and learning of pre-service History teachers as the advantages of incorporating this emerging technology exceed its disadvantages by far. It was also found that by utilising VR-HMDs in the teaching and learning of pre-service history teachers fostered certain SDL skills such as goal setting, the regulation of own learning, motivation, critical thinking that includes the skills to question, inquire, analyse, debate and to keep an open mind to collect new and relevant information. In conclusion recommendations are made from this study for the effective incorporation VR-HMDs into the pedagogy of history education.

Key words: virtual reality (VR), virtual reality head mounted displays (VR-HMDs), virtual learning environments (VLEs), information and communications technology

(ICT), self-directed learning (SDL), pre-service history teachers, history teaching and learning

OPSOMMING

As gevolg van die Vierde Industriële Revolusie (4IR) en die noodsaaklike gevraagde 21ste-eeuse vaardighede, ondergaan die huidige onderwysstelsel 'n proses van metodologiese en pedagogiese hervorming. Inligtings- en Kommunikasietegnologieë (IKT's) soos Virtuele Realiteit (VR) en sy gepaardgaande tegnologieë soos die Kop Gemonteerde Skerm (KGS) kan moontlik bydra tot die verryking van die onderrig en leer van voordiensgeskiedenis-onderwysers in virtuele leeromgewings (VLO's). Hierdie navorsingsstudie is daarop gemik om die lewensvatbaarheid van Virtuele Realiteit Kop Gemonteerde Skerms (VR-KGS) as 'n IKT pedagogiese hulpmiddel (instruksionele tegnologie) te ondersoek ter ondersteuning van die onderrig en leer van voordiensgeskiedenis-onderwysers in VLO's. Hierdie studie het ook verder ten doel gehad om vas te stel of VLO's studente se selfgerigte leer (SGL) vaardighede kan bevorder. Die navorsing is in 'n klaskameromgewing van 'n tersiêre opvoedingsinstansie uitgevoer waar die voordiensgeskiedenis-onderwysers betrokke was by VR om sekere geskiedenislesdoelwitte te bereik. Gefundeer in konstruktiewe en interpretatiewe paradigmas, is 'n enkele verkennende kwalitatiewe gevallestudie-ontwerp met 'n nie-waarskynlikheid doelgerigte steekproef en diskoersanalise gevolg. Om die fenomeen wat ondersoek word beter te verstaan, is daar tot 'n beperkte mate en aanvullend en ter ondersteuning van die oorwegende kwalitatiewe ontwerp, ook enkele kwantitatiewe data gerapporteer. Verskillende instrumente is gebruik om die navorsingsdata van die 15 deelnemers in te samel wat vraelyste, werkkaarte, fokusgroeponderhoude en veldnotas ingesluit het. Die bevindinge van hierdie studie het getoon dat VR-KGS in VLO's lewensvatbaar is vir die onderrig en leer van voordiensgeskiedenis-onderwysers, aangesien die voordele vir die inkorporering van hierdie opkomende tegnologie die nadele daarvan by verre oorskry. Ook is bevind dat deur gebruik te maak van VR-KGS in die onderrig en leer van voordiensgeskiedenis-onderwysers dit sekere SDL-vaardighede bevorder soos doelwitstelling, die regulering van eie leer, motivering, kritiese denke wat die vaardighede insluit om te bevraagteken, navraag te doen, te analyseer, te debatteer en 'n oop gemoed te hê om nuwe en relevante inligting in te samel. Ten slotte word aanbevelings gemaak vir die effektiewe inkorporering van VR-KGS in die pedagogie van geskiedenisonderwys.

Sleutelwoorden: virtuele realiteit (VR), virtuele realiteit koppelgemonteerde skerms (VR-KGS), virtuele leeromgewings (VLOs), inligting- en kommunikasietegnologie (IKT), selfgerigte leer (SGL), voordiensgeskiedenis-onderwysers, gekiedenis onderrig en leer

KEY TERMINOLOGY

The Fourth Industrial Revolution (4IR):	The Fourth Industrial Revolution (4IR) could be thought of as the age of digitalisation where products and services are digitally connected. Thus, the 4IR can be characterised by a fusion of technologies that blurs the lines between the physical and digital realities (Fazlul Hoque, 2019).
History:	History is an academic discipline and is the scientific method by which information from the past is used to find answers to modern-day difficulties. Through the studying of History, a person can determine and analyse their role within their society (Marwick, 2001). History allows the historian or students of History to comprehend the reasoning behind the innumerable actions taken by past generations, thereby encouraging a mutual understanding of the historical origins of ethnic and cultural diversity through open discussion (Lorenz, 2013). History as an academic discipline should be classified as the primary method to be used when analysing the impact the past has on the present (DoE, 2011).
Information and Communication Technologies (ICT's):	Information and Communication Technologies (ICT's) refers to technologies that provide the user with information and should be considered to be telecommunication technology (ICASA, 2021). According to Ratheeswari (2018), ICT's provide both students and educators with additional teaching and learning opportunities to aid the educational needs of the 21st-century learner.
Self-directed learning (SDL):	In its broadest description self-directed learning (SDL) refers to the educational approach in which individuals diagnose their learning needs, formulate their learning goals and choose and implement appropriate resources and learning strategies. In this manner individuals accept responsibility for their own learning

	(Wirth, 2019; Knowles, 1975).
Pre-service teacher:	Often referred to as a student teacher, a student who attends a tertiary institution intending to become a teacher. They are trained by way of theory and practice (Chitpin, Yahya & Simon, 2010) whereby they observe classroom teaching and teach while being closely supervised by a qualified teacher (English Dictionary, 2020). Pre-service teachers can further be considered to be students that are in the process of gaining confidence in teaching methodologies and subject content with the aim of teaching within a classroom (Oswald & Swart, 2011).
Virtual Learning Environment (VLE):	A Virtual Learning Environment (VLE) in this study can be considered to be multiple e-learning tools that allow users to interact with each other and the technological tool through the medium of a standard interface that is aimed at sharing data between these e-learning tools (Ip & Li, 2015). Also, according to Al-Obaydi (2020) VLEs are reliant on computer-based environments and accompanying online resources and requires clear curriculum mapping, electronic communication and online assessment portfolios.
Virtual Reality (VR):	The terminology pertaining to Virtual Reality (VR) and Virtual Environments (VE) are used interchangeably and while the terminology used may differ from study to study both these terms mean that VR is an interactive and immersive experience within a simulated environment where the laws of physics and locomotive abilities can be applied (Krajcovi, Gabajová, Matys, Furmannová & Dulina, 2022). Mandal (2013) defines VR as a computer-simulated environment which is also known as cyberspace or augmented reality with which the user of the ICT can interact. The augmented environment in question will correspondingly then be in general scale and size with the environment that it supposedly represents from the real world.

	Within this cyberspace or augmented reality, the aim is to create an immersive experience through the use of virtual sights and sounds that imitates what a person will find in the real world. Additionally, according to Cochrane (2016), VR can be defined as an interactive and immersive computer-created environment with which a person can interact through the use of a Head-Mounted Display (HMD); therefore, VR could be considered to be an ICT simulated technology.
Virtual Reality Head-Mounted Displays (VR-HMDs):	These are virtual reality goggles (VR-Goggles), or otherwise known and referred to from here on forward as Head-Mounted Displays (HMDs). This is a form of technology allows the user to interact with a computer-simulated environment that reflects the real world in scale and size through the creation of or an already computer-created avatar. VR-HMDs generate a comprehensive immersive, three-dimensional simulated environment which can be engaged with by placing the HMD on the user's head in front of the eyes in order for the users' field of vision to be completely occupied by the HMD (Specht, Schroeder, Krakow, Meinhardt, Stegmann & Meinhardt-Injac, 2021). Examples of these VR-Goggles are VRClassroom, VR S-MAC; Oculus Rift and PlayStation VR.

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ABBREVIATIONS AND ACRONYMS

SDL	Self-Directed Learning
TPACK	Technological Pedagogical and Content Knowledge
VR	Virtual Reality
VR-HMDs	Virtual Reality Head-Mounted Displays

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CHAPTER 1

BACKGROUND AND OVERVIEW

1.1 INTRODUCTION

As a result of the Fourth Industrial Revolution (4IR) the use of technology has become an integral cog of society at various levels and especially within the modern classroom (Haupt, 2017). Thus, it should only be logical then to continue the introduction of the latest forms of technology and its continuous advancements to the educational process to maximise learning potential by ensuring a more meaningful and engaged form of History education for the 21st-century student (Green & Hannon, 2007). With the incorporation of Virtual Reality Head-Mounted Displays (VR-HMDs) in Virtual Learning Environments (VLEs), the primary aim will become the strengthening of the educational process and initiation of an extended way in which educational technology enhanced methodologies can be used. According to Hu-Au and Lee (2018) VR as an immersive pedagogical tool (instructional technology) creates the opportunity for a higher quality of education as more students will become engaged in their learning. The aforementioned statement cannot be stressed enough as it aids the primary aim of this study in attempting to add to the existing pool of educational technology-based methodologies without advocating to discard previously and more commonly used methodologies.

By continuously adapting to new ICT's new possibilities are cultivated that support the contextual process of self-directed Learning (SDL) (Varughese, 2016). SDL primarily refers to the deliberate action of making informed decisions to direct and manage one's learning (Havenga, 2016). To this effect Mentz, Laubscher & Olivier (2021) and Bagheri, Ali, Abdullah & Daud (2013) argued that SDL is an essential skill that necessitated higher education to place more emphasis on teaching and learning strategies that will enhance the development of SDL competencies. The acquisition of lower-level content knowledge using memorisation and reproduction of facts might soon become redundant and will not be enough to equip students for the fast-paced changing technology-driven 21st - century digital economy. Students in the 21st century should be able to take responsibility for their own learning in promoting and implanting life-long abilities which will aid them to adapt and be more responsible and flexible to the changes in the world

around them (Warnich, 2022). In the end students should be able to collaborate and communicate effectively with others, think creatively and critically to solve new problems, and at the same time continuously adapting to new technologies (Mentz & Bailey, 2019).

Before examining how VR-HMDs, VLEs, and other contemporary ICT's can enhance the educational process, it is of vital importance to examine how ICT's have been developed into mainstream tools in society, culminating in their all-important role in education. This point was not reached through one giant leap, but through an experimental systematic process (Karki, 2019). At present educational technologies have a wide variety of approaches to its incorporation of education to choose from (Ratheeswari, 2018). VR-HMDs as an emerging ICT teaching and learning tool is one of these technologies that can be incorporated into an ever-changing educational system (Lege & Bonner, 2020) due to its increased learner-centred and SDL potential (Jensen & Konradsen, 2018).

Over the past few decades, as the ongoing process of technological development for commercial use picked up steam, it has resulted in instructional technologies developing at a similar pace (Bozalek, Brown, Gachago, Ng'ambi & Wood, 2016). It is this continuous innovation and development that has led educational systems to see the advantages of technology within the classroom once they could eliminate or minimise negative uses of technological devices and the internet (Burns & Graafland, 2018). According to Gunter, Gunter and Shelly (2012), educational systems and institutions of learning, upon establishing what they (institutions) deemed feasible ICT policies, began incorporating innovative and modern approaches by creating computer labs. This initiative aimed to modernise teaching and learning experiences holistically within classroom settings, while also aligning what and how a subject is taught with values and skills that students will be faced with in their lives (Alam, 2020; Munje & Jita, 2020). These computer labs. are still in use at many educational institutions (tertiary and otherwise) due to the advantages regarding the hands-on innovative computer experiences taking place and their ability to handle various class sizes filled with students with different life goals (Sharma, 2019; Gunter *et al.*, 2012).

In the 21st century as the continuous development of instructional technologies took place, interactive whiteboards (IWB) and data projectors started to play a more significant role within the classroom. The IWB and data projector probably became two of if not the most common primary instructional tools that educational institutions opted for if they could financially afford it (Benoit, 2018). Through the use of the aforementioned instructional technologies, the educational environment of these institutions has become more visual and auditive, which aids the teaching and learning process of the 21st-century student (Hirschman & Wood, 2018) and as a result the 21st-century History classroom should also be aided (Adesote & Fatoki, 2013). VR-HMDs can then become another ICT teaching and learning tool to be considered, as it can be measured to be an advancement of current visual and audio-based instructional technologies (Yildirim, Elban, & Yildirim, 2018).

It should be noted that the application of ICT as a teaching and learning tool within a classroom will vary depending on the requirements needed to reach the lesson objectives, the contextual factors of the classroom and the educational desires and motivation of the students (Gómez-Poyato, Eito-Mateo, Mira-Tamayo & Matías-Solanilla, 2022; Groff, 2009). Due to these four attributing factors, it can be asserted that thorough planning should be done to not only ensure the effectiveness of the ICT being used in the classroom but to also to lay the pedagogical, methodological and content foundation of any lesson (Elmqaddem, 2019). However, it is important to stress that especially VR-HMDs as an ICT pedagogical tool should be used in the classroom to support and facilitate teaching and learning in order for the educational process to become interdisciplinary and avoid stagnation (Leung, Zulkernine & Isah, 2018; Muller & Young, 2010). The reality, however, is that times and society are changing and as a result, the type of student enrolled at institutions of teaching and learning is changing (Bloom, 2016). According to Cytrin (2018) it is therefore imperative for History as subject to adapt its methodology in an attempt to remain relevant as an academic discipline. The overarching aim of this study was, to discern the viability of VR-HMDs when incorporating it into the teaching and learning of pre-service History teachers in VLEs.

The remainder of Chapter 1 will focus on the study's guiding principles that include the problem statement (sec.1.2), research questions (sec. 1.3), aims and objectives (sec.

1.4), the research design and methodologies (sec. 1.5), quality assurance (sec. 1.6), ethical considerations (sec. 1.7), contribution to the study (sec. 1.8), and the chapter division (sec. 1.9).

1.2 PROBLEM STATEMENT

Since post-apartheid (1994) the South African educational system has undergone, and is still undergoing a process of pedagogical and methodological transitioning (Crouch & Hoadley, 2018). This process of transition includes the use of ICT's as educators should equip students with not only subject matter but also with the skills to develop their knowledge concerning the subject matter and ways in which information can be gathered to improve subject knowledge (Mashile, 2016). As previously discussed, the training of pre-service History teachers should also be no exception to this transitional process as the teaching and learning of History for the 21st-century education student need to be adapted (Battaglia & McDonald, 2015). When this teaching and learning process is adapted to the current era, we find that students are generally not only more open to the learning of new content, but that they also take on more responsibility for their own learning than in the case of the traditional teacher-centred way of teaching (Dada, Laseinde & Tartibu, 2023). Once the student takes on autonomy of their own learning and attempts to actively engage with the subject content in a different manner to gain additional understanding, we find that skills such as, critical thinking – a key component of SDL – starts to be promoted (Francis, 2017).

These 21st-century students - a term coined to describe the students who have been attending academic institutions since the turn of the century (Hirschman & Wood (2018) - are more inclined to digital learning, which shows that visual and audible sources of information will most likely aid their learning and training more than the traditional chalk-and-talk method of teaching (Battaglia & McDonald, 2015) where chalkboards and transparencies were predominantly used (Del Campo, Negro & Nunez, 2012). The majority of 21st-century students devote their time in one way or the other to digital devices (Male, 2016), most of which are screen devices and when allowed to learn and engage with academic content through this medium they are accustomed to they would generally be more motivated (Arias, 2021).

According to Herring and Mourlan (2016) as well as Mumcu (2017), this move to use ICT's becomes more apparent because there is an emergent theme concerning the use of ICT's when pre-service teachers are planning their lessons. Furthermore, according to an educational policy document developed by two Rwandan Ministerial task teams (Rwandan Ministry of Education, 2018) that were based on the United Nations Educational, Scientific and Cultural Organization ICT Competency Framework for Teachers (UNESCO, 2011) the use of ICT's in lesson planning should actively be promoted through various activities. These activities should test not only content knowledge but also the ICT-based skills needed to acquire this knowledge. This inclusion of ICT's during lesson-planning is indicative of the times we find ourselves in and also of how times are changing as it becomes increasingly more important to meet the students at their level. As a result of students that were, historically speaking, inactive during the teaching and learning process and a new generation of students, the 21st-century student, a need arose to generate and adjust methodological and pedagogical approaches to teaching, learning and training at educational institutions to produce an equilibrium between instructional technologies, the curriculum and content knowledge (Mumcu, 2017).

History as an academic discipline is confronted with the fact that History educators in South Africa need to adapt their teaching and learning methodologies to incorporate more learner-centred pedagogies in the understanding and development of historical content and skills (Warnich & Meyer, 2013). One way of doing so is not to spoon-feed history students through knowledge transmission and the recalling of facts (Thabe, 2020) but to include an emerging ICT such as VR into the teaching and learning of history (Hasan, Kuswandi & Thaariq, 2023). Unfortunately, History educators are not always trained to include ICT's in their teaching and learning repertoire. The lack in proper ICT training of the educator can be considered as one of the reasons why History students revert to surface learning as this is what they are accustomed to (Hasan *et al.*, 2023; Callinicus, Esterhuizen, Lekgoathi, Mhize, Ndlovu, Sithole & Weldon, 2018).

Price and Roth (2016:195) believe that the development of educators to continuously adapt to their students' learning needs is a necessity for effective teaching and learning. However, History teaching methodologies do not need to undergo a complete

conversion but does need a series of smaller transformations in teaching methodologies (Romera, Ibañez & Martínez, 2022). These methodological transformations, however, allow for the opportunity to include VR as an ICT teaching and learning tool in an attempt to create and facilitate an environment that will provide more opportunities for the 21 century student while fulfilling their educational needs and fostering improved learning and understanding (Lee & Hwang, 2022; Toala-Palma, Arteaga-Mera, Quintana-Loor & Santana-Vergara, 2020; Romero, Ferran & Sangrà, 2016). In order to create these learning opportunities, complex and creative higher order cognitive activities will be required and encouraged to support the student's capacities to become critical thinkers and self-directed learners (Van der Vleuten & Schuwirth, 2019; Frey, Schmitt & Allen, 2012).

Furthermore, it could be theorised that VR-HMDs in VLEs are generally well suited to teaching and learning strategies of the 21st-century student as it provides visual teaching and learning opportunities that allows for gains in conceptual understandings (Youngs, Stehle & Walsh, 2020). When looking at VR-HMDs as a possible ICT teaching and learning tool, one of its more attractive advantages is its ability to transfer learners from the classroom setting to anywhere and to any time, but it could also transport the classroom environment into a simulated environment to the learners (Jumani, Siddique, Laghari, Ahad, Ayub & Khan, 2022; VReddo, 2019; Mandal, 2013). VR-HMDs and VLEs afford students the opportunity to overcome the physical and temporal constraints they find themselves in. Thus students are through the use of VR-HMDs and VLEs able to visit historical sites and periods that would otherwise be inaccessible due to distance or time limitations (Victor, 2023). Therefore, VR-HMDs are ideally suited to the classroom as they can aid not only students but also educators to gain a deeper understanding of subject content (Hussein & Nätterdal, 2015). The use of VR-HMDs should, in theory, be able to aid in the preserving of History's relevancy and value, but should also hypothetically provide an immersive History teaching and learning experience (Victor, 2023). Moreover, the rationale behind the inclusion of VR-HMDs within VLEs is due to its ability to reach the 21st-century pre-service teacher in a way that traditional methods might not be able to as these students could possibly be more motivated when working with ICT's as a pedagogical tool (Ayanwaleb, Ayanwale, Isholac, Oladejod & Adewuyie, 2023). Research by Da Silva and Pohlmann (2019) and

also Lund and Wang (2019), show that learner motivation generally increases through the use of VR-HMDs. This increase of learner motivation served as further impetus for the researcher of this study to apply VR-HMDs to History teaching and learning in order to establish if it has the same result within the academic discipline of History.

Despite the above-mentioned advantages that VR-HMDs hold when applied to history teaching and learning, there are also certain challenges when this innovative ICT will be applied in the pedagogy of history. The key challenges regarding the incorporation and application of VR-HMDs within the pedagogy of pre-service history education can be considered to be the costs, availability and accessibility thereof. According to Creed, Al-Kalbani, Theil, Sarcar and Williams (2024) there has been limited effort in addressing the accessibility challenges related to VR hardware and software platforms. Creed *et al.* (2024) further mentions that the costs relating to these hardware and software platforms are contributing factors to the lack of availability. The definitive lack of accessibility and availability is further substantiated by the study of Clark and Lischer-Katz (2020) when noticing that there is no formalised training with regards to the incorporation of VR-HMDs as an ICT. This lack of formalised training in turn then acts as a compounding result due to the lack of costs, accessibility and availability associated with the incorporation of VR-HMDs in history pedagogy.

As far as the researcher could determine, there is currently no empirical research within the South African or international context on the viability of VR-HMDs in the teaching and learning of pre-service History teachers. It is this gap in the existing research that will drive this study by exposing pre-service History teachers to VR-HMD's technology to establish the viability thereof to optimise history objectives.

1.3 RESEARCH QUESTIONS

The primary research question that directed this study was:

- What is the viability of VR-HMDs when incorporating it into the teaching and learning of pre-service History teachers?

In an attempt to answer the primary research question, the following sub-questions were formulated:

- How can VR-HMDs as instructional technologies effectively be integrated into the teacher training of pre-service History teachers?
- What are the primary advantages when VR-HMDs are integrated with the teaching and learning of pre-service History teachers?
- What are the challenges when VR-HMDs are integrated with teaching and learning of pre-service History teachers?
- When incorporating VR-HMDs what will the influence thereof be on pre-service History teachers' various domains of SDL abilities?

1.4 AIMS AND OBJECTIVES

The overarching aim of this research study was:

- To explore how VR-HMDs can be viable when incorporating it in the teaching and learning of pre-service History teachers.

To accomplish or reach the primary research aim, the following sub-aims were formulated:

- To determine how can VR-HMDs as instructional technologies be effectively integrated with pre-service History teacher training.
- To establish what the primary advantages are when integrating VR-HMDs into teaching and learning of pre-service History teachers.
- To determine what the challenges are when integrating VR-HMDs into the teaching and learning of pre-service History teachers.
- To demonstrate the influence of VR-HMDs on pre-service History teachers' domains of SDL abilities.

1.5 RESEARCH DESIGN, METHODOLOGY AND METHODS

In Chapter 4, the research design and methodology of the study will be discussed in more detail and where a justification for the choices made will be given. The sections to follow will serve as an overview of the research design, methodology and methods followed to gather the research data.

1.5.1 Research design

A research design can be defined as a strategy used by the researcher to establish the study's framework in its entirety while it further develops the underlying philosophical assumptions in which the study is grounded (Nieuwenhuis, 2016c). Creswell (2014) defines a research design as the logical sequence that connects the collected empirical data with the initial research questions of the study, and that enables the researcher to reach conclusions. For Durrheim (2004) the research design is used as a bridge between the research questions and the actual execution of the research process in an attempt to provide credibility to the study.

A predominately qualitative research design was chosen for this study due to its exploratory, descriptive and contextual nature. Secondary and complementary to the study's qualitative nature numerical data was also analysed and by doing so integrating some quantitative information. To this effect Maxwell (2010:482) is of the opinion that "the use of numbers is a legitimate and valuable strategy for qualitative researchers when used as a compliment" for qualitative research.

This study aimed to investigate by means of progressive data collection second year pre-service History students' perspectives, beliefs and experiences after they have been exposed to VR-HMDs in VLEs in order to explore the viability of this emerging ICT in the teaching and learning/training of History teachers.

1.5.2 Research paradigm

According to Alharthi and Rehman (2016), a paradigm can be clarified as the rudimentary belief system and theoretical framework with pre-conceived assumptions regarding ontology, epistemology, methodology and methods that serve as the fundamental basis of a study. Therefore, a paradigm can be considered to be the way that a study is understood in its entirety.

For this study the researcher adopted a mixed paradigmatic perspective using the constructivist and interpretivists paradigms. This is in accordance with Firestone's (1990:109) belief to allow for a more dialectical process in "cross-paradigm research".

The constructivist paradigm attempts to derive meaning from subjective assumptions and experiences and directly correlates to the research being done regarding VR-HMDs in VLEs and the preconceived ideas surrounding it. Thus, the constructivist paradigm, according to Jagtap (2017), is an individualised process wherein the individual takes on more responsibilities concerning the acquisition of new knowledge and skills and is an ever-ongoing process. This paradigm allows students to deal with knowledge and skills development in an active, constructive and self-directed manner where the learning and assessment processes focus on what the student can provide as much as on what is received from the learning environment (Rowe, 2006). Furthermore, the constructivist paradigm deals with the idea that learning does not necessarily need to occur in the conventional method, as students could learn more when discovering the knowledge for themselves through doing (Adom, Ankrah & Yeboah, 2016). Learning through doing can be linked to VR-HMDs and its ability to insert a person cognitively within a VLE in which the individual can move and interact to reach the desired content-based outcomes.

Constructivism was used within the interpretivist paradigm in this study. The interpretivist paradigm was applied where the phenomenological method was used to carry out the study. Phenomenology focuses on the participants' actual experience of a phenomenon. Phenomenology determines what meaning was given by individuals to a real experience (Nieuwenhuis, 2016b). In this study the participants were exposed to first-hand experiences in regarding to VR-HMDs after which they gave an extensive description of their experiences. Researchers who use the interpretivist paradigm and employ qualitative research methods are often looking for the experiences, attitudes and understanding of individuals in order to uncover the reality in their research data (Maree, 2016a).

1.5.3 Research methodology: Case Study

A research methodology refers to the theory of how the research process should be conducted (Schwardt, 2007). According to Hesse-Bibber (2010), a methodology provides the theoretical perspective that serves as the bridge between a research problem and a specific method that guides the research.

The research methodology that was identified for this research study was a single exploratory case study and can be clarified as an empirical in depth inquiry regarding a

contemporary phenomenon within a real-life/world context (Hamilton & Corbett-Whittier, 2013; Yin, 2009). The “case” in question would be the viability of the use of ICT’s and, more specifically VR-HMDs in the teaching and learning process of pre-service History teachers at a tertiary institution. Also, a case study was chosen due to its descriptive qualities within an interpretivist-constructivist paradigm (Yin, 2003) where meaning was derived from the subjective assumptions of the experiences of pre-service history teacher-students when utilising VR-HMDs in VLEs.

1.5.4 Population and sample

Population refers to the participants taking part in the research study through providing additional empirical data to the researcher; likewise, the participants who make up the population also share a common attribute (Asiamah, Mensah & Oteng-Abayie, 2017). The population group chosen comprises pre-service History teachers at a specific tertiary institution in South Africa as they are already sharing the developmental experience of becoming a teacher. This shared experience serves as their common attribute. Sampling, on the other hand can be defined as the process in which a sample (smaller group or subset) of the whole of the research population is chosen (Cohen, Manion & Morrison, 2011).

For this research study, a non-probability sampling method was used and more specifically, the purposive sampling type. The non-probability sample is frequently used in small-scale case study research where the researcher is targeting a particular group (Cohen *et al.*, 2011) with the aim of answering the research questions. In turn, purposive sampling refers to a strategy used in which a specific group of individuals are chosen to deliberately provide crucial information due to the specific qualities portrayed by the individuals, events or things. In a purposive sample, some members of the population are excluded while others are included (Maree & Pietersen, 2016). In this study a sample of 15 second-year pre-service History teachers were used to draw data from.

1.5.5 Data collection techniques

According to Parveen and Showkat (2017), research is an extremely intricate process which includes the collecting of data in a targeted method which will be analysed in an

attempt to reach certain goals and answer research specific questions. By using a variety of techniques in the collection of data, it ensures that the research problem is not only examined through one lens, but rather through a variety of lenses. This contributes to several facets of the phenomenon being revealed and understood (Baxter & Jack, 2008).

In order to accurately collect data that would reflect the aims and objectives of this study the following techniques were used: Open and close-ended questionnaires, an e-electronic worksheet (using the *Kahoot* quiz application), a paper-based worksheet, focus group interviews and field notes. (See section 4.6.3. for an in-depth discussion on how each of these techniques was utilised in the collection of data).

1.5.6 Data collection process

Data collection refers to the process which encompasses the systematic gathering of data from various sources in order to obtain relevant and reliable data with the aim of answering the research questions while also realising the research aims and objectives (Kumar, 2018). Data collection ultimately aims to acquire high-quality data to analyse and derive meaning from in order to eventually present reliable findings and recommendations. This study primarily focused on gathering qualitative data supported by quantitative data through the use of a five phase intervention process over a period of three weeks. (See sec. 4.7 for an in depth discussion of the data collection process).

1.5.7 Data analysis and Interpretation

Qualitative data analysis is according to Nieuwenhuis (2016a) based on a repetitive process with the aim of better understanding the participants' experiences of a specific phenomenon in order to answer the research questions. During this process, the data is summarised, organised and described. Data analysis and its interpretation is nothing else than the process where data is processed in such a way that the researcher shows an understanding about what the data produced (Nieuwenhuis, 2016a). In this study all the qualitative data that was gathered from the open-ended questionnaire, the paper-based worksheet, the interviews as well as the observations that were written down in field notes were thematically analysed. A benefit of the thematic approach is its flexibility as it identifies, analyses and reports patterns or themes from the data collected.

Furthermore, the thematic method of data analysis is compatible with the constructivist paradigm (Braun & Clarke, 2006) that was used in this study.

The themes identified from the qualitative data, were done by means of open-coding that forms part of the inductive approach of data analyses. According to Creswell (2014) the open-coding method is part of the inductive approach as categories are created, and relevant information is extracted from the data. Maree and Pieterse (2016) describe open-coding as the process during which the researcher breaks down the transcribed data into more controllable sections using symbols, codes and descriptive vocabulary. Matching words, phrases or events can be sorted into specific categories and sub-categories according to the related content or ideas to crystallise into particular themes eventually. (See more on qualitative data analysis and interpretation in sections 4.8.1 and 5.2.1).

In addition to and in support of the qualitative data, some quantitative data was also gathered from the two close-ended 5-point Likert scales questionnaires and the e-electronic *Kahoot* quiz worksheet. A descriptive statistics procedure was used to organise and analyse the quantitative data which allows for procedures such as frequencies, distribution, percentages, averages, median, modus and standard deviation (Grosser, 2016). By applying numerical distributions, the researcher summarised the characteristics of the numerical data in the respective response categories and variables. In doing so the quantitative data was presented in tables using percentages and mean scores. The analysis and interpretation of the collected qualitative and quantitative data will ultimately answer the research questions that will give rise to particular conclusions, findings and recommendations.

1.6 QUALITY ASSURANCE

Quality assurance in research can be described as the planned methodical process in which interventions and instruments are used to ensure that data collection, analysis and reporting of findings meet the required standards of quality and integrity within academic writing (Gamage, Pradeep, Najdanovic-Visak & Gunawardhana, 2020). Moreover, the objective of quality assurance can further be outlined as the process within research that enhances the ethical nature of a study especially when considering the study's trustworthiness and validity.

1.6.1 Trustworthiness

According to Connelly (2016:435) trustworthiness refers to the “degree of confidence in data, interpretation, and methods used to ensure the quality of the study”. For Gunawan (2015) trustworthiness deals with the way in which data is collected, categorised and eventually rationalised. The primary aspect of trustworthiness to be considered is the fact that it should be consistent (Heale & Twycross, 2015).

Trustworthiness is further divided into different components that include credibility, transferability, dependability and conformability. Based on the researcher’s understanding these four components of trustworthiness can be defined as follows:

- **Credibility** – Refers to the truth value of the research, or whether the study's conclusions are true and accurate (Nieuwenhuis, 2016a). The credibility of this study was determined by an extended literature review and by triangulation in utilising different data gathering instruments in the collection of the empirical data (Creswell, 2014) which enabled the researcher to answer the research questions. Furthermore, the focus group interviews data were audiotaped in an effort to ensure that no data will be lost. Moreover, verbatim quotes were used in analysing and interpreting the data to substantiate the conclusions that were made.
- **Transferability** – Deals with the extent to which a study’s findings can be used in other contexts and studies (Nieuwenhuis, 2016a). The transferability of this study specifically aims to determine how VR-HMDs can be used in History education. In Chapters 5 and 6 where the data was analysed and interpreted and the results and findings of the study were made, it was shown to what extent this study relate to other similar studies in which VR-HMDs in VLEs was utilised. Through transferability this study will further provide a “roadmap” to how the findings of this study could possibly assist in future studies.
- **Dependability** - Refers to the degree to which the researcher explains the context of the research for the audience to agree with the conclusions (Newly, 2010). In this study the researcher believes that he sufficiently explained the research procedures that are well documented and available for someone not involved in the research to track and evaluate. Documentation and records used in the study

were stored safely after the completion of the study and readily available to verify what this study reports. In doing this the researcher left an audit trail. All the data collected was done anonymously that further improved the dependability of the study.

- Conformability – Deals with the objectivity of the study and the potential agreement between two or more independent parties regarding the accuracy, applicability, and significance of the data (Nieuwenhuis, 2016a). The cross-examination of the transcribed data by the participants (member checking) ensured that the data was validated and without researcher bias. In this manner the criteria of conformability was supported.

1.6.2 Validity

Validity has been defined as the appropriateness, correctness, meaningfulness and usefulness of the research being done (Fraenkel, Hyun & Wallen, 2015). While qualitative research was primarily being conducted, and especially when focus group interviews are being used, it is imperative to remember that impartiality is indispensable in an attempt to ensure the validity of the study. Thus, when the analysis and interpretation of the data occurred it should be done to prove whether or not the use of VR-HMDs should be considered in the teaching and learning of pre-service History teachers training. (See sec. 4.10 for the three forms of validity that impacted on the study).

1.7 ETHICAL CONSIDERATIONS

Ethical considerations refer to the practices that the researcher and participants partake to ensure the upholding of ethical principles (Arifin, 2018).

In an attempt to ensure that this study was ethical it underwent a rigorous ethical process to ensure, through the institution of the researcher, that information was not falsified and that no harm will befall any participant, whether they be the researcher or participant. To assist in this regard, the researcher received supervisors to oversee this study and who are experts in their respective fields. On approval of the research proposal by the relevant scientific committee of the Research Unit for Self-Directed Learning at the Faculty of Education of the NWU, the NWU's scientific ethics committee

(ANNEXURE B) and the University's gatekeeping committee (ANNEXURE I) the researcher started his research. These committees assessed this study's possible academic value and evaluated its risk factor and credibility before clearance was given that the researcher may proceed with the research. (See sections 4.7.1.1. and 4.9 for a more extensive discussion on what ethical considerations were taken into account for this study).

1.8 CONTRIBUTION TO THE STUDY

The overarching goal of this study was to assess whether or not VR-HMDs can be considered viable ICT's within the teaching and learning of pre-service History teachers. Thus, this study attempts to provide insightful food for thought that could assist in the training and development of pre- and in-service History teaching and learning programmes. The findings and recommendations of this study can also be of merit to role players such as educators for VR-HMDs implementation at their respective institutions. The researcher is also of the hope that pre-service History teachers will find the study of value and cause them to consider continuing the development of VR-related History education policy by teaching through VR-HMDs and developing VR History related subject content.

Furthermore, the results of this study can contribute to the National Department of Higher Education and within time the National Department of Basic Education in their attempts to develop and revise the effectiveness of future and current History curricula and the manner in which VR-HMDs and ICT's in general are incorporated.

Additionally, this study was done under the umbrella of SDL where it will also attempt to show how VR-HMDs can be used to develop and improve SDL skills that will result in the students becoming life-long students. This study will therefore make a contribution to the pool of knowledge within the Research Unit of SDL at the North-West University on strategies how VR-HMDs can be applied in the promotion of SDL skills for the 21st century student to respond to demands of the 4IR.

1.9 CHAPTER DIVISION

In relation the organisation of the study, it consists of six separate chapters, as indicated in Table 1-1.

Table 1-1: The organisation of the study

CHAPTER 1:	BACKGROUND AND OVERVIEW OF STUDY
CHAPTER 2:	INFORMATION AND COMMUNICATIONS TECHNOLOGY, SELF-DIRECTED LEARNING AND HISTORY TEACHING AND LEARNING IN THE 21ST CENTURY
CHAPTER 3:	VIRTUAL REALITY HEAD-MOUNTED DISPLAYS AS AN INFORMATION AND COMMUNICATIONS TECHNOLOGY INSTRUCTIONAL TOOL IN EDUCATION
CHAPTER 4:	RESEARCH DESIGN AND METHODOLOGY
CHAPTER 5:	DATA ANALYSIS AND INTERPRETATION
CHAPTER 6:	SUMMARY, FINDINGS AND RECOMMENDATIONS

1.10 CONCLUSION

Chapter 1 served the purpose of providing an outline to the study in its entirety which guided the researcher in his attempt to discern the viability of VR within the teaching and learning of pre-service History teachers. During Chapter 1 the researcher laid the foundation of what will be discussed in the following five chapters by providing the problem statement, the primary- and secondary research questions, the aims and objectives of the study. Moreover, Chapter 1 accentuated the research design and methodology that includes the data collection and analysis process. Additionally, this Chapter provides a summation of the quality assurance and ethical considerations that underpin the research process of this study. It is the combination of all these aforementioned segments that make up Chapter 1 that in turn leads to the discussion on the contribution the study possibly can make, followed by the chapter layout of the study.

In Chapter 2 a literature review regarding ICT, SDL and its role in the teaching and learning of History in the 21st century will follow in order to establish a theoretical and conceptual framework for the study.

CHAPTER 2

INFORMATIONS AND COMMUNICATIONS TECHNOLOGY, SELF-DIRECTED LEARNING AND HISTORY TEACHING AND LEARNING IN THE 21ST CENTURY

2.1 INTRODUCTION AND ORIENTATION

This research study is aimed at discerning the viability of VR-HMDs as pedagogical tools within the teaching and learning of pre-service History teachers. When these VR-HMDs are used as teaching and learning ICT's, they create a VLE that facilitates the teaching and learning process by presenting the subject content in such a way that learning occurs through an experience that imitates real life. This study also aims to determine if the use of VR-HMDs in these VLEs could foster students' SDL skills. This attempt at discerning the viability of VR-HMDs in the training of pre-service History teachers and at the same time determine to what extent it fosters SDL skills is required in order for educational experiences to continue its process of methodological and pedagogical reform in combination with the expectations set by the Fourth Industrial Revolution (4IR).

This process of methodological and pedagogical reform during the 4IR is aimed at enriching not only the experience of teaching, but also the learning experiences of pre-service History educators, through advocating for the use of ICT's. Furthermore, reform requires intentional and goal-orientated use of ICT's in order for it to have an enriching effect on the teaching and learning experience. This enrichment should then in theory prevent one-dimensional teaching and learning as this form of teaching and learning is counter-intuitive to what is not only required but also desired for the development of education. In this regard Hasan *et al.* (2023) is of the opinion that while History education has developed from a one-dimensional teaching and learning narrative to a complex study to understand History there are still some educators that make use of traditional History teaching methods where little to no room is allowed for the development of critical skills. While this opinion from Hasan *et al.* (2023) should warrant some concern and change, it should not become the History educators' sole motive for

adapting to ICT's and including them to their teaching repertoire as according to Mathevula and Uwizeyimana (2014) there are still other obstacles that first need to be overcome. Therefore, according to Mathevula & Uwizeyimana (2014) if the teacher is not fully capable of using the ICT but merely doing so to tick policy "boxes", the ICT would then be used to the detriment of the teaching and learning process. Therefore, based on the statements of these abovementioned scholars the avowal can be made that a balance can be achieved between face-to-face instruction and the inclusion of ICT's, but that ICT's are necessary for modern 21st century teaching and learning.

Additionally, it is due to the necessity of including ICT's within the educational system holistically that Chapter 2 will at first briefly place its focus on the 4IR and SDL (sec. 2.2) to be followed by ICT and SDL (sec. 2.3). Hereafter, the emphasis falls on the expectations that are set and the challenges that are experienced when integrating ICT within South African schooling context (sec. 2.4). Then the focus shifts to History teaching and learning in particular where the researcher will in the first place concentrate on the potential benefits when incorporating ICT in the teaching and learning of History (sec. 2.5). This will be followed by imperative considerations which must be taken into account when training pre-service History teachers in ICT at tertiary education institutions (sec. 2.6) after which the chapter ends with the conclusion (sec. 2.7).

By reviewing previous research on these content matters as indicated above, the researcher provided further orientation of the research topic by concentrating on the interrelationship of 21 century ICT education in general, SDL and in particular ICT application in History teaching and learning. At the same time the researcher was able to establish in this chapter an important and firm literature groundwork for the study from where knowledge and theory were advanced and facilitated when interpreting the research data in reaching sound conclusions.

2.2 THE PARTNERSHIP FOR 21ST CENTURY SKILLS FRAMEWORK, THE FOURTH INDUSTRIAL REVOLUTION AND SELF-DIRECTED LEARNING

Due to the 4IR in which technological development and the prospective innovative usage of technology has come to the forefront, it can be stated that as previously mentioned a clear process of methodological and pedagogical reform in the educational

system has been developed (McLaughlin & Ruby, 2021). This educational shift relies, amongst others on the use of ICT's and the acquisition of 21st century SDL skills such as critical and creative thinking, to name but two (Warnich, 2022; OECD, 2018).

When considering the required SDL skills we find that the Partnership for 21st Century Skills (P21) Framework provides an easily understandable visual representation of the skills required to determine the success of teaching and learning of, for example, in a subject discipline such as History when attempting to foster 21st century SDL skills.

2.2.1 The Partnership for 21st Century Skills Framework

The P21 Framework was created to be a model that provides a structure for the incorporation of 21st century skills into teaching and learning. Furthermore, the P21 Framework received input from teachers, experts in the educational field, and various business leaders in order to clarify and illustrate the skills and knowledge students require to be successful in their professions, life and citizenship (Literacy, 2015). Figure 2-1 below is a visual representation of the P21 Framework that shows the relationship between the different elements found within the framework. While the figure outlines each element separately and descriptively all components can be perceived as if they are in an intricate relationship within the process of 21st century teaching and learning (Literacy, 2015).

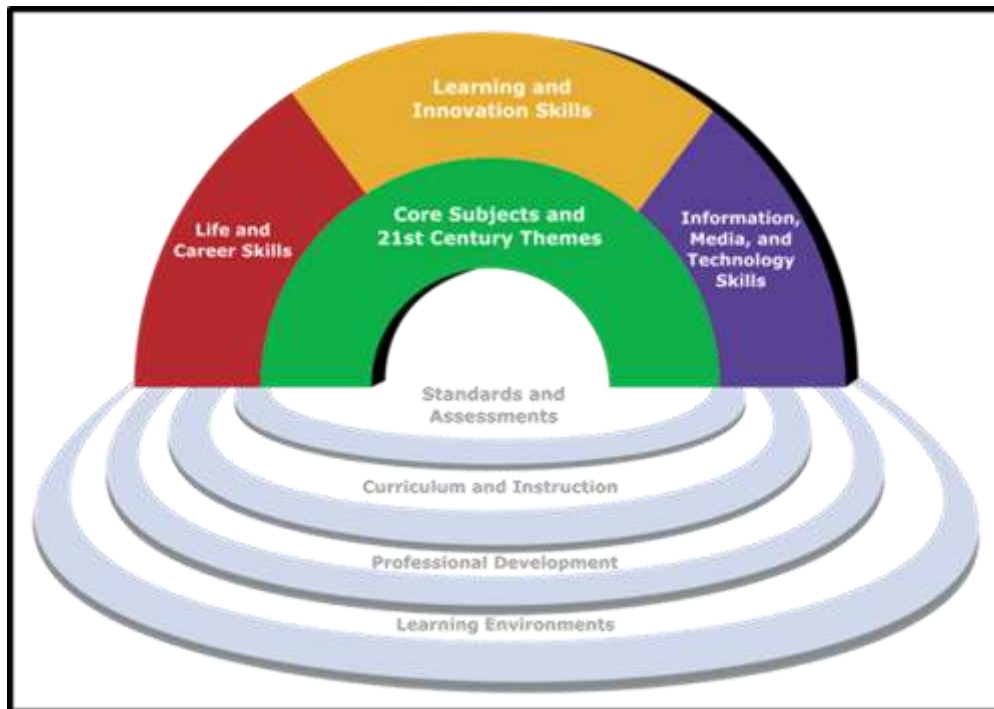


Figure 2-1: P21 Framework for 21st century learning

Source: Literacy (2015)

The P21 Framework's various elements can be broken down into the following specific components (Literacy, 2015) as can be seen and clarify in Table 2-1.

Table 2-1: The P21 Framework clarified

COMPONENTS	CLARIFICATION
1. 4IR and 21st Century Standards	Focus is placed on the acquisition and development of 21 st -century skills, content knowledge and expertise. These 21 st -century skills in turn also emphasize a deep understanding instead of the shallow acquisition of content knowledge. In order for this deep learning to effectively take place students are allowed to engage with real world encounters, data and tools through the exposure to 21 st -century skills. These learning opportunities allow students to learn through actively being involved

	in the educational process.
2. Assessment of 21st Century Skills	Supports a balance of high-quality effective formative and summative classroom assessments. The assessment of 21 st -century skills allow for opportunities where these competencies can be applied and demonstrated to authentic real world contexts. During this facet of the P21 Framework emphasis is placed on informative feedback on student performance with a reliance on a balance of technology-enhanced assessment methodology. The P21 Framework also serves as a method to assess the effectiveness of an educational system and whether or not it is achieving at high levels.
3. 21st Century Curriculum and Instruction	21 st -century skills are taught by means of subject content through the use of interdisciplinary themes and methodologies. The P21 Framework places focus on affording students the opportunity to not only acquire, but to also apply 21 st -century skills across their various learning areas. When applying the P21 framework to the curriculum it allows for innovative learning methods that assimilate the use of supportive technologies, inquiry- and problem-based approaches and higher order thinking skills.
4. 21st Century Professional Development	This facet highlights the various ways educators can take hold of opportunities for integrating 21st century skills, pedagogical tools and teaching methodologies into their classroom practice. Educators are afforded the opportunity to actively balance the teaching of subject content with project-oriented teaching methodologies in order

	to transfer a deeper understanding of subject content to students so as to enhance problem-solving, critical thinking and the acquisition of 21st century skills.
5. 21st Century Learning Environments	Learning environments are created that should in theory support teaching and learning practices that in turn foster 21 st -century skills. Additionally, while students may benefit from this proposed 21 st -century classroom, the educator is also afforded professional support through a collaborative community that share the finest educational practices. These learning environments provide students with opportunities to learn in real world 21 st -century contexts through the use of pedagogical tools such as ICT's and other resources.

After taking the information of above into consideration we find that this study and its inspective look at SDL shares a link to the P21 Framework, specifically when focusing on the framework's "Learning and Innovation Skills" (Figure 2-1) element. It is this element that highly values the skills that are considered to be SDL skills such as, creative thinking, critical thinking, collaboration and communication. The aim of teaching and learning is to assist students in their attempts to adapt to the societies that they live in and similarly the P21 Framework and SDL is aimed at doing just that, assisting students in the acquisition of skills that will allow to them to not only live, but thrive as life-long learners in an ever increasingly complex 21st-century society (Erdem, 2019).

When breaking down the P21 Framework into its various components (Table 2-1) it becomes even more noticeable as to how the framework's content becomes a critical component required to ensure that students are well adapted to modern society. According to Partnership for 21st Century Skills assessments, curriculum, instruction, technology, professional development, learning environments and 21st century

standards are obligated to be aligned in order to achieve the required results that would determine the successes or failures of teaching and learning during the 21st century.

Thus, while the P21 Framework affords its user the opportunity to easily understand what is needed to successfully teach and learn in our modern society, it still remains the History educators' responsibility to find the most effective and reliable method of implementation.

In History education, students need to be confronted with real life scenarios and should be able to analyse the cause, effect and relationships between the various historical events, while also seeing the true nature of historical events, and lastly construct their own critiques regarding these events (Akhan, 2021). Students should be able to make use of information that they have acquired during their studies in problem solving, then apply their knowledge and appropriately convey their knowledge in order to create unique solutions to present day events by drawing on historical information (Vasilievich, 2015). While students are confronted with a multitude of perspectives, SDL skills allows them to gain the ability to interpret history perspectives and information in various topics and manners that are supported by policy documents such as the National Curriculum Statement in the Curriculum Assessment Policy Statements (NCS-CAPS). Another key goal of History education is to develop historical thinking and historical reasoning skills (Akhan, 2021). When applying this opinion of Akhan (2021) to communication, collaboration, critical thinking, and creativity (the 4C's of SDL) it can be argued that there is a clear relationship between the goals of History education and SDL.

In the following section the relationship between ICT and SDL will be investigated.

2.3 INFORMATIONS AND COMMUNICATIONS TECHNOLOGY AND SELF-DIRECTED LEARNING

According to Umamah (2022) the process of learning can be considered to be a combination of interaction between educators and students, methodologies, pedagogical tools (teaching and learning facilities and equipment), procedures, subject content and learning objectives. The combination of these elements when appropriately balanced should lead to the creation of learning interactions that would achieve the

various learning outcomes as determined and set out by educators, students and administrators.

Over the past decades the growth and integration of ICT's as pedagogical tools in the teaching and learning process became one of the most important topics of discussion by scholars in the field of education (Koehler, Cheng, Fiock, Wang, Janakiraman & Chartier, 2022). Gavifeker, Razak, Ghani, Ran, Meixi & Tengyue, 2014). As a broad concept ICT allows for multiple possibilities to be integrated into an educational setting. According to UNESCO (2009:120) ICT refers to multiple technological tools and resources that include "computers, the internet (websites, blogs and emails), live broadcasting technologies (radio, television and webcasting), recorded broadcasting technologies (podcasting, audio and video players, and storage devices) and telephony (fixed or mobile, satellite, visio/video-conferencing, etc.)". ICT's can be considered as an important teaching and learning tool for educational change and reform as it has the potential to motivate and engage students in the learning process (Fu, 2013).

In order to create an interactive classroom the educator should provide students with learning opportunities through the use of various teaching and learning methodologies that would promote SDL (Laubscher, Bailey & Du Toit-Brits, 2019). It is within these SDL classroom environments that the educator is to provide efficient facilitation in the use of ICT's while also providing guidance to all students through medium of real-life teaching and learning opportunities (Koehler, Cheng, Fiock, Wang, Janakiraman & Chartier, 2022). To this effect Ghavifekr, Salleh, Shaharom, Rahim and Yue (2016) believe that when students interact with ICT tools it can contribute to the promotion of their SDL skills. The systematic process in which the student takes more responsibility for their own learning is at its core. It is a process not to be rushed but rather a process that gradually occurs through trial and error until a favoured equilibrium between all facets of the educational process has been achieved (Masoumi, 2021). Borysiuk (2013) was of this same opinion eight years before the aforementioned remark was constructed by declaring that not only should there be an equilibrium within the teaching and learning processes, but that said equilibrium has to be first determined between the frequency and phase of the lesson in which the ICT will be used.

Furthermore, while making use of suitable educator and student interaction in combination to the effective use of ICT's it will result in a more informative and interactive teaching and learning environment. Once ICT's are used in combination with a teaching and learning strategy like SDL, students would then not only engage with pedagogical tools but rather become instruments of their own learning (Holzweber, 2018). Two integral features of the SDL classroom would firstly be the willingness of the educator to adapt and incorporate ICT's and student opinions and experiences into future lessons (Sointu, Valtonen, Hirsto, Kankaanpää, Saarelainen, Mäkitalo, Smits & Manninen, 2021). Secondly, students will primarily be responsible for the completion of work and acquisition of knowledge within the classroom environment while the educator will be responsible for planning and facilitating the lesson. Through effective planning and facilitation on the educator's part and the continuous participation and learning by students' within-and-out of the classroom the success of SDL and ICT's within the teaching and learning will be ensured (Len & Tieme, 2022).

When incorporating SDL and ICT's it is crucial to ensure that the educator and students are comfortable while engaging with the subject content and ICT's as both parties have different levels of responsibilities. When both parties involved reach an acceptable level of comfort within the teaching and learning environment and when both parties are comfortable within the parameters of their responsibilities the following will be according to Aidoo, Macdonald, Vesterinen, Pétursdóttir and Gísladóttir (2022) achievable:

- students will become more engaged in the educational process while still receiving active instruction,
- communication will be emphasised and developed,
- students will gain the skills to decipher the understanding of a content topic instead of merely further developing their memorisation skills in isolation, and
- students will be more motivated to partake in the lesson due to entire lesson not being spent on merely taking notes.

As an emerging technology in the ICT industry, VR-HMDs gained increased attention for the potential benefits it holds as a teaching and learning tool (Brahmaa, Rejulab, Srinivasanc, Kumard, Banue, Malarvizhif, Priyae & Kumar, 2023; Han, Shin, Ko & Shin, 2022). With reference to SDL, Chien, Hwang and Jong (2020) are of the opinion that

immersive VR environments create a sense of reality that has the potential to increase student motivation and the development of critical thinking skills. Both these skills are characteristic of self-directed students (Chukwunemerem, 2023; Du Toit-Brits & Van Zyl, 2017). (See Chapter 3 for a comprehensive review of VR-HMDs as an ICT teaching and learning tool).

In the section to follow the Technological Pedagogical Content Knowledge (TPACK) framework will be discussed that defines the kinds of knowledge that educators need to competently integrate to provide opportunities for the promotion of SDL skills.

2.3.1 The Technological Pedagogical Content Knowledge framework

In 2006, Mishra and Koehler (2006) presented a new approach to teaching and learning that amalgamates innovative tools (ICT's), understanding of methodology and subject content knowledge – known as the Technological Pedagogical Content Knowledge (TPACK) framework. In many of the research studies with the focus on pre-service and in-service teachers and their use of technology, the TPACK framework was applied as the conceptual model (Abbitt & Davis, 2021). It is this framework that according to Cheng, Molina, Lin, Liu and Chang (2022) emphasises the integration of ICT's into teaching and learning environments in such a way that it not only advocates for the academic development of the students, but also for the academic development of the educators. This acknowledgement by Cheng *et al.* (2022) of educators needing to continue their academic development further reinforces the connection between the TPACK framework, SDL skills, ICT's and the teaching and learning environment.

The TPACK framework, however affords the educator the opportunity to ascertain the competencies that require development in order to not only make use of ICT's in a manner that is superficial but actually meaningful (Cheng *et al.*, 2022). Against this background to provide for the meaningful integration of ICT, many countries across the globe are calling for traditional teaching and learning methods to be reviewed and revised if necessary (Nasri, 2017) which will in turn open greater possibilities to enhance student-centred learning and the development of SDL skills (Fu, 2013).

In the call for the more traditional teaching and learning methods to be supported by ICT's, Haupt (2017) postulates that our modern society and its increasingly complex

nature is because at its core society revolves around technological development and innovation that in theory fundamentally adjusts the way we live. This continuous development of technology has afforded the education with the opportunity to teach and learn outside the confines of regular brick-and-mortar classrooms where educators can adapt by incorporating ICT's in their teaching and learning approaches. Furthermore, the effective use of ICT's when aided by SDL skills such as critical thinking, for example, assist the student with the interpretation and understanding of the vast amount of information that they are confronted with while also allowing them and their educators to assess the level of success that they achieved (Dawson, Macfadyen, Risko, Foulsham & Kingstone, 2012).

As life-long learners of education it becomes apparent that the movement to adapt educational systems through the use of ICT's and frameworks like the P21 Framework and the TPACK has started, but the pace at which it is being implemented is less than ideal (Munje & Jita, 2020). It would also be a gross generalisation to assume that due to the technologically driven society that we live in, pre-service teachers at tertiary institutions have had invaluable experiences with ICT's that would allow them to effectively use it themselves. The exposure that pre-service teachers generally tend to have with ICT's proves to be in most cases unsatisfactory as these pre-service teachers are more accustomed to use ICT's such as PowerPoint Presentations for a more aesthetic way of presenting the subject content (Fan & Tan, 2019). In contrast to the previous statement ICT's should be used for more than just aesthetic purposes and should rather be used in innovative methodologies and as effective pedagogical tools that adds to the lesson in a way that regular visual and auditory stimuli cannot. Therefore, it is vitally important to establish a working relationship between pre-service educators, ICT's and a favourable mind-set towards student-centred approaches that include ICT's in the development of 21st century SDL skills (Zyad, 2016).

Thus, it is due to ICT's becoming an integral feature to the educational environment that pre-service teachers should as mentioned above develop a favourable mind-set towards student-centred ICT approaches. Similarly, these pre-service teachers could acquaint themselves more with technology in order to design effective blended learning tasks and sufficient ways to assess the teaching and learning being done in the educational environment (Bosch, Van der Westhuizen & Mihai, 2022). It is this

amalgamation of the aforementioned shift in mind-set and inclusion of ICT's that then reinforces the idea of TPACK being a foundation for the manner in which ICT's should be thought of within the educational process. In a study conducted by Wong and Hsu (2008) it was recounted that the use of ICT's had encouraging results with the teacher participants' teaching and learning methodologies. These results from Wong and Hsu (2008) have matured well over the years and have been shown to be true by other and similar studies over the past decade (compare Meladi & Awolusi (2020); Saprikis, Anastasia & Charitoudi (2019); Chouthaiwale & Al-Kamel (2018)).

In conclusion, it is essential to note that the incorporation of ICT's is systematically taking place as a newer generation of educators are engaging more with newer trends and finding their feet in the academic environment (Kapoor & Gusain, 2020). However, for different reasons some educators are still resistant to incorporate ICT's into their teaching and learning repertoire. One reason for this attitude is due to a lack of proper facilitation and support in the educational environment they find themselves in (Hamlaoui, 2021; Sello, 2021; Lee, Suharwoto, Niess & Sadri, 2016).

The participants used in this study were pre-service History teachers who will one day become full-fledged teachers in schools. Within the school environment the participants will be confronted with the expectations and challenges when it comes to ICT incorporation in their schools. It is for this reason that the researcher considered it necessary to report on the state of ICT integration in South African schools.

2.4 HISTORY TEACHING AND LEARNING AND THE INCORPORATION OF INFORMATIONS AND COMMUNICATIONS TECHNOLOGY WITHIN THE SOUTH AFRICAN SCHOOLING CONTEXT: EXPECTATIONS AND CHALLENGES

When attempting to provide an account on the use of ICT's in the South African educational school system that also applies to the South African History curriculum, a wide-ranging inquiry into its various policy documents is important. In particular the NCS-CAPS (DoE, 2011) and The Department on Basic Education White Paper on e-Education (2004) will be examine in order to establish some of the directions when it comes to the incorporation of ICT in school history classes. While both the NCS-CAPS and White Paper on e-Education was used to substantiate the argument of the

researcher it is worth mentioning that both these documents speak of the incorporation of ICT's in general. Moreover, both the NCS-CAPS and White Paper policy documents do not refer to its application in a specific subject discipline despite the fact that ICT applications provide different advantages to different subjects (Haydn, 2005).

When referring to the White Paper on e-Education (2004) it is at a very basic entrance level when it comes to its directions on the incorporation of e-learning in the classroom. The White Paper refers to the use of the "Internet, CD-ROM, software, other media and telecommunications" as possible e-learning tools that can be involved in the teaching and learning process (DoE, 2004:15). With regard to online learning the White Paper makes reference to the "Internet and associated web-based applications as the delivery medium for the learning experience" (DoE, 2004:15). According to Padayache (2017) the White Paper policy document does not in particular identify the categories of technologies that can be utilised in the teaching and learning process. Tshimanika, Chigona and Sadeck (2022) believe that due to several reasons the White Paper was unsuccessful to achieve its goals that were set for 2013 and therefore failed in its vision to successfully incorporate ICT's in an effort to transform teaching and learning landscape.

While the White Paper policy document acts as an entrance level document to ICT incorporation it is not however the sole policy document that South African teachers need to contend with. The NCS-CAPS mentions that the use of technology should be done in such a way that its critical and effective use promotes responsibility towards others (DoE, 2011). When specifically referring to the FET History NCS-CAPS it can be seen that this policy document encourages History teachers to use technology within their classrooms through the promotion of skills such as to "Understand the range of sources of information available for studying the past" which promotes the use of "video or film" (DoE, 2011:9). While the History NCS-CAPS document acknowledges the importance of visual stimuli to some extent within the teaching and learning process of History it does not provide educators with a means (e.g. on how to use a specific software) to include ICT's effectively into their teaching repertoire.

In the following sections the expectations and challenges will be explored for ICT's to be incorporated in the teaching and learning of History at schools.

2.4.1 Expectations

When judging the influence of the above-mentioned documents had on the practical ICT implementation, scholars such as Nkula and Krauss (2014) are of the opinion while ICT's may be a lasting feature of the 21st century classroom it cannot truly be associated with South African classrooms. Vandeyar (2015) supports this view and is of the opinion that the practical implementation of e-learning in schools (and by implication also in History classes) is still lacking.

The White Paper on e-Education (2004) and the NCS-CAPS document (DoE, 2011) have the following holistic expectations for the inclusion of ICT's within South African schools:

- To improve the quality of teaching and learning.
- To provide both teachers and learners with new innovative ways to gather and engage with information.
- To improve the administration and management of schools.
- To develop digital and information literacy in learners in order for them to become more competent in their use of ICT's.

While examining both the ambiguity of these expectations and the conviction of Nkula and Krauss (2014) and Vandeyar (2015) it requires mentioning that while these are obstacles to the inclusion of ICT's in South African schools it should not exclude the incorporation or at least the attempted incorporation of ICT's into schools and the History classroom. This lack of specific subject related ICT policy is indicative to the difficulties faced within teaching and learning to adapt to ICT applications that offer dissimilar advantages to different subjects.

In conclusion, the study conducted by Akhan (2021) discovered that there is a direct link between the way that History educators teach the content and how they were taught the subject content. For obvious reasons this will influence pre-service History educators' expectations and attitudes when it comes to their training and the extent to which they will incorporate ICT in their future instructional practices.

2.4.2 Challenges

The lack of guidance on the practical application of ICT's that is subject-specific does not necessarily provide solutions that would assist especially disadvantaged schools in obtaining not only the ICT's but the knowledge and skills to use these ICT's effectively in, for example, the teaching and learning of History. It is this challenge in ICT-related policies that is indicative of a lack of informed support required for effective incorporation to the educational system and stands in stark contrast to the opinion of Van Greunen, Kativu, Veldsman and Botha (2021) that highlights the necessity of a supportive policy environment that emphasises innovative technology as a requirement for beneficial ICT incorporation into South African schools and History classes.

When addressing the teaching and learning capabilities of South African educators within South African schools the expectation for the inclusion of e-learning is to a great extent watered down by traditional teacher-centred methods like the chalk and talk method (Blignaut, Hinostroza, Els & Brun, 2010). In this respect the South African History classroom is no exception as indicated by Odendaal-Kroon & Poole (2018) who are of the opinion that History educators persist in the primarily use of traditional teacher-centred approaches that is a challenge because it hinders the appropriate use of ICT and ensuring quality education (Adesote & Fakoti, 2013). In the same vein Motumi (2020:57) postulates that one of the major challenges in the teaching and learning of History in South Africa is the "inability and/or lack of competence" of educators to present history "in an interesting and meaningful way to meet the needs of the 21st century".

According to both the Ministerial Task Team Report on History (2018) and Nishizawa, Shimada, Ohno and Yoshioka (2013) the traditional method of chalk and talk focuses primarily on textbook instruction. This textbook instruction in turn allows the bare minimum social and educational interaction between students and History educators. This methodology finds that teaching and learning work best when communication occurs in a so-called direct line. Thus, meaning that the flow of information can be a direct process with which information is transferred primarily from the educator to the student (Renau, 2016). While traditional teaching methodologies like the chalk and talk method affords the in-service History educator the ability to regulate the information

being amassed by students it is also this ability that may hamper its continuous use and the fostering of SDL skills. Moreover, according to Damodharan and Rengarajan (2007) the teacher-centred chalk and talk approach has the following limitations:

- The flow of information constitutes a direct line of communication from the educator to the student.
- There is bare minimum student interaction, thus resulting in insufficient teaching and learning responses in a constructivist way.
- Learning material is one-dimensional as it is solely dependent on the over-use of textbooks and notes that the educator created from other sources.
- Students are not afforded the opportunities to engage with real life learning situations. This lack of engagement with the subject content in ways that are not one-dimensional of nature might possibly lead to lower levels of student motivation.
- Solitary emphasis and value are placed on only one of the various learning skills. Memorisation of subject content instead of a deeper understanding of subject content becomes the primary focus.

When applying the thought process that includes the use of ICT's to History it should be noted that an improved incorporation of ICT's is required in order to move away from using the traditional chalk and talk methodology as one of the sole methodologies to History instruction at schools (Haupt, 2017). In this regard a further challenge is "the problem of the unavailability of teachers for History" resulting in some educators in schools not teaching the subject that they were qualified in to teach (Tabe, 2020:179). This resulted in these "History teachers" often use the traditional methodology as their only pedagogical tool that they feel comfortable with when teaching History. When History educators are not applying technology-facilitated strategies in their classes it can discourage school history students of an opportunity to take responsibility for their own learning where knowledge and skills are acquired in a self-directed active and constructive way (Adesote & Fatoki, 2013).

A further challenge that avoids the proper incorporation of ICT's can be ascribed to the vast differences between schools that are under-resourced – especially those in the rural and township areas - in comparison to those that are sufficiently sourced with

ICT's (Srisakda, *et al.*, 2016). Likewise, according to Mlambo *et al.* (2020) the nine educational provincial departments of South Africa have implemented various methods of intervention aimed at including ICT's to South African school classrooms. According to Mweli (2013) schools from the Western Cape and Gauteng are predominantly the schools that has shown some success with their developed ICT projects. This statement by Mweli (2013) further supports the findings of Adukaite, Van Zyl and Cantoni (2016) by stating that there is a difference at institutional level with regards to the use of ICT's that result in the suboptimal use thereof within specific South African regions. Within our ever-evolving modern 21st century society this lack of educational development is a challenge and a concern as ICT's are cognitive tools that are neglected within a South African school context (Pakdaman-Savoji, Nesbit & Gajdamaschka, 2019).

A further challenge, according to Adukaite *et al.* (2016) and Pakdaman-Savoji *et al.* (2019) is that South African educators, and by implication also History educators, primarily use ICT's for aesthetic purposes instead of for the development of 21st century skills. Thus, South African educators rely on ICT's for their demonstrational uses, but not as pedagogical tools (Padayachee, 2017; Aslan & Zhu, 2016). While South African educators and institutions are primarily making use of ICT's for aesthetic purposes contributes to a further reason why they are according to Adukaite *et al.* (2016) used in an erratic manner.

Padayachee (2017) highlights the fact that technology cannot just be provided without proper training on how to effectively incorporate said technology as an ICT. According to Adukaite *et al.* (2016) individual educators' knowledge levels are directly associated to effective use or lack thereof when using ICT's as pedagogical tools. Thus, in clarification of the previous statement, the use of ICT's would be used erratically due to the fact that some history educators are familiar with ICT's within an educational setting while others have little to no understanding of ICT's as pedagogical tools.

In the next section a brief overview will be given of potential benefits when ICT are incorporated in the teaching and learning of History.

2.5 INCORPORATING INFORMATIONS AND COMMUNICATIONS TECHNOLOGY INTO THE TEACHING AND LEARNING OF HISTORY: POTENTIAL BENEFITS

The incorporation of ICT in the teaching and learning of History has potential benefits. In this regard several suggestions are made by scholars in the field on different ways how ICT can help history students of all ages in the development of their historical skills and knowledge. When ICT are included in the teaching and learning of History, it will allow students with opportunities to (Hamaundu & Mwansa, 2020; Bukar & Azare, 2018; Harris, 2014):

- access to a wide range of diverse information and historical sources;
- critically assessing the reliability of electronic sources of information;
- contextualised, restructure, interpret and simulate historical events;
- develop the skill of historical enquiry, where hypotheses can be formulated and tested, in contrast to only the memorising of historical facts;
- experience digital video simulations in a blended learning environment that will allow a better understanding on how important decisions in history were influenced by decisions made by individuals, the influence of the environment and the pressure of the time, and
- promote opportunities for collaborative and cooperative learning environments for the development of historical thinking and reasoning.

As indicated earlier on, the 21st century with its improvement of technology assigned new teaching and learning challenges to the role of the modern History educator. The rapid development of technology as part of the 4IR expects from History educators to realise the benefits of ICT and to be informed when it comes to the latest developments in ICT's and the manner in which they are willing to adapt their instructional approaches (Mary & Familugba, 2021). For most of these benefits to realise an instructional shift is necessary in the curriculum of teacher training from a behaviourist to a more constructive learning paradigm which is characterised by students who are actively, collaboratively and cooperatively involved in the teaching and learning events. A

constructivist learning environment is contextualised which provide students with opportunities to deeper learning competencies where constructed knowledge is applied to authentic and new contexts where learning does not need to take place as a traditional lecture (Adom, Ankrah & Yeboah, 2016).

As ICT's provide students with the opportunity to engage with the 21st century skills the expectation is that a more standardised methodology regarding ICT's as pedagogical tools needs to be developed (Mlambo, Rambe & Schlebusch, 2020). This expectation of a standardised methodology would then, in theory, prevent the erratic use of ICT's in the History class as mentioned by Adukaite *et al.* (2016) while also affording students new and different learning experiences through the development of 21st century skills such as problem solving- and critical thinking skills (Kurt, 2010). In the same vein, Palacios-Mena, Garcia, Mosquera and Alarcón (2020), and Trujillo Sáez, (2017) postulate that a new methodological focus is essential in History teaching and learning; one which promotes greater interaction and the development of skills which enable students to argue, debate and construct historical contents dealt with in the classroom, promoting the use of more active methodologies, such as problem-based learning, service-learning, inquiry-based learning, gamification and the use of videogames and virtual reality. Such strategies and methods are more related with a critical approach to the teaching and learning (Giménez, 2019) and which will further encourage the development of the historical thinking skills (Seixas & Morton, 2012). Lawrence and Tar (2018) are convinced that ICT's as pedagogical tools will meet the expectation in providing (history) students with multimodal teaching and learning experiences that permit greater flexibility and interaction between the students and their content.

For reason that this study is about the teaching and learning of pre-service history teachers, the next section will briefly look into factors that affect their ICT training at tertiary education institutions.

2.6 THE TRAINING OF PRE-SERVICE HISTORY TEACHERS AND INFORMATIONS AND COMMUNICATIONS TECHNOLOGY AT TERTIARY EDUCATION INSTITUTIONS

In the first place it should be mentioned that newly trained History educators in South Africa do receive some training in the use of ICT's, but according to Ramnarain, Pieters,

and Wu (2021) and Maphalala (2021) the training of pre-service teachers in general is not always as comprehensive as training programs in other countries. This pre-service teacher training when coupled with ICT's aren't always as comprehensive due to the general lack of teaching experience with ICT, lack of support in the use of ICT's, the lack of ICT specialists, lack in the availability of computers, and the lack of financial support (Ramnarai *et al.*, 2021). In the same vein Banda, Hamaundu and Mwansa (2020) are of the opinion that due to a lack of training in ICT mediated technologies History educators are not always confident to incorporate ICT into their teaching and learning.

As previously indicated, the 21st century with its improvement of technology assigned new teaching and learning challenges to the role of the modern History educator. The rapid development of technology as part of the 4IR expects from History educators to be informed when it comes to the latest developments in ICT's and the manner in which they are willing to adapt their instructional approaches (Tirado-Olivares, Cózar-Gutiérrez, García-Olivares & González-Calero, 2021). With all of these expectations which are placed on the 21st century History teacher the following question can be raised when it comes to their training: What are considered as successful training practices when it comes to the training of pre-service History teachers in ICT? To put it in another way: What are the key competencies pre-service History teachers are supposed to demonstrate after receiving training in ICT?

In this regard Kirschner and Davis (2003) identified the following key competencies: (i) competence in the personal use of ICT, (ii) competence in the utilisation of ICT as a mind tool in facilitating higher order cognitive skills (iii) competence in utilising ICT as a teaching and learning tool (iv) the mastering of educational paradigms that make use of ICT, (v) the mastering of various assessment paradigms in which ICT are used, and (vi) to understand the policies when it comes to the application of ICT in the teaching and learning environment.

For pre-service History teachers to achieve and demonstrate these key competencies the role of their educators at tertiary education institutions cannot be underestimated. In the research of Hakkarainen *et al.* (2001) and Moseley, Higgins, Bramald, Hardman, Miller, Mroz, Tse, Newton, Thompson, Williamson, Halligan, Barmald, Tymms,

Henderson & Stout (1999) it was found that there is a relationship between educators' pedagogical conceptions and the type of instructional use of ICT. Educators who intensively used ICT emphasised the importance of using ICT for facilitating students' participation in progressive inquiry, collaborative learning, and the students' active engagement in the knowledge formation process, but as Bansa (2020) cautions the relationship between lecturers' conceptions and practice are complex, not clear or simple.

Educators at tertiary institutions attitudes are thus major predictors of the use of new technologies in instructional settings. According to Ertmer (2005) the attitudes of educators in their perceptions and belief of ICT do influence their decision to incorporate ICT in their classes. Taking the role of educators into account one should remember that there are often factors beyond their control that will influence ICT uptake, e.g. institutional cultures, leadership, the curriculum and assessment programmes (Jošanov, 2008). However, the individual educator typically holds the authority to make decisions regarding the practical use of technology in the classroom. Educators' attitudes toward ICT shape not only their own ICT experiences, but also the experiences of the students they teach. According to Rogers (1995) one of the major factors affecting people's (in the case of this study pre-service History teachers and their educators) attitudes toward a new technology is related to the features of the technology itself. Rogers's (1995) points out four basic features of technology that affect its acceptance and subsequent incorporation, namely: relative advantage, compatibility, complexity, and observability.

These features mentioned by Rogers (1995) played a role in History educators at tertiary education institutions acceptance of ICT, especially when they have to switch to an online teaching and learning methodology in the time of the nationwide Covid-19 lockdown. During this time the traditional face-to-face classes came to an end and were substituted by various online teaching strategies that involved different ICT's tools such as, for example, WhatsApp, mobile phones, Zoom, Google Meet, emails, Zoom, Skype, pre-recorded Voice over PowerPoints, YouTube, VideoScribe, Powtoons, Doodly and Toonly (Sebbowa, 2022; Bunt, 2021; Halsall, 2020; Iyer, 2020). Most of these ICT tools that the History educators used for their remote teaching and learning were in the words of Rodgers (1995) compatible and observable with the e-Learning Management

Systems of the respective institutions that, in most cases, already existed before the Covid-19 outbreak.

The attitudes of History educators at tertiary education institutions towards technology integration in the training of their students can largely be established from some of the challenges they experienced during their online teaching and learning during the time of the Covid-19 pandemic. Based on their challenges some requirements were set that History educators felt will ensure the incorporation of technology resources in a more meaningful way (Sebbowa, 2022; Bunt, 2021; Dube, 2020; Halsall, 2020; Iyer, 2020; Nasson, 2020):

- the revision and adoption of teacher education programmes for the incorporation of different ICT's to blend with the traditional methodological approaches;
- continuous professional training in the use technology to improve ICT skills that will motivate and empower,
- embrace specific ICT tools that will cater for the diverse learning styles of the students;
- incorporate ICT technology that will promote an active and enquiry-based learner-centred approach;
- employ in proper planning ICT infrastructure planning and support policies for educators and students, and
- ensure adequate and reliable internet connectivity.

2.7 CONCLUSION

Chapter 2 concentrated on the role of ICT's and SDL within the 21st century's History teaching and learning environment. This chapter started off with a look into the relationship between the P21 Framework, the 4IR and SDL after which the role of ICT's in the promotion of SDL skills were examined. Hereafter, the expectations and challenges faced when attempting to incorporate ICT's at South African schools were discussed. Subsequently, the use of ICT's within the teaching and learning of History and the potential benefits were examined. After the benefits of ICT's within History

teaching and learning were reflected upon, it was followed by a discussion on the ICT training of pre-service History teachers at tertiary educational institutions.

In Chapter 3 the role of VR-HMDs as an ICT instructional tool in education will be discussed.

CHAPTER 3

VIRTUAL REALITY HEAD-MOUNTED DISPLAYS AS AN INFORMATION AND COMMUNICATIONS TECHNOLOGY INSTRUCTIONAL TOOL IN EDUCATION

3.1 INTRODUCTION

While Chapter 2 focused on the use of ICT's and SDL within History education in the 21st century and as a result lay the foundation for Chapter three.

The purpose of this chapter is to provide a review of the scholarly literature and conceptual framework in relation to Virtual Reality Head-mounted Displays (VR-HMDs) as an Information and Communications Technology (ICT) instructional tool not only in education in general but also in History education in the specific. A literature review is a critical, impartial overview of published research literature pertinent to the topic at hand. Its goal is to familiarise the researcher with current thinking and research on a specific topic (Maggio, Sewell & Artino, 2016).

Modern society is ever-changing and developing (Levin & Mamlok, 2021) and has reached a stage where it would not be out of place to refer to the modern society as a digital age due to the digital saturation experienced by a person as a result of the vast amount of technologies that an individual is exposed to (Lendzhova, Milenkova & Manov, 2022). It is in this digital age that there is a move to find new ways to engage with students even though effective engagement becomes ever more difficult as the complexity of the ICT increases (ClassVr, 2022; Levin & Mamlok, 2021). The technologies found within this digital age ranging from cell phones to gaming consoles have become widely more accessible and popular while their incorporation to education has been somewhat harder (ClassVr, 2022; Haleem, Javaid, Qadri & Suman, 2022).

Köse (2017) opines that modern History educators are confronted with the complexity and nuances of teaching History and the barriers to effective History teaching and learning. History teachers are placed in this precarious position due to the combination of information pollution through the use of a host of media platforms that are able to

reach students' screen and the educators' inability to stay on trend with modern developments in ICT's. It is these difficulties in separating the aforementioned digital factors that could possibly influence both pre-service and in-service teachers' technological knowledge used to impart their content knowledge (Ciriza-Mendívil, Lacambra & Hernández De la Cruz, 2022).

Historically speaking during the 1980s personal computers (PCs) were considered to be the modern ICT that was incorporated into the educational system. This incorporation of computers provided diverse opportunities across various educational levels for both students and educators (Kobusingye, 2022). In the 21st century educators and students now experienced an age where innovative ways of teaching and learning were available to them that started a period of excitement and improved learner engagement (ClassVr, 2022). This incorporation of PCs improved engagement and excitement while the innovativeness of computers and other educational technologies delivered newer methodologies that drove students and educators to incorporate technologies into their teaching and learning repertoire (Stecula & Wolniak, 2022).

If focus is now shifted from the 1980s to the modern society, virtual reality (VR) has become a relatively new addition to the educational field. The influence and importance that VR has, differs from the PCs of the 1980s. PCs relied on its modernism at the time whereas VRs influence and importance is based on its ability to be innovative when being applied to the teaching and learning of pre-service teachers. VR as an emerging technology and its accompanying HMD device afford students captivating and engaging teaching and learning experiences beyond the classroom while still being in the classroom (Abbitt & Davis, 2021; Makransky & Petersen, 2021; Yildirim, *et al.*, 2018).

Chapter 3 will in the first place focus on clarifying the concept of VR (sec. 3.2.) after which the benefits of VR (sec. 3.3.) will be discussed. If benefits are looked at it naturally requires an examination of the limitations and challenges attributed to VR (sec. 3.4.) in order to ensure objectivity. Once the concept of VR has been clarified and the benefits and limitations have been determined, then a look at how VR has been used within education globally will take place (sec. 3.5.). Once the use of VR globally has been determined, the use thereof in History education (sec. 3.6.) will be examined. This will then be followed with a conclusion to the chapter (sec. 3.7.).

3.2 WHAT IS VIRTUAL REALITY?

Concannon, Esmail & Roduta (2019) and Smutný, Babiuch and Foltýnek (2019) state that VR can be considered to be a simulated environment that incorporates the use of artificial visuals, auditory, haptic and other sensory stimuli to provide feedback that creates the illusion of realism. For Abbitt and Davis (2021:835) VR refers to a technology “in which an immersive digital simulation of a physical space allows users to interact as if they were present in that space”. Renganayagalu, Mallam and Nazir, (2021) define VR as “a computer-generated three-dimensional graphical representation of the real or imaginary environment in which users are immersed through a dedicated headset or an array of display walls”. VR thus creates environments that imitate the real world or any other environment that the creator of the simulated environment wishes to create. The creation of these environments provides first-hand experiences that might not be possible to have within the realm of physical reality. Within the VR environment, users are stimulated in a multisensory way that adds to create an illusion of reality. Moreover, VR can be incorporated into a wide variety of academic disciplines including technology training, medicine, natural sciences, history or architecture (Smutný *et al.*, 2019).

3.2.1 Historical attempts at virtual reality

While the modern idea of VR can be dated back to the 1960s (Renganayagalu *et al.*, 2021) it is however not mankind's first attempts to realism within a realm outside of the physical (Virtual Reality Society, 2022) as painters from the nineteenth century attempted to create panoramic paintings. These paintings were 360° degree murals that attempted to fill the viewer's entire field of vision, while making the viewer feel present at the event being portrayed. These nineteenth century panoramic paintings were however not the only historical iterations of VR as Charles Wheatstone's research during 1838 established that the brain processes the different two-dimensional images being

observed as a single object even if each eye focuses on the object separately. Thus, the use of stereoscopic images came into use.¹

The use of the View-Master stereoscope (see Figures 3-1 – 3-3) that became quite popular was patented during 1939 and was used in virtual tourism. Furthermore, the argument can be made that the View-Master was the predecessor to VR-HMDs such as Google Cardboard and other low-end VR-HMDs that make use of mobile phones (Virtual Reality Society, 2022).



Figure 3-1: Illustration of a first attempt at a View-Master head set



Figure 3-2: Illustration of a traditional View-Master head-set

¹ According TechTarget (2022) stereoscopy, often called stereoscopic imaging, is a technique used to provide a three-dimensional effect while creating an illusion of depth to a flat image. Therefore, the use of stereoscopic imaging provides the user with a sense of depth and immersion.



Figure 3-3: Modern illustration of a View-Master head-set

Source: Virtual Reality Society (2022)

As time passed mankind attempted to continuously improve the technologies available while also attempting to create improved ways to stimulate human senses (ABC News, 2015). This process took flight in the 20th century with the development of computer technology and electronics (Virtual Reality Society, 2022).

In 1935 the science fiction writer Stanley G. Weinbaum coined the idea of a VR-headset in his collection of short science fiction stories (*Pygmalion's Spectacles*) that would allow the user to experience a fictional reality through holographic technology, smell, taste and touch. This idea by Weinbaum was brought to fruition in the 1960's when Morton Heilig patented Telesphere Mask in 1961. This Telesphere Mask (see Figures 3-4 and 3-5) served as the first attempt at HMDs. It made use of wide stereoscopic 3D imaging with sound, but unfortunately it did not make use of head-motion tracking and showed a non-interactive film (Brockwell, 2016).



Figure 3-4: Telesphere mask demonstration

Source: Virtual Reality Society (2022)

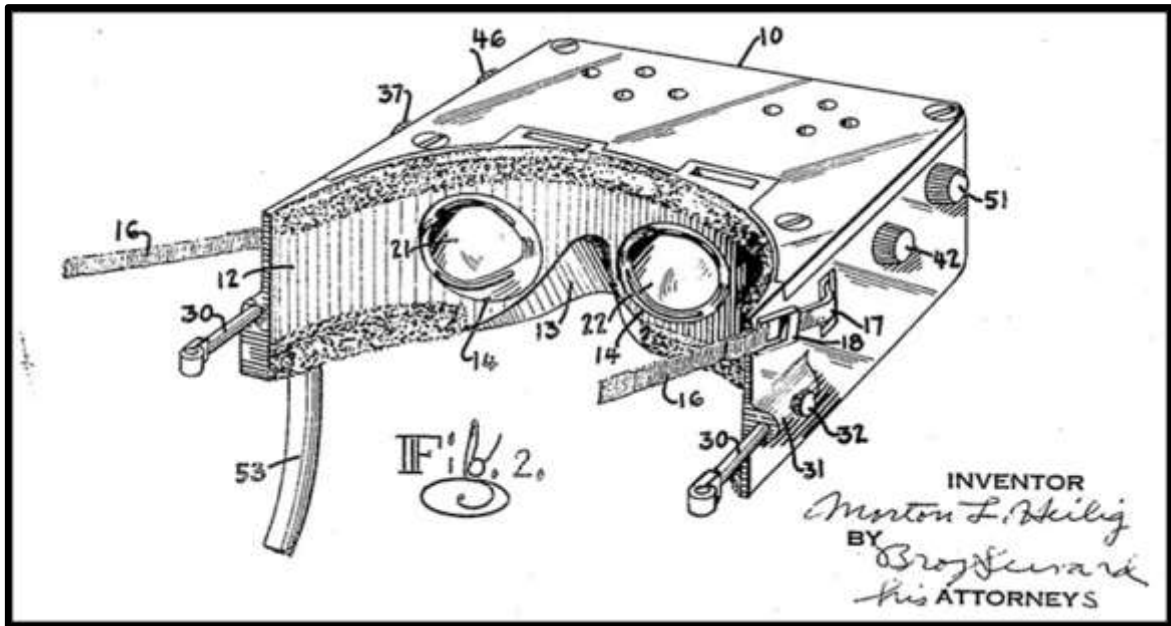


Figure 3-5: A drawing from Telesphere Mask patent

Source: Ngu-Leubou (2021)

3.2.2 Head mounted displays as virtual reality devices

Although the first iterations of VR came to be during the 1960's and became public knowledge during the 1980's, it has only seen a rise in popularity in the last decade (Smutný *et al.*, 2019). This rise in popularity is due to the creation of new hardware that entered the consumer market and as a result provided a variety and affordable new options to access VR environments. Virtual Reality Head-Mounted Displays (VR-HMDs) is currently the principal hardware device of VR technology (Renganayagalu *et al.*, 2021). HMDs are devices that are placed on a user's head while also covering the user's field of vision and works through the use of head tracking technology that determines the direction one moves in within the virtual environment (Specht *et al.*, 2021). Additionally, the rise of VR-HMDs can be tracked back to 2012 when the Oculus Rift was introduced as an affordable and high-quality HMD (Concannon *et al.*, 2019; Smutný *et al.*, 2019). With VR-HMDs now more affordable and easier to use, this technology was introduced in education and training with some promising results (Renganayagalu *et al.*, 2021). For Souchet, Philippe, Lourdeaux & Leroy (2022) VR-HMDs application to pedagogy appears to be one of its fastest-growing core characteristics.

3.2.3 How do VR-HMDs work?

While above definitions on VR and HMDs is informative it does not necessarily explain the way it operates. According to the Virtual Reality Society (2022) HMDs provide each eye with a near identical, but slightly offset, version of the same image that creates an illusion of stereoscopy. In an attempt to cut costs a lot of HMDs do not make use of dual-screens, but rather utilizes a single screen with a divider to ensure each eye can only see the specialized image that is required to create the stereoscopic image. The focal point is an image at the centre while the edges create a curvature with a gradual loss of sharpness that results in the fuzzy grey edges. The simulation by the HMD is a representation of a person's actual field of vision, but viewed through the HMD and its special lenses at the correct distance these images fit naturally into a person's field of vision and then appears to create a natural simulation of a real scene. It is this combination of the human field of vision, head motion-tracking, and off-set images through the specialised lenses at the correct distance that creates a virtual world (Virtual Reality Society, 2022).

HMDs comfortably fits to the user's face, effectively blocking light that may hinder the experience, while incorporating auditive stimuli through the use speakers or headphones, thereby minimalising the user's ability to hear and react to sounds not found within the accessed VLE. VR-HMDs offer a nigh perfect field of vision that can dynamically adjust the visual stimuli the user sees based on the user's detected head movements through making use of accelerometers. Visual stimuli update in real-time and it is this real-time update that creates and enhances the immersive experience while also simulating the practice of exploration within the VLE in order for the user to have experiences akin to real-world interactions (Baker, Nam & Dutt, 2023).

3.3 BENEFITS OF THE USE OF VIRTUAL REALITY AND HEAD-MOUNTED DISPLAYS

According to Checa and Bustillo (2020) VR has shown tremendous growth in nearly all spheres of society where it has been incorporated and has thus as a result shown a discernible influence on a variety of professions such as Education, Marketing, Engineering, Robotics, Entertainment, Health sector, Heritage, Archeology, Industrial Protection, and Community Skills. This influence that VR has would however only be

possible if it had a wide range of benefits. Additionally, it has to be stated that there are various forms of VR, but this study focuses on VR that makes use of VR-HMDs as the possible ICT teaching and learning tool (Concannon *et al.*, 2019).

The most noticeable benefit to the use of VR is that it allows for visualizations that aren't necessarily possible in the traditional classroom (Hicks, 2016). VR allows the user to explore a vast amount of realities and experiences. By using a VR-HMD, the user encounters high-quality visuals that could have a constructive effect on the learning experience (Lauer, Altmeyer, Malone, Barz, Brünken, Sonntag & Peschel, 2021). Moreover, according Taranilla, Cózar-Gutiérrez, González-Calero & Cirugeda (2022) VR stimulates a deeper understanding of content due to the connection between information and experience.

According to a study done by Alfarsi, Yusof, Malik and Tawafak (2021) VR-HMDs are devices that are used for in the educational fields of gaming, aviation simulations, medicine and engineering. In the academic field of engineering the benefits of VR-HMDs became obvious through the research done by Alhalabi (2019). He shows that when engineering students were afforded the opportunity to experience teaching and learning through VR-HMDs they performed higher than their peers who did not have this same opportunity. Based on these results Alhalabi (2019) is further of the opinion that VR-HMDs could be considered a useful and clinical ICT tool for assessment and the retaining of information – an opinion supported by Taranilla *et al.* (2022). As far as it concerns History education, Victor (2023) and Yildirim *et al.* (2018) believe that VR-HMDs could also effectively be used within this subject discipline.

In the research of Aubrey, Robb, Bailey and Bailenson (2018) of the Commonsense organisation into VR, they discovered that 56% parents whose children are within the group of 8 to 17 years of age are of the opinion that VR could possibly assist their children in learning to emphasise with others, while 76% of parents from the same sampling group believed that VR would provide opportunities to their children that they wouldn't normally have, thus reinforcing the primary advantage of VR, to be cognitively transported outside of the classroom (Victor, 2023; Capatina, Sching & Rusu, 2017; Hicks, 2016).

The abovementioned findings by Aubrey *et al.* (2018) were however not the only findings worth mentioning but rather the tip of the academic iceberg. Other positive

findings and benefits of VR and HMDs are (Akgün & Atici, 2022; Han, Shin, Ko & Shin, 2022; Taranilla *et al.*, 2022; Hamilton, Edgerton & Wilson, 2021; Baceviciute, Mottelson, Terkildsen & Makransky, 2020; Audrey *et al.*, 2018; Jensen & Konradsen, 2018; Wang, 2018; Huang, Liaw & Lai, 2016; Nadan, Alexandrov, Jamieson & Watson, 2011):

- It provided an immersive virtual reality environment that was found useful by students and made their learning more enjoyable.
- It affords the user the ability to understand different perspectives while diminishing racial bias while encouraging users to be more empathetic.
- It goes beyond the visual drawbacks of the traditional teaching and learning pedagogy.
- It provides immersive experiences of which the intensity of the virtual reality environment provides a sense of being present in the moment.
- It provides a platform where learning is subjectively and independently encounter by students in a first -person hands-on experience that occurs without the intervention of their educators.
- It allows students in gaining cognitive, affective and psycho-motor skills where learning is experienced in virtual environments that would otherwise logistically to problematic to physically visit.
- It promotes self-efficacy and improved learner attention.
- It contributes to a better understanding and remembering of visual and spatial information.
- It adds to students being more enthusiastic for learning which develops into increased levels of motivation.
- It increases critical thinking and the development of other professional skills.
- It promotes active, deep and self-regulated learning.

Furthermore, VR-HMDs as an ICT teaching and learning tool also has the possibility to enhance the professional development of teachers and more so when it is introduced during their training. Through the ability of VR-HMDs to be innovative, it exposes teachers to new environments by providing teaching and learning simulations that peak

their interest (Capatina, Sching & Rusu, 2017). Moreover, Advanced Micro Devices Inc. (AMD) (2017) conducted a study and discovered that VR affords its users the possibilities within the educational system that has not yet been observed.

Therefore, given that VR prioritises learning by enabling users to experience subject content first-hand, it can be argued that this interactive experience arises from VR's immersive nature, which in turn significantly influences the user's cognitive perception of reality (Makransky & Petersen, 2021). Thus, it is due to VR's ability to be immersive that sets it apart from its modern ICT compatriots and that allows for its comprehensive teaching and learning experience (Lege & Bonner, 2020). Also, according to a study conducted by Alfarsi, Yusof, Malik & Tawafak (2021) VR has a positive influence on the learning process as it allows learners to improve upon their learning outcomes while providing experiences that they usually wouldn't be exposed to while also developing their intrinsic motivation and interest. By keeping the statement by Lege & Bonner (2020) in mind the assumption can be made that VR-HMDs could benefit the educational system in its entirety while also providing subject specific content to subjects like History.

Thus, based on the information above the foremost argument for the inclusion of VR-HMDs is due to it endeavouring to create learning environments that promote a sense of being present which, in a subject like History, could be of utmost benefit when teaching content that students can't relate with otherwise.

3.4 LIMITATIONS AND CHALLENGES IN THE USE OF VIRTUAL REALITY AND HEAD-MOUNTED DISPLAYS

While VR and HMDs certainly has its advantages and benefits within the education setting it naturally has its disadvantages and limitations as an ICT teaching and learning tool as well (Fernandez, 2017).

Though the study conducted by AMD (2017) mostly advocates for the use of VR as a pedagogical tool, it also warns that the over-use of VR might desensitise the students to what they are experiencing while also diminishing the progressive effect to learning that it may have on students. While not referring to the learning experience as the before mentioned statement does, a study conducted by the Commonsense organisation with Aubrey *et al.* (2018) found that according to the majority of parents they initially don't

expect children to learn skills that would allow them to emphasise with others (This opinion of the parents did change when only observing the parents of children that use VR as mentioned in the previous section when the benefits of VR was discussed). Aforementioned statement is further supported by Hicks (2016) when stating that VR could possibly damage and lead to the deterioration of human relationships.

While there are clearly identified limitations and disadvantages Aubrey *et al.* (2018) also outlined that long-term effects to health and mental well-being on children that make use of VR is mostly unknown, but there are still concerns regarding this and why moderation and supervision is recommended. This concern is echoed by Milanese (2016) and Mon-Williams (2017) who are of the opinion that additional VR research on children is required before VR can be used as a regular ICT in the classroom. When looking at possible problems to health and VR, it is discerned that VR-HMDs makes use of images that are centimetres from their eyes while the images appear to have depth. This disparity between what the brain sees and reality could cause eyestrain and headaches (Renganayagalu *et al.*, 2021; Mon-Williams, 2017). For Kaleci, Tepe and Tüzün (2017) (as cited in Agün & Atici, 2022) VR-HMDs users might also experience health issues such as dizziness, anxiety, nausea and blurred eyes.

3.5 THE UTILISATION OF VIRTUAL REALITY AND HEAD-MOUNTED DISPLAYS WITHIN AN EDUCATIONAL CONTEXT ACROSS THE GLOBE

The consideration of VR for educational purposes has been increasing in various academic disciplines such as, for example, teacher training (Eutsler & Long, 2021). Additionally, the ever-increasing interest in VR has resulted in several studies regarding the application of VR on education (Han *et al.*, 2022; Khukalenko, Kaplan-Rakowski, An & Lushina, 2022). It is by keeping the aforementioned in mind as well as both the advantages and disadvantages of VR-HMDs that it becomes apparent that VR devices are not all singular in their use. There are various VR devices available each with their own qualities and performance abilities. Additionally, these VR devices rely on teacher and student competency in order to improve the educational process (Wang, Wu, Wang, Chih & Wang, 2018). It is due to this aforementioned statement and other VR-HMDs related studies of a similar nature that were conducted over the past five years that Table 3-1 was constructed. This table below will focus on examples of various VR

and VR-HMDs related studies in different countries and comparatively examine the manner in which VR and VR-HMDs were used to conduct the research, the limitations and the general findings of each of these studies. Distinctive attention needs to be paid to the study of Khukalenko *et al.* (2022) in which VR-technology was not used to collect data, but where a literature review was rather used.

Table 3-1: A recollection of VR and VR-HMDs as an ICT application within an educational setting for the past five years across multiple countries

No	Author/s and country of origin	Research application	Limitations experienced
1.	Yildirim, <i>et al.</i> (2018) Turkey	VR-HMDs (referred to as VR glasses within this study) were used. During the data collection phase of this study nearly five-minute of learning content was provided to the participants – this learning content was new to all participants as well. Additionally, the researchers attempted to provide participants with the opportunity to guide their own learning experience by not setting a time limit, thus allowing the participants to work through the VR-HMD experience at pace that suits them.	• Participants required prior training to their use of the VR-HMDs. • Since each student was afforded the opportunity to engage with the content at their own pace it did result in time becoming a contextual factor. • A large space was required due to the fact that participants made use of wheeled chairs to not only turn-around and thus having 360°degree field of vision but to also move around in the VLE.
Findings made by the		The study aimed to discern the opinions regarding VR and found that participants enjoyed the learning experience through the use of VR-	

study	HMDs. As mentioned previously in this study, VR affords its user the ability to be cognitively transported out of the classroom and learn through experience and this study by Yildirim <i>et al.</i> (2018) reinforces this primary benefit of VR. Additionally, the participants of this study emphasised the fact that the VLE consolidated the learning of new content and thus according to their opinions making the learning content (Islam History) more memorable. Moreover, for the researchers of this study it seems that the VLE not only increased the participants' willingness to engage with the learning content but to also visit the present day real life location. Thus, the overarching observable fact discerned by this study is that participants found the VLE through the use of VR-HMDs useful, enjoyable and memorable – three factors required to become life-long learners.
2.	Pirker & Dengel, (2020) Austria and Germany This study made use of a systematic review as an approach to collect data from various existing studies on the use of VR. Furthermore, this reviewing process took part over four phases where certain key terms were used to screen these existing studies to ensure their applicability to the research. • The study made use of only textual data and did not make use of any VR devices and software. • There was no sampling group as the study relied on the data gathered in other studies.
Findings made by the study	The findings for this study were categorised into various academic disciplines but for the purpose of this study only the findings on VR within History education are used. According to the findings by Pirker & Dengel (2020) the use of 360° VR simulation videos within History has shown value in various subject-related topics. They also found that the participants from other studies enjoyed the use of VR and were more motivated to learn more. The academic performance of these

		participants did however not outscore their results gained through traditional teaching and learning methods – it is crucial to note however that these results are of an immediate nature and don't necessarily reflect the long-term results. Additionally, these immersive experiences from the various studies reviewed by Pirker & Dengel (2020) afforded participants the opportunity to gain experiences that they normally would not have had. The general opinion of the researchers is that VR has major advantages to education, but also identified a gap in the literature regarding to the application of VR and more overly noticed that the limitations to VR do not outweigh the advantages.
3.	Graeske & Sjöberg (2021) Sweden	This study was implemented to test the application of VR to teach Swedish in two 'Swedish 1' classes. The one class was from the Technical Programme and the other class was from the Electrical and Energy Programme. During, the study the participants participated in an 80-minute lesson where after they had to complete a writing assignment. • Before this study could effectively take place the teachers of the respective classes and others that participated in the study had to undergo a VR workshop to familiarise themselves with the VR. • Space was a contextual factor that required participants to work together in pairs. • This study also highlights that in order to effectively make use of VR a fair amount of planning is required.
Findings made by the study		Many participants from both classes were of the opinion that VR would motivate them to engage more with their studies. Also, the length of the written assignments handed in after the VR-based lesson showed an improvement to what was handed in to teachers before the study. Additionally, participants said that VR increased their desire to learn and

		explore VR experiences. The teachers and researchers also observed that students appeared to be happy but also noted that while the lesson certainly had an enjoyment factor that there are issues associated with VR-based lessons and therefore advocate that VR is not used by itself in a lesson but rather as a tool in a wider teaching and learning repertoire.² The study definitely showcases that participants became more engaged with the study content provided. The conclusion that Graeske & Sjöberg, 2021 came up with is that TPACK-competencies are of the utmost importance as there should be a clear connection between subject content, VR technologies and participants previous experiences.
4.	Riner (2021) United States of America	This study made use of two Honours History classes. One class incorporate VR as a pedagogy in order to study world History while the other group made use of more traditional means. This VR experience allowed the participants to experience the VLE that Anne Frank experienced without experiencing the violent aspects surrounding WW2. Within this study the activities of the two classes were mirrored but differed in its use of VR and the traditional method as the • As with most educational issues the VR-based lesson was time consuming. The VR class and traditional class had different class times. • There were participants who were absent thus impacting the sampling size. • The study was conducted towards the end of the school year and as a result participants had other distractions one of which could have been exams.

² This is an important factor to take note of as this conclusion made by Graeske & Sjöberg (2021) accentuates the opinion of the researcher from this study that VR ought to be used as a teaching and learning tool within the educational system instead of a method to completely reinvent the wheel.

		researchers wanted to explore the different experiences of the participants.	
Findings made by the study	The primary findings showed that participants desire to make use of VR within a classroom setting was quite high while the teacher's experience regarding the integration of VR was quite encouraging and progressive. Furthermore, Riner (2021) is of the opinion that leaders within education should be willing to assist in the professional development of teachers who are willing to integrate VR into their teaching repertoire.		
5.	Cabero-Almenara, Llorente-Cejudo & Martinez-Roig (2022) Spain	During this study a VR excursion was held to see the Church of the Annunciation in Seville. This study made use of 20 Master's Degree students that specialise in Art. During this excursion the participants were able to see the altar and all the rest of the interior details. This excursion also allowed for a 360°degree experience through the use of a VR-HMD. The study made use of questionnaires to collect data.	• Due to the lesson taking place in a classroom setting the participants and teacher had limited space to work in. • VR was used in conjunction with various other methods and as a result became time consuming. • Another limitation faced by the study is the sample size as the researcher would have preferred a group larger than 20 participants.
Findings made by the study	According to the findings of this study the use of VR in a university classroom showcased a great amount of interest among the participants while also clearly showcasing a high degree of acceptance for VR. Additionally, the study found that the visual from the VLE and the objects from the actual environment showed no significant difference and thus the researcher is of the assumption that VR lends itself to realism.		

6.	Khukalenko <i>et al.</i> (2022) Australia and United States of America	This study made use of an online survey in the Russian Federation where the researchers attempted to discern 20,876 Russian educators' perceptions and experiences after prior experiences in the use of VR in their classes. The educators who participated in this study taught the following subjects: computer science, chemistry, physics, biology, technology, mathematics, Russian, foreign languages, social science, and literature. Thus, these 20,876 educators were representative of the Russian educational system. This study did not make use VR devices and software and as such solely relied on the survey and a literature review.	• The lack of actual VR devices and software. • Solely relying on sets of questions. • While having a large sample pool the wide range of participants could also hamper the longevity of the data as narrowed. Subject specific sampling groups are also required. • The researchers are of the opinion that in further studies multiple data collection methods should be used.
Findings made by the study		The authors of this study are of the opinion that the practicality of VR may differ across academic disciplines and that the perspectives of subject specific teachers may possibly produce thought-provoking results. In addition, the researchers believe that VR could be beneficial to an educational context in general terms but first requires incorporation to IT studies and later other academic disciplines as school curricula aren't yet aligned to incorporate VR. The researchers also believe that before VR could be incorporated into education teachers need to be observed using it.	

While the examples of the studies above were used to offer a bird's eye overview in the utilisation of VR and VR-HMDs over the past five years, there are more studies and surveys that provide additional perceptions and perspectives regarding VR application within an education context such as, for example:

- (i) Samsung Electronics (2016) that surveyed a 1000 U.S. based-teachers wherein 93% (930 teachers) pointed out that their learners would be excited by the use of VR within a classroom setting while 85% (850 teachers) opined that they believe VR could assist in improving learning outcomes.
- (ii) The Common Sense Media (2018) conducted a study in which they discerned that 84% of parents with children that make use of VR are of the opinion that VR does have educational value.
- (iii) The study of Fineman (2018) finds that less than 50% of universities in the U.S. have made use of VR.

While studies have been conducted into VR it also requires mentioning that VR has been used in various academic disciplines ranging from subjects that can be found at primary schools all the way up to higher education institutions (Dick, 2021). Some of the fields that VR has been used in, is (Dick, 2021):

- | | | | |
|-----------------------|----------------------------|----------------|-----------------------|
| • STEM education | • Medical training | • Art | • History |
| | • Mathematics | • Science | • Literature |
| • Geography | • First responder training | • Architecture | • Engineering |
| • Career developments | | | • Technical Education |

3.6 THE APPLICATION OF VIRTUAL REALITY AND HEAD-MOUNTED DISPLAYS IN THE TEACHING AND LEARNING OF HISTORY

When further examining the use of VR-HMDs within History education there is a vast amount of VR content that could be used by making use of VR resources such as Avantis World, ClassVR and other VR History inspired applications for download on Google Playstore that require the use of HMDs. In Table 3-2 a summary is given of VR

resources and content that can be used in the teaching and learning of History (ClassVR, 2021; Eduverse, 2021; Google Playstore, 2024).

Table 3-2: VR resources and content that can be used for the teaching and learning of History

History inspired content accessible through Avantis World
Avantis World³ is an online platform that is divided into various zones called “lands” that provide VLEs for students to explore independently. Every VLE provides a fully immersive experience where students can discover, investigate and conduct research as if they were at the location physically. Additionally, Avantis World provides VR lesson plans where the VLEs are accompanied with lesson plans and methods of assessment. When specifically focussing on History, Avantis World provides the <i>Trip Through Time Land</i> with the following topics: • prehistoric period, • early humanity, • early civilisations, • age of exploration, • age of revolution, and • the modern world.
 Figure 3-6: Visualisation of Avantis World various educational portals

³ Avantis World while being an online entity by its own accord can also be accessed through the use of ClassVR.



Figure 3-7: Avantis World: A trip through Time land

Accessible History subject content through ClassVR

World War 2	Students are able to engage with topic related content such as a 360° WW 2 battle re-enactment, a 360° Pearl Harbour summary, the Birkenau concentration camp and the virtual Holocaust museum. It was these VLEs (with the exception of the Birkenau concentration camp) provided by ClassVR that were used during the data collection process of this study. Additionally, an ARCube ⁴ can be used to examine a tank and fighter plane used during WW2.
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Figure 3-8: Illustration showing the ClassVR portal, History topics, ARCube and its accompanying 3D model

⁴ The ARCube used by ClassVR is a cube with black and white markings that provides the user with 3D models of inanimate objects such as tanks and other war machinery that can only be seen through the use of VR-HMDs.

VR History inspired applications for download on Google Playstore that require the use of HMDs	
Ancient Athens in VR	This application was created by Lithodomos VR with its last update in 2021. It assists the user in exploring ancient Athens but also provides interactive guided tours with audio and visual stimuli.
Civilisations AR	Civilisations AR is an application created by BBC Media App Technologies. The aim of this application is to bring art and culture found across the globe to the user of this application.
Egypt VR: Pyramid Tomb Adventures	Created by Virtual Amigos, this application attempts to provide a History-based adventure where the user explore tombs from ancient Egypt.
Sites in VR	Sites in VR was created by Ercan Gigi with its latest update in 2019. This application attempts to provide immersive VR experiences through the use of virtual tours of landmarks created through the use of 360° panoramic images.

Source: ClassVR (2021); Eduverse (2021); Google Playstore (2024)

3.7 CONCLUSION

Chapter 3 placed emphasis on the use of VR-HMDs as an instructional tool not only in education in general but also in History education in the specific. To that aim the chapter first endeavoured to define and clarify the concept of VR. Successively, Chapter 3 attempted to establish the benefits of VR-HMDs within education while also discussing the potential limitations and challenges. Hereafter, an overview followed on the utilisation of VR-HMDs within an educational context across the globe. Once all the aforementioned has been discussed this Chapter examined the manner in which VR-HMDs can be potentially utilised within the teaching and learning of History. One of the most difficult aspects of teaching and learning History has always been the inability to immerse oneself within the subject content in order to have memorable experiences, but VR-HMDs circumvents this problem and now affords its user the ability to experience

History within all senses except taste as even with haptic technology the sense touch can be conveyed through force, vibrations and motions.

In Chapter 4 the research design and methodology applied in this study will be discussed.

CHAPTER 4

RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

In Chapters 2 and 3 an extended literature review was done on the research topic that served as a theoretical and conceptual framework and assisted in the collection and interpretation of the data gathered. In the previous Chapter 3 the role of VR-HMDs as an instructional tool in education was specified that also included both its benefits and limitations.

In this chapter, the research design and methodology of the study are discussed. The research design refers to the specific plan or blueprint that the researcher will carry out to investigate the research problem (Hartell & Bosman, 2016). The research methodology in turn then narrates the research procedures and the research techniques (Mouton, 2001) used within this study.

This chapter first discusses the research questions (sec. 4.2) and the aims and objectives (sec. 4.3) of the study, after which it broadens the focal point of discussion to include the research paradigm (sec. 4.4), the research design (sec. 4.5) and the method of investigation (sec. 4.6). These sections are then followed by a discussion regarding the data collection process (sec. 4.7), the role of the researcher in this study (sec. 4.8) and ethical considerations (sec. 4.9) and the assurance of quality (sec. 4.10). The chapter then closes by providing a conclusion to the chapter (sec. 4.11) that serves as a summary of the chapter and positions the study to start with the data analysis and interpretation in Chapter 5.

4.2 RESEARCH QUESTIONS

A research question addresses the research problem and purpose of the study. For this reason research questions are considered to be the driving force behind the researching process (Tiala, 2022).

4.2.1 Primary research question

As previously discussed, research conducted into VR, its advantages, disadvantages and how it is incorporated into education has increased over the past years. These studies into VR with various research questions and aims that guided these studies received the attention of researchers from various academic disciplines. As one would expect, if one academic discipline enjoys the integration of VR as an ICT teaching and learning tool it should naturally roll-over into other academic disciplines such as History. Thus, it is by keeping the aforementioned in mind that this study made use of the following primary research question to guide the study:

- What is the viability of VR-HMDs when incorporating them into the teaching and learning of pre-service History teachers?

4.2.2 Secondary research questions

In addition to the primary research question the following sub-questions were asked:

- How can VR-HMDs as instruction technologies effectively be integrated into the teacher training of pre-service History teachers?
- What are the primary advantages when VR-HMDs are integrated with the teaching and learning of pre-service History teachers?
- What are the challenges when VR-HMDs are integrated with teaching and learning of pre-service History teachers?
- When incorporating VR-HMDs what will the influence thereof be on pre-service History teachers' various domains of SDL abilities?

4.3 RESEARCH AIMS AND OBJECTIVES OF THE STUDY

The research aim is to clearly address the purpose of the study. Moreover, Thomas & Hodges (2010) are of the opinion that a research study will have several objectives that are considered key issues that the study needs to address. According to Creswell (2014), the research objectives need to pertinently establish the overarching theme of the study. Furthermore, this overarching theme has to be realistic in nature and provide information about the main phenomenon that is investigated in the study, specify the

participants, as well as the place where the research will take place (Creswell, 2014). It is through keeping the aforementioned comments from Thomas & Hodges (2010) and Creswell (2014) in mind that the overarching aim of this study was to:

- Explore how VR-HMDs can be viable when incorporating it in the teaching and learning of pre-service History teachers.

To accomplish the primary research aim, the following sub-objectives were formulated:

- To determine how can VR-HMDs as instructional technologies be effectively integrated with pre-service History teacher training.
- To establish what the primary advantages are when integrating VR-HMDs into teaching and learning of pre-service History teachers.
- To determine what the challenges are when integrating VR-HMDs into the teaching and learning of pre-service History teachers.
- To demonstrate the influence of VR-HMDs on pre-service History teachers' domains of SDL abilities.

4.4 RESEARCH PARADIGM

The term paradigm was first coined by the philosopher Thomas Kuhn (1970) in his writing, *The Structure of Scientific Revolutions*, as he required a single-word expression that could be used to describe one's philosophical way of thinking. When applying this single-word expression, "paradigm", to educational research it noticeably identifies the world view that the researcher ascribes to. This world view that the researcher makes use of emphasises the researcher's perspectives, thought patterns and values that were used in interpreting the gathered data (Kivunja & Kuyini, 2017). Thus, the research paradigm guides the researcher in the attempt to discern meaning through the use of abstract beliefs regarding the research subject.

When research is being conducted a paradigm is to be considered an integral building block of the study as without a clearly identified paradigm there is no thought process that guides the study. By identifying and using a research paradigm as a guiding force within a research study it correspondingly assists with the formulation of the research

aims and objectives while also assisting in identifying research data collection and analysing methods (Duit & Treagust 2012).

4.4.1 Constructivist - interpretivist paradigms

The paradigm used within this study is a mixed paradigmatic perspective of both the constructivist and interpretivists paradigms. The varied approach to the paradigms used is further supported by Firestone (1990) as he believes that a “cross paradigm approach” offers an improved dialectical result.

According to Jagtap (2017) the constructivist approach affords the students – or in this case the participants – the opportunity to take responsibility for the manner and extent to which they acquire and construct new knowledge and skills that may well instil a need for life-long learning. Moreover, constructivism necessitates the use of textual data in order to discern meaning from the subjective views of participants (Waring, 2012). Therefore, the constructivist paradigm used in this study aimed to afford participants with the opportunity to construct and derive meaning from their experiences within VLEs through the use of VR-HMDs. This constructivist approach correspondingly acknowledges the subjectivity of participants' preconceived beliefs and attitudes regarding the integration of VR into history teaching and learning.

While the constructivist approach is ideally suited to this study, it is influenced and enriched by the use of the interpretivist paradigm that will accentuate the motive behind the subjectivity of the participants. Interpretivism acknowledges the individuality of the participants through acknowledging their backgrounds, opinions and experiences that assisted them in constructing their reality within a wider social environment. It is this subjective nature of the participants' experiences that should afford the research study a more reliable outcome. Interpretivism helps to create a meaningful understanding based on human experience (Maree, 2016a) - in the case of this study, pre-service History teachers' experiences in their application of VR-HMDs. Using constructivism within interpretivism as the research paradigm it served to highlight the multiple realities that are present at any given time. If the participants' opinions regarding the viability of VR-HMDs and their application to teaching and learning are aligned after the data collection process it will strengthen the credibility of the research as the interpretivist paradigm highlights their differences while showing their unison in opinion. Furthermore, the

interpretivist paradigm is particularly suitable for qualitative data as it provides detail descriptive responses of the experiences of the specific reality being research within a narrative form (Wahyuni, 2012).

4.4.2 Ontological, epistemological and methodological assumptions

According to Alharthi and Rehman (2016) a paradigm can be explained as the rudimentary belief system and theoretical framework with pre-conceived assumptions regarding ontology, epistemology, methodology and methods that serve as the fundamental basis of a study. Waring (2012) opines that it is of the utmost importance to the researcher to discern the fundamental relationship between the ontological, epistemological and methodological assumptions and views that underline the research study. In Table 4-1 the relationship between the ontology, epistemology, methodology and method used within this research study are explained.

Table 4-1: The relationship between the ontology, epistemology, methodology and method used within this research study

ONTOLOGY	EPISTEMOLOGY
Ontology refers to the view that a person has regarding the physical reality that one lives in (Wahyuni, 2012). Furthermore, ontology within an interpretivist and constructivist framework emphasises the subjective experience of the participants within a social environment (Hesse-Biber, 2011). Thus, ontology when grounded in the boundaries as set out by constructivism and interpretivism refers to the reality created by the individual based on experiences formed through various life-interactions. Moreover, ontology when combined with interpretivism states that the manner in which we perceive reality is	Epistemology from the interpretivist perspective emphasises the specifics of a situation that creates a subjective reality with subjective meanings and motivations (Wahyuni, 2012). The reality constantly in question can only be understood when the underlying actions within social contexts are studied. Essentially this means that the reality one ascribes to is represented through activities, situations and occurrences in the social world through the construction and interpretation of patterns and interpretation processes (Lombard, 2016). Within the context of education

constantly changing, thus highlighting the individual growth of a person when engaging with information (Lombard, 2016). It is by keeping these abovementioned statements in mind that it can be concluded that interpretivism supports the notion that there are multiple realities and that they are dependent on time and context. It is due to the aforementioned that the reality of interpretivism and ontology within the context of this study is the separation between the physical-and-virtual realities. It is this relationship between interpretivism and ontology that then further strengthens the person's ability to construct their pools of knowledge. Learning can take place in a cognitive manner without leaving the boundaries of a physical space while having the added effect that the information presented within the virtual reality changes the individual's reality in the physical world. Moreover, this research study aims to discern the experiences, attitudes and perceptions of pre-service History teachers with regards to the viability of VR-HMDs within their teaching and learning.	research the actual research process focusses on the subjective interpretations and experiences regarding a social phenomenon (Leavy, 2017). While grounding this opinion of Leavy (2017) on the current study it can be stated that the research aims as mentioned and discussed above directly aligns with what Leavy (2017) believes to be crucial to the epistemology of a study as VR could be considered a contemporary phenomenon that is increasing in popularity which can also have possible positive outcomes when applied to the teaching and learning of History. Founding this opinion of Leavy (2017) on the study even further clearly outlines the study's inquiry into how VR as a contemporary ICT creates a VLE that affords the participants to use their subjective life experiences in constructing an academic reality aimed at answering the question: "Are VR-HMDs a viable option to the teaching and learning of pre-service History teachers?".
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METHODOLOGY	METHOD
According to Waring, (2012) the methodology is a reflection of the ontological and epistemology's assumptions that underlines the paradigms being used within the research study. Moreover, the methodology refers to not what the reality is but rather refers to the manner in which a person discovers the knowledge of the reality that they find themselves in. According to the methodological approach within the confines of the interpretivist paradigm knowledge is gained through "engaging in conversation" with the reality one is confronted by (Lombard, 2016:9). With special mention to this study the participants will have to face the reality of the historical content being shown to them in the VLEs through the use of VR-HMDs and be willing to not only engage with the content but be open to change within their constructed reality with the accumulation of new information.	Method refers to the manner in which the research will be done and does not rely on the ontology and epistemology. Thus, the method differs from the methodology as the methodology is a wider concept that focusses more on the manner in which the participants construct their own knowledge whereas the method could be considered to be the actual plan constructed by the researcher that will assist in the data collection process (Waring, 2012). The data collection process will however be further discussed later in this study (sec. 4.7).

In Figure 4-1 below the researcher further attempts to show the interrelationship that exists between VR (in establishing VLE's); the paradigms of interpretivism and constructivism working in tandem within the framework of the ontology, epistemology methodology and methods of this research study.

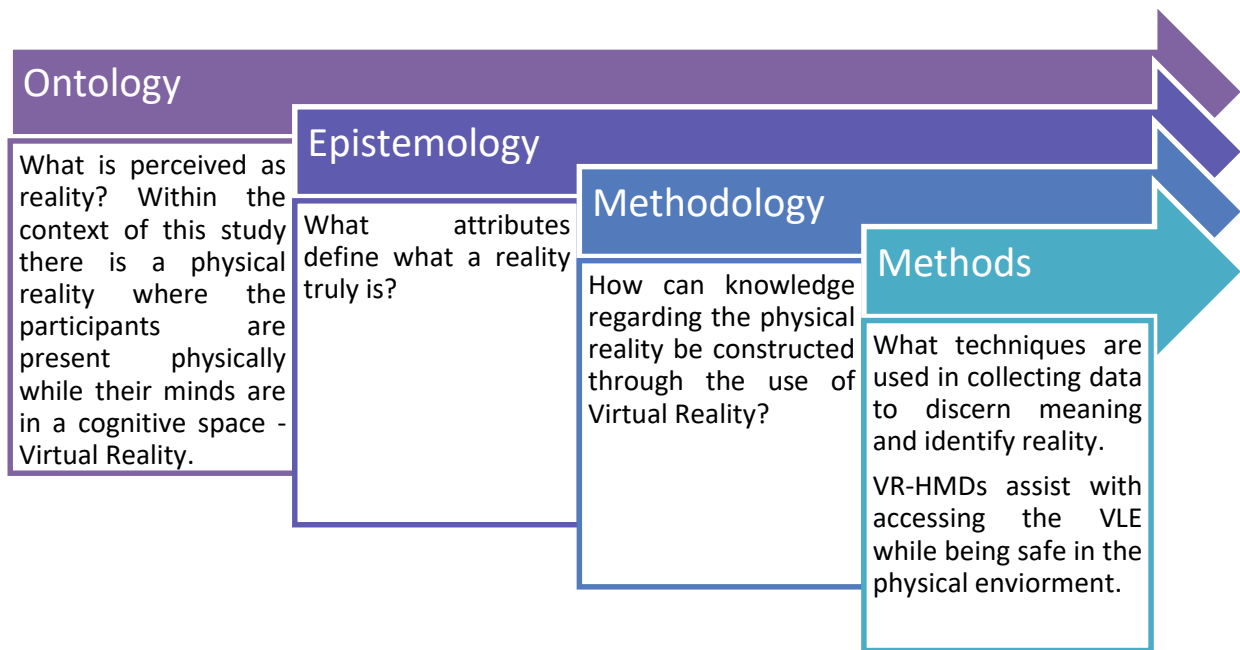


Figure 4-1: The interrelationship between VR and the paradigms of interpretivism and constructivism

4.5 RESEARCH DESIGN

The research design can be clarified as the strategy used by the researcher to develop the philosophical assumptions in which the study finds its foundation (Nieuwenhuis, 2016c) and serves as a bridge between the theoretical and empirical side of the research (Durrheim, 2004). It can therefore be considered to be the “glue” of a research study because it gives structure and direction to answer the research questions (McMillan & Schumacher, 2010). Additionally, Kowalczyk and Scalia (2013) opine that research should to be carefully thought-through and specific in nature. This is necessary in order to effectively study a specific issue through making use of various methods and techniques to gain a scientific understanding of the issue being studied. Seabi (2012) agrees with this view and goes a step further by declaring that the research design is nothing else than a structure or plan according to which the researcher determines which theories, sources and methods, as well as data collection tools will be used to conduct the study.

A predominately qualitative research design was chosen for this study. To a limited degree and in support of the qualitative focus of the research conducted, this study additionally examined numerical data. This method involved incorporating quantitative information, aligned with Maxwell's opinion (2010) that the use of numbers can be an effective and advantageous strategy for qualitative researchers when used as a supplement to qualitative research.

4.5.1 The qualitative research design

The qualitative research design was chosen for this study as it lends itself towards data of an exploratory, descriptive and contextual nature. According to Maree (2016a) qualitative research refers to a study being done by examining linguistic data instead of numerical data. Additionally, Maree (2016a) states that it is this linguistic data that affords the researcher the opportunity to discern meaning from the assumptions, beliefs and values of the participants regarding the phenomenon being investigated. Thus, it is during the qualitative data collection process of this study that pre-service History teachers filled the role of participants and conveyed their beliefs and experiences regarding VR-HMDs in VLEs and ICT's as a whole.

Also, the reason for the use of a qualitative research design is due to its advantages when analysing linguistic data. As with data of a linguistic nature more detailed responses are gathered from participants who naturally fit into the aims of this study and the vision of the researcher in the attempt to answer both the primary and secondary research questions. (The data collection instruments that were used to collect the qualitative data for this study are discussed in section 4.6.3).

4.5.2 The quantitative research design

In an attempt to complement and strengthen the qualitative approach that forms the basis of this study, some quantitative data was also gathered. Quantitative research involves the utilisation of numerical data to determine the relationship between possible variables found within data. In synchronicity with qualitative data, the numerical data assists to clarify aspects of the phenomenon being studied that cannot be satisfactorily addressed by qualitative data alone (Nieuwenhuis, 2016c).

Moreover, a descriptive statistics procedure was used to organise and analyse the data. According to Newly (2014) a quantitative descriptive analysis further facilitates the formation of summaries that identify specific messages, which assists the researcher in gaining a thorough understanding of the gathered data. Newly (2014:522) further emphasises that this descriptive quantitative analysis "can shed light on issues in ways that other approaches cannot". Descriptive statistics are using procedures such as frequencies, distribution, percentages, averages, median, modus and standard deviation (Grosser, 2016) and are simply concerned with the listing, organisation and report on what has been found (Cohen *et al.*, 2011). By using a numerical distribution in this study, the researcher was able to summarise the characteristics of the data in the response categories of the variables. This data was presented in tables and illustrated in percentages and mean scores. (The data collection instruments that were used to collect the quantitative data for this study are discussed in sec. 4.6.3).

The choice to integrate quantitative data as a supporting influence alongside qualitative data within this study stems from the effectiveness quantitative data portrays when reporting on certain issues. However, the fundamental emphasis in data collection and analysis found within this study remains qualitative in nature as this is a single exploratory qualitative case study design where the emphasis lies in the quest for understanding and for in-depth inquiry (Henning *et al.*, 2004). Quantitative results contribute to the in-depth understanding of the phenomenon under investigation.

4.6 METHOD OF INVESTIGATION

4.6.1 Case study

Yin (2009:14) describes a case study as "an empirical enquiry that investigates a contemporary phenomenon in depth and within its real-life context". Case studies are about real people in real situations where it strives to depict the experiences of these people being in a particular environment (Cohen *et al.*, 2011). A case study caters for an in-depth exploration that allows for many types of data collection instruments to be utilised in answering the research questions (Stewart, 2014; McMillan & Schumacher, 2010). For this reason, Wills (2014) is of the opinion that case studies apply a variety of qualitative and/or quantitative strategies in the collection of data. In doing so, it

contributes to an empirically-rich, nuanced and holistic exploration of the specific phenomena under investigation.

There are several types of case studies, for example, explanatory, multi-case, intrinsic and instrumental to mention a few (Nieuwenhuis, 2016c). For this study a single exploratory case study was used. According to Hamilton and Corbett-Whittier (2013) the single exploratory case study launches an inquiry into contemporary phenomena that have real-life significance. Exploratory case studies examine and illuminate on what's essentially unknown, and it is for this reason that Chopard and Przybylski (2021) stress the importance why case studies of this nature should be steered by a specific purpose that focus and frame the phenomenon that the researcher wants to investigate.

It is due to this real-life significance that the case being investigated in this research study was the phenomena of VR and the manner in which it is being accessed through medium of VR-HMDs. The potential use of VR-HMDs, a technology commonly linked with recreational activities like gaming, can now as an ICT, offer a promising chance to enrich the teaching and learning environment of history education. This transformative potential was highlighted by Ford (2017), suggesting that VR-HMDs could redefine our approach to teaching history. Thus, it is for this reason that the case study fits this phenomenological study, as this study involves socially oriented research that aims to understand a specific phenomenon in our modern society (Swanborn, 2010).

While the study regarding the viability of VR-HMDs within the teaching and learning of pre-service History teachers is examined, it requires mentioning that the data gathered had interpretive and descriptive qualities that eased the analysis process of the research data (Nieuwenhuis, 2016c). The reason why these interpretive and descriptive qualities eased the analysis of the data was due to it clearly conveying the thoughts, opinions and attitudes of the participants towards the use of VR-HMDs as an ICT pedagogical tool to promote SDL within the teaching and learning of History. This eased process of analysis ought however not be thought of as the singular benefit of the case study, as according to Cohen (2007) the case study is a realistic approach that allows the researcher to comprehend a phenomenon more thoroughly, while it divulges the unique characteristics of the phenomenon being studied.

In conclusion Leedy and Ormrod (2013) opines that when a case study is used within research the researcher is obliged to spend a reasonable amount of time at the place where the research (data collection process) is taking place in order to stay in contact with the participants. It is with this opinion of Leedy and Ormrod (2013) in mind that the researcher conducted the data collection process at the Faculty of Education of the North-West University (NWU) at the Potchefstroom Campus. This is a location that the participants are familiar and comfortable with while also being a place that the researcher can easily reach and access.

4.6.2 Population and sample

Although the concepts of population and sample both deal with who will be involved in a study as participants, a small distinction can and should be made in order to distinguish between these two concepts. According to Cohen *et al.* (2011) the term population refers to the target group of the research as a whole and thus identifies the wider total of individuals that can be used to obtain the relevant data. Sample, on the other hand, refers to the smaller group of participants within the identified population that categorically participates in the study. Additionally, McMillan and Schumacher (2010), state that the researcher has the responsibility to identify the population before a sample group can be taken.

The population identified for this study was the pre-service History teachers at the Faculty of Education at the NWU Potchefstroom campus. This group has been chosen due to their current developmental experience in which they attempt to qualify themselves as History teachers. It is these shared experiences that serve as the common characteristic between these students that makes them a plausible population.

In order to determine the sample group a purposive sampling approach was adopted which is a form of non-probability sampling where the researcher depends on his own judgment when selecting members from the population to participate in the data collection process. Purposive sampling is frequently used in small-scale case study research, where the researcher is targeting a particular group (Cohen *et al.*, 2011) with the aim of answering the research questions.

The researcher decided to make use of the second year pre-service History teachers at the Faculty of Education at the NWU Campus in Potchefstroom as the sample to draw data from. A primary reason for the inclusion of second year pre-service History teachers is due to the fact that third- and fourth year students are too far along in their studies to take part in possible future and follow-up studies. Additionally, the researcher is of the opinion that the majority of third- and fourth year students have already developed some or other form of teaching ethos based on their existing pedagogical and methodological knowledge. They would then as a result perhaps not be as open to the use of VR within History teaching and learning as in the case of the second year pre-service History teachers. Moreover, the researcher is of the opinion that second year pre-service History teachers are more suited to the study than their first year peers as last mentioned were found lacking in pedagogical and methodological knowledge due to the fact that they only started their academic studies. While this was the identified sampling group these second year pre-service History teachers were still afforded the opportunity to decide for themselves whether or not they want to participate in this study. In the end 15 agreed to participate and provide their opinions and answers in order for the researcher to answer the primary and secondary research questions.

4.6.3 Data collection instruments

Data collection instruments are used by researchers to collect their data during the research process in answering the research questions. In the case of a case study within the interpretivist-constructivist paradigm, there is a tendency to make use of a variety of data collection tools (Cohen *et al.*, 2011). This belief is supported by Newby (2014) that confirms that a case study lends itself to the use of a wide range of data collection instruments in order to collect data in an effective manner. For this study various qualitative and quantitative data collection instruments were used ranging from questionnaires, an e-electronic worksheet (using the *Kahoot* quiz application), a paper-based worksheet, semi-structured focus group interviews and observations that were pinned down in field notes.

4.6.3.1 Questionnaires

According to Roopa and Satya (2012) a questionnaire can be thought of as a list of printed questions that require answers from participants. These answers will then in turn

reflect the pre-dispositional opinions of the participants and will be analysed by the researcher during the data analysis phase. A questionnaire should be thought of as the most common form of data collection as it allows the participants to answer questions regarding a phenomenon without the researcher's influence (Maree, 2016b).

This study made use of open-ended and close-ended questionnaires in an attempt to gather data in such a manner that it adds validity to the study. The use of an open-ended questionnaire (ANNEXURE D) provided the participants with the opportunity to openly express their opinions and in doing so allows the researcher to obtain information regarding their feelings, attitudes and understanding of the phenomena being investigated (Cohen *et al.*, 2011). Through means of an open-ended questionnaire data was gathered on the biographical information of the participants and the participants' prior experiences, attitude and perceptions of the use of ICT's and VR within History education.

While the open-ended questionnaire offers data that is descriptive in nature the use of a close-ended questionnaire, according to Desai and Reimers (2018), provides the researcher with numerical data, where:

- participants could answer questions more easily,
- answer options are provided and in return a better understanding of the gathered data could be discerned,
- irrelevant answers are discarded, and
- answers are more easily compared.

In this study two close-ended questionnaires (referred to as a pre-test VLE and a post-test VLE questionnaire) (ANNEXURE E) were used as instruments to gather some quantitative data. These questionnaires were adapted from the Cheng Self-Directed Learning Instrument (SDLI) (Cheng *et al.*, 2010). The aim of the pre-test VLE questionnaire was to determine the participants' prior knowledge and ability to use ICT's within the SDL mind-set, while the post-test VLE questionnaire established how the exposure to VR-HMDs influenced the participants' beliefs and attitudes regarding the relationship between VR, ICT's and SDL. The aim of the pre- and post -VLE questionnaires was thus to discern if the participants showed any ability to engaged

more in some of the SDL skills after being exposed to VR-HMDs in VLE. These two close-ended questionnaires used a 5-point Likert scale with the variables of (1) strongly disagree; (2) disagree; (3) neutral; (4) agree and (5) strongly agree.

A Likert scale is according to Maree and Pietersen (2016) a popular method of gathering data in survey research. It provides for a range of responses to a given statement or question (Cohen *et al.*, 2011). Likert scales allow researchers to locate and measure the strength of a sentiment, viewpoint or attitude to a particular construct, such as SDL for example. The variables of the different categories in a Likert scale can be measured and presented as numerical scores (Maree & Pietersen, 2016) as was done in this study.

4.6.3.2 Worksheets

Worksheets are generally speaking useful instruments to determine academic achievement (Lee, 2014). Therefore, the use of worksheets will aid the researcher in determining whether or not the participants were able to convey and capture content information effectively after being exposed to VR-HMDs.

4.6.3.2.1 Electronic

Based on the premise that worksheets can add value to the research process of this study, the researcher decided to make use of the e-electronic *Kahoot* quiz application (sec. 5.5.2) as an instrument to gather quantitative data. *Kahoot* is a game-based learning platform that transforms the educational process into an interactive student-centred experience. Educators are responsible for the creation of e.g. quizzes that turns what would be traditional lessons into new academic and engaging games. Furthermore, students participate by accessing the quiz on their mobile devices and selects answers in real-time. Points are awarded to each student when answering question timely and more importantly correctly, which then fosters a competitive yet collaborative atmosphere. Thus, *Kahoot* encourages active learning, improves student engagement, and provides instant feedback (Licorish, Owen, Daniel & George, 2018).

It is these aforementioned benefits of *Kahoot* that perfectly suits this study as it allowed the researcher to quickly gauge, record and provide a preliminary analysis regarding the

extent to which participants remembered subject content that they were exposed to within the VLE through medium of the VR-HMDs.

4.6.3.2.2 Paper-based

According to Lee (2014:96) the blanks found within paper-based worksheets invite students to fill in the gaps, thus providing them with the opportunity to construct their own knowledge. Kisiel (2003) further elaborates and states that worksheets can function as a tool to organise students' observations and knowledge within their learning environments.

It is based on these opinions of Lee (2014) and Kisiel (2003) that the researcher decided to use a worksheet (ANNEXURE F) as an instrument of qualitative data collection. Even though other instruments were used within this study and provided data that was more than adequate, the worksheet and the questions that it asks provided a supplementary dimension to the participants understanding when it comes to determine their deeper factual knowledge after being exposed to historical content using VR-HMDs in VLEs. Moreover, based on the open-ended questions used within this paper-based worksheet the researcher made the choice to let the worksheet double as a questionnaire due it not only dealing with the subject content from the VLE, but also due to it addressing the primary and secondary research questions.

4.6.3.3 Semi-structured focus group interviews

The interviewing process is not a practice that happens by chance but should rather be thought of as a designed plan created by the researcher (Brinkman, 2013). Conducting interview research has become a wide spread practice within qualitative research and within social sciences (Flick, 2022). A primary reason for the use of interviews within the data collection process is due to its ability to quickly and effectively collect statements, answers and narratives from participants that reflects their subjective perspectives and experiences. Interviews are recognised as an essential method for gathering data through verbal communication between researchers and participants, and are frequently used in exploratory and descriptive studies (Batmanabane & Kfourri, 2017) such as this study.

Semi-structured focus group interviews can be completed in a relatively short period of time (Engelbrecht, 2016) and are used to not only gain the individual response, but rather group answers and narratives regarding the research topic (Flick, 2022). Aspects that, for example, cannot be addressed in a questionnaire can be followed up in semi-structured focus group interviews where reactions, motives and emotions of the participants can be thoroughly investigated. The focus group interview offers the researcher a further opportunity to elicit responses from participants on questions about which more clarity is sought (Engelbrecht, 2016).

Semi-structured focus group interviews are thus a socially oriented research procedure that facilitates interaction between group members and provides a rich description of communication about a phenomenon. Semi-structured focus group interviews create the space within which meaning is negotiated between group members, rather than relying on individual meaning-making (Cohen *et al.*, 2011).

During the qualitative data collection phase of this study semi-structured group interviews (ANNEXURE G) were held in order to expand upon the individual opinions and experiences of participants by gathering group opinions regarding the use of VR-HMDs within the teaching and learning of History. These interviews served as a data collection instrument to further explore the perceptions, attitudes and experiences of the participants not only towards VR-HMDs as an independent technology, but also to the viability of VR-HMDs within pre-service History teacher training. In this study semi-structured focus group interviews were conducted with pre-determined open-ended and non-leading questions. These pre-determined set of questions being asked by the researcher at times changed once the focus group interviews have started, and data is accumulating at a rapid pace (Adams, 2015). The researcher acted as a partial participating observer in which he had a moderate degree of participation through only asking the open-ended questions and adapting to the direction in which the focus group interviews were going. If the discussion started to move away from the topic at hand the researcher led the discussion back to the topic on hand by posing a new, but topic-related open-ended question. Moreover, these semi-structure focus group interviews used within this study acted as the final cog within the data collection process. Before these interviews took place the participants individually responded to the multiple other data collection instruments individually, and when five participants completed all four of

their previous data collection phases, the semi-structured focus group interviews took place (See sec. 4.7.2 for the phases of data collection).

These interviews made use of five participants within a focus group and thus resulted in three semi-structured focus group interviews ((p)5 x (g)3 = 15) taking place. Within these interviews participants were encouraged to converse with one another and to build on each other's views and comments. It is however important to note that not a single participant was pressured to participate in these interviews if they did not wish to do so as this study made use of voluntary participation throughout. In addition, these interviews were audio recorded with the participants' permission to ensure that no data went lost.

4.6.3.4 Field notes

Phillippi and Lauderdale (2018) believe that field notes are essential to the qualitative research process in particular. Field notes are the written observations by the researcher that are documented during or immediately following the data collection process and are considered to be critical in understanding the phenomena that the study is examining (Tenzek, 2017). Moreover, within social sciences observation field notes are thought of as an essential researching method as the data gathered through this means could be extremely diverse (Boström, Ciesielska & Öhlander, 2018).

When using field notes, however, there is the concern that there is negligible guidance within literature (Phillippi & Lauderdale, 2018), and it is due to this neglect within the literature that Phillippi & Lauderdale (2018) provide their opinions on categories regarding how field notes need to be structured. It was also these categories that were used by the researcher of this study during the data collection process, specifically the observation section of the researching process, in order to jot down what was being observed. The following five categories as suggested by Phillippi & Lauderdale (2018) were deemed to be applicable to this study as illustrated in Figure 4-2 and Table 4-2.

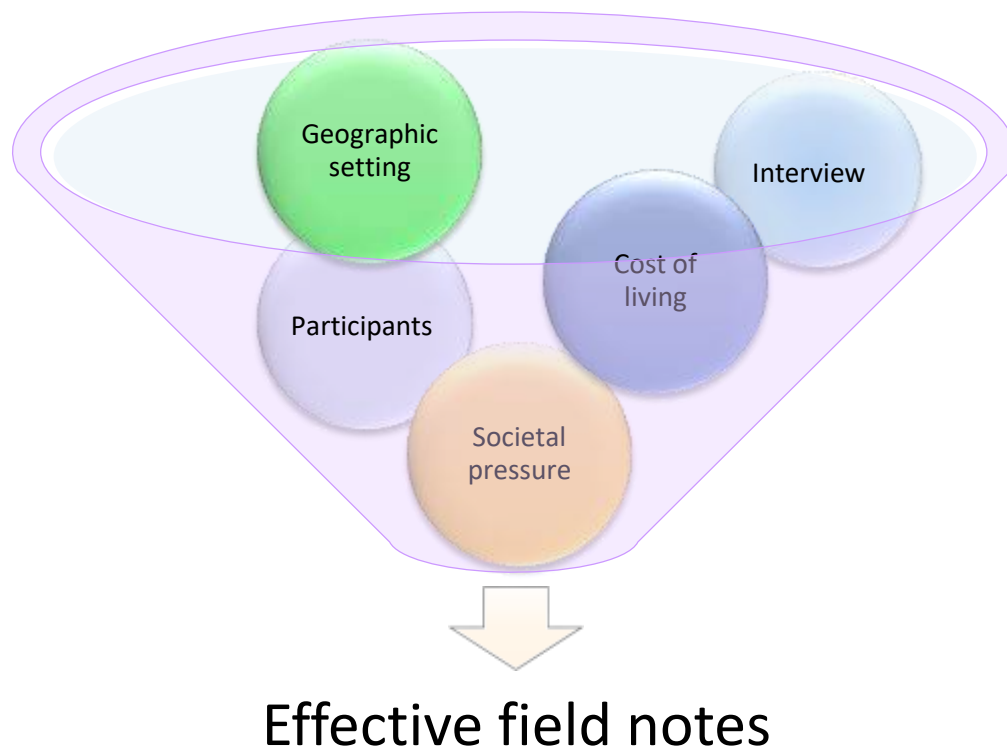


Figure 4-2: Illustration regarding the relationship between the characteristics of effective field notes

Source: Adapted from Phillippi & Lauderdale (2018)

Table 4-2 below clarifies the characteristics of effective field notes mentioned in the figure above and the manner in which it applies to this study.

Table 4-2: Clarification of characteristics of effective field notes

Cost of living	The researcher needs to keep the cost of daily life in mind when conducting the interventions as these day-to-day costs could influence participation. It is with this in mind that the interventions that include observations and field notes were done at a time and day that suited the participants as these allocated slots allowed the participants to be on campus at a time that would normally fit into their time. As such they did not need to travel or use finances report to campus and allow the researcher to do the observations and write field notes.
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Geographical setting	When jotting down notes based on what is being observed the researcher needs to provide some context to the intervention by providing information regarding the setting of the study. By providing the setting wherein the intervention is taking place the researcher can determine if there are any external factors that may influence the data being gathered through the field notes based on his observations. As previously mentioned, the setting for this study was a classroom at the Faculty of Education on the Potchefstroom Campus of the NWU. This setting is one that the participants are familiar and comfortable with and thus provides them with a researching environment where, in theory, they should be able to express themselves in the way that they deem best.
Interview	When jotting down field notes based on the observations during the interviews and other interventions the participants' responses need to be written down as fully as possible. Within this part of observation and jotting down of notes both verbal and non-verbal cues could provide data that is of use to the researcher. Also, afterwards to go through the questions again and ensure that what was asked is what was answered.
Participants	The demographic of the sample group (n=15) should be representative of the population identified for this study and is reflective of the various races and genders found on the Potchefstroom Campus of NWU. Additionally, the overall demeanour (non-verbal cues) should be jotted down as well as their verbal responses. This will assist the researcher in discerning a deeper understanding of the data being gathered regarding the participants' experiences and exposure to VR-HMDs and VLEs.
Societal pressure	Events, similar to this study, that take place within the wider community (population) have the ability to influence participants' perceptions. Socio-cultural backgrounds and personal behaviours and thoughts of the participants are at stake here which will

	inevitably influence the manner in which they experienced their interaction with the VLE. In an attempt to accommodate this matter the researcher allowed participants to interact with the VLE through the VR-HMD individually while the researcher jots down notes based on his observations. This researcher's observation with regard to the participants interaction with the VLE is however not the only observation that took take place. During the semi-structured focus group interviews the researcher also jotted down notes in order to analyse the data effectively.
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At the outset, field notes are to be considered as the researchers' personal thoughts, ideas, and questions regarding what he observed during the research interventions. It is by this aforementioned statement and as illustrated and explained in Figure 4-2 and Table 4-2 that the researcher has found it not only purposeful, but necessary to write field notes regarding the observations that were made during the data collection process of this study.

4.7 THE DATA COLLECTION PROCESS

When collecting data, a clear description must be given of how the researcher will proceed to carry out the study in order to answer research questions (Maree, 2016b).

4.7.1 Preparatory steps

In the sections to follow the researcher will first elaborate on the preparatory steps taken before the start of the five phase intervention process of data collection (sec. 4.7.2.). By doing this, it will provide important information that will serve as background and an orientation before the data collection process started.

4.7.1.1 Ethical clearance procedures

The first preparatory steps taken involved procedures related to the ethics of the study. After consent was obtained to continue with the study, the researcher attended a one-day workshop on "Research ethics in Education" (ANNEXURE A) to familiarise himself with the different ethical principles and issues when conducting research. On approval

of the research proposal by the relevant scientific committee of the Research Unit for Self-Directed Learning at the Faculty of Education of the NWU, the researcher applied for ethical clearance. The application was approved by the North-West University Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences Research Ethics (NWU-EMELTEN-REC) committee after which an ethics clearance number (NWU-02056-20-A2) was issued (ANNEXURE B) for official permission to continue with the research. Hereafter, an application was also submitted to the NWU Research Data Gatekeeper Committee (NWU-RDGC). This application was approved (ANNEXURE I) which gave the researcher permission to conduct his research at the NWU.

4.7.1.2 Identification and preparation of the data collection instruments

As a second step the researcher identified and prepared the data collection instruments used in this study, namely the questionnaires, worksheets, semi-structured group interviews and field notes (sec. 4.6.3). The supervisors evaluated the data collection instruments to determine their credibility and approved them. The criteria for how the data will be analysed have also been determined (sec. 4.8).

4.7.1.3 Recruitment and informed consent

As a third preparatory step an independent person assisted the researcher to recruit the participants where after informed consent to participate in the study was obtained. At the same time the participants were informed about the aim and purpose of the research study; their right to anonymity and to withdraw from the study at any time (ANNEXURE C). Furthermore, the participants were briefed on the procedures and processes to be followed when they report for the intervention sessions (sec. 4.7.2) of the data collection process. The participants were provided with multiple dates and various allocated time slots over the span of three weeks from which they could choose to come to the classroom setting and partake in the intervention sessions of the research process. Based on the time slots that the participants chose they were grouped into one of three groups for data collection purposes. Once at the classroom, the participants engaged with the VLE through the VR-HMD after which they were required to analyse, summarise and construct their knowledge from this VLE in completing the different activities associated with the VLEs. It was during these

intervention sessions (sec. 4.7.2) where participants completed the activities that were requested from the data collection instruments and where the researcher also made his observations that were jotted down in the field notes. The whole of the data gathering process took place in one of the classrooms of the Faculty of Education at the NWU.

4.7.1.4 The NCS History CAPS policy document

By looking at the subject content and skillset required to be a student of History in education, the NCS History CAPS policy document will serve as a guiding principle in what VLE content participants will be exposed to through medium of VR-HMDs. In order to effectively comprehend the five phase intervention process (sec. 4.7.2) and the subject topics used within the data collection process of this study, a brief look into the NCS History CAPS policy document ought to be considered compulsory as it provides important background knowledge on subject content and skills that the pre-service History teacher should take note of. It is this background knowledge of the NCS History CAPS policy document accompanied by the subject content of the VLE, e.g. the Holocaust museum, which allows for the holistic understanding of the five phase data collection intervention process. In Table 4-3 the data collection process in relation to the NCS History CAPS document (DoE, 2011) is explained.

Table 4-3: The data collection process in relation to the History NCS-CAPS subject content

LINK BETWEEN DATA COLLECTION AND THE NCS HISTORY CAPS DOCUMENT		
Overarching Topic:	“Ideas of Race in the late 19th and 20th centuries” (DoE, 2011:21)	
Sub-Topic:	• How Eugenics influenced NAZI legislation during the years 1933-1945 – FET Phase • The rise of NAZI-Germany and NAZI legislation, e.g. Nuremberg laws, Enabling Acts & Anti-Semitic laws – Senior Phase	
FET PHASE		SENIOR PHASE
According to the NCS FET History CAPS		“This content must be integrated with the

policy document it aims to produce learners that are able to:	historical aims and skills and the associated concepts....” (DoE, 2011:41)
• “use science and technology effectively and critically showing responsibility towards the environment and the health of others” (DoE, 2011:5) • “communicate effectively using visual, symbolic and/or language skills in various modes” (DoE, 2011:5) • “collect, analyse, organise and critically evaluate information” (DoE, 2011:5)	According to the DoE (2011:8): • “The Social Sciences (History) curriculum as outlined within the CAPS document aims to provide opportunities to learners to look at their own worlds with fresh, critical eyes, and perhaps more importantly, it aims to introduce learners to a world beyond their everyday realities. Schools should be special places that provide learners with knowledge to which they would otherwise not have access”
In order to produce learners that are able to achieve within the academic boundaries as set out by the aims of the NCS, the following historical skills from the Senior and FET History NCS CAPS policy document are expected to be developed:	Additionally, the Senior Phase Social Sciences (History) NCS CAPS document (DoE, 2011:13) clearly states that students need to ask questions like: “Who? Where? What? Why? When? How? Should? Could? Is/Are? And, by the time they reach the FET Phase: If?”
• “Evaluate the usefulness of sources, including reliability, stereotyping and subjectivity” (DoE, 2011:9) • “Explain why there are different interpretations of historical events and peoples’ actions” (DoE, 2011:9) • “Extract and interpret information from a number of sources” (DoE, 2011:9)	Additionally, the Senior Phase Social Sciences (History) NCS CAPS document (DoE, 2011:14) states: “It is important to bring the world into the Social Sciences classroom. Visual resources can make information more accessible to many learners and then starts to list resources that can be used to achieve this goal”: • Magazines, newspapers, pictures, TV, DVD, CD, the internet and Youtube

4.7.1.5 Resources

In Table 4-4 below the resources used in order to conduct the data collection process is delineated.

Table 4-4: Resources used during the data collection process

Resources:	• Pre-determined visuals ○ VR Museum regarding the NAZI-Germany ○ A 1941 battle re-enactment ○ A brief summation of Pearl Harbour • VR-HMD ○ The VR-HMD used is the Class VR Premium Headset ○ Memory / storage capacity of 64GB ○ Built in screen and therefore does not require an additional device like a cell phone to play the pre-determined visual • Laptop / tablet ○ While the VR-HMD does not require another device to play the visual for the participant an additional device is required for the researcher. The researcher requires the laptop/tablet as this screen device that would allow him to see what the participant is seeing while in the VLE ○ Both a laptop and tablet could be used by the researcher in monitoring and guiding the participants within the VLE.
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4.7.2 The five phase intervention process of data collection

In this study the intervention processes of data collection consisted out of five phases utilising a variety of methods in the gathering of the research data. These different methods of data collection were used within the research procedure in order to provide

credibility to the study. In the data collection process the data were gathered through the following sequence of methods:

- i. an open-ended questionnaire (ANNEXURE D) with biographical information of the participants and their prior experiences and perceptions of ICT's and VR within History education. Furthermore, a pre-test VLE experience using a close-ended Likert scale questionnaire (ANNEXURE E) that aimed at determining the participants' knowledge and ability to use ICT's within a SDL mindset.
- ii. an e-electronic quiz on the *Kahoot* application (sec.4.7.2.2) that tested the retention of content information after a participant was in a VLE,
- iii. a paper-based worksheet (ANNEXURE F) that doubled as an open-ended questionnaire to determine the participants' deeper factual knowledge and understanding after being exposed to historical content using VR-HMDs in VLEs,
- iv. a post-test VLE experience by means of a close-ended Likert scale questionnaire (ANNEXURE E) to determine the participant's perceptions, ability and confidence after their experiences with the VR-HMDs in VLEs and if their involvement with this ICT by any means contributed to the development and promotion of their SDL skills.
- v. a list of questions to be used in the semi-structured focus group interviews (ANNEXURE G) that was audio recorded in which participants verbally communicated their opinions on VR-HMDs to the researcher and other participants, and in doing so initiated an academic discussion on the merits and limitations of VR. During the interviews the researcher also took field notes based on his observations.

4.7.2.1 First phase

The initial intervention phase of the data collection process started with a first meeting with all the participants in a classroom as earlier indicated. During this phase the participants were introduced by the researcher to VR-HMDs where guidelines were given on the scope and general operation of these technologies. This initial intervention further provided participants with a foundational knowledge regarding the use of VR-HMDs. Additionally, participants also received a demonstration on the use of VR-HMDs and could also participate in a guided demonstration in order to familiarise themselves

with the technology. Furthermore, the participants also received information on some of the qualities that characterise a SDL student (ANNEXURE H).

After the short information session on the above aspects, the first phase started to serve as a data collection opportunity. The participants were asked to complete an open-ended questionnaire consisting of questions of a biographical nature as well as questions to gather baseline data concerning their prior knowledge of ICT's and VR in History education (ANNEXURE D). The data gathered from this questionnaire was qualitatively analysed (sec. 5.3.1).

After completing the open-ended questionnaire, the participants then received the adapted close-ended questionnaire that was originally designed by Cheng *et al.* (2010) on SDL domains. The participants were asked to complete this pre-test VLE 5 point Likert scale questionnaire in an attempt to discern the participants' prior SDL knowledge and capabilities in utilising ICT's within a SDL mind-set. This raw data was quantitatively summarised through the use of a table that presented numerical data using percentages and mean scores (sec. 5.5.1).

4.7.2.2 Second phase

In the second phase of the data collection process, the intervention took place with participants partaking in individual sessions. During these individual sessions each participant, using the HMDs, did a walkthrough through a virtual NAZI-Holocaust museum after which the participants answered an e-electronic quiz on the *Kahoot* application (sec. 4.7.2.2.2) in order to test their memory retention. According to Van Boxtel and Van Drie (2018) students' historical reasoning within the context of their historical inquiry is dependent on historical interest and historical content knowledge which in turn means students require historical facts, concepts and chronological information. It is due to this opinion of Van Boxtel and Van Drie (2018) that the second phase of the data collection process purely looked at the retention of content knowledge as it is an important facet of History education.

In order to complete the quiz on the *Kahoot* platform the participants were required to make use of a laptop, cell phone or tablet. Provision was made for those participants who were unable to bring their own devices by having two laptops already set up to

access the *Kahoot* quiz. The entire museum walkthrough had to occur in order to answer the *Kahoot* quiz effectively. In the Figures (screenshots) 4-3 to 4-36 which follow the participants interacted with the Virtual Holocaust Museum's exhibits.

4.7.2.2.1 Figures visualising the Holocaust Museum



Figure 4-3: The entrance to the virtual Holocaust Museum



Figure 4-4: Exhibit about Arian Jews



Figure 4-5: Exhibit Polish Jews



Figure 4-6: 1936 Olympics & Anti-Semitism



Figure 4-7: Jews and the ghettos

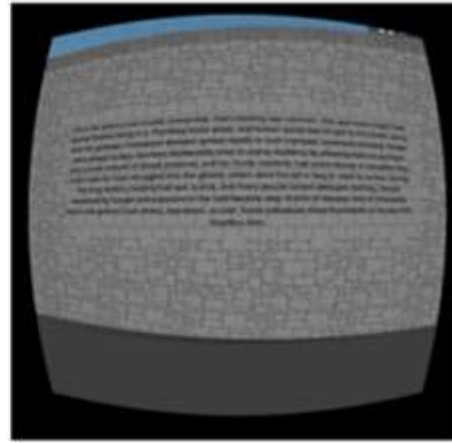


Figure 4-8: The ghettos



Figure 4-9: Jews in the ghettos



Figure 4-10: Anti-Semitism wing



Figure 4-11: Star of David

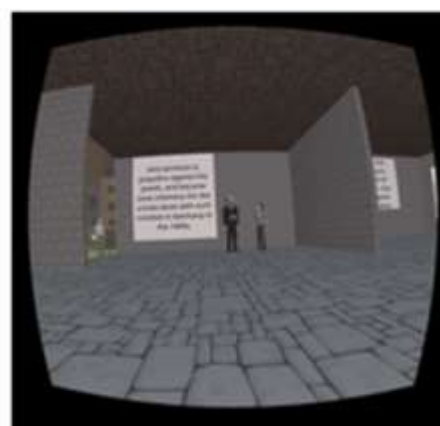


Figure 4-12: Anti-Semitism definition



Figure 4-13: Kristalnacht

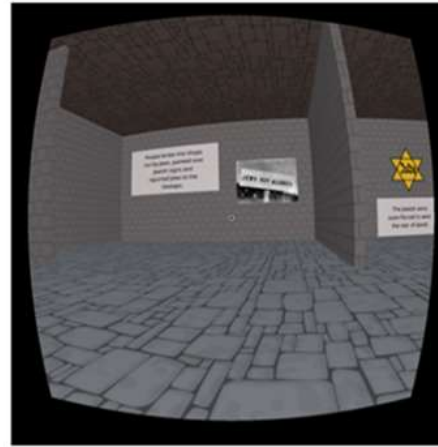


Figure 4-14: Discrimination against Jews



Figure 4-15: Ghetto wing of the Museum



Figure 4-16: Creation of ghettos

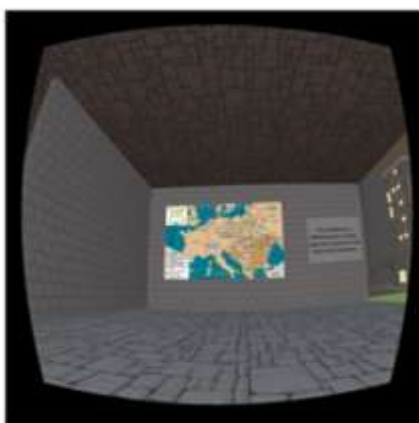


Figure 4-17: Ghetto locations

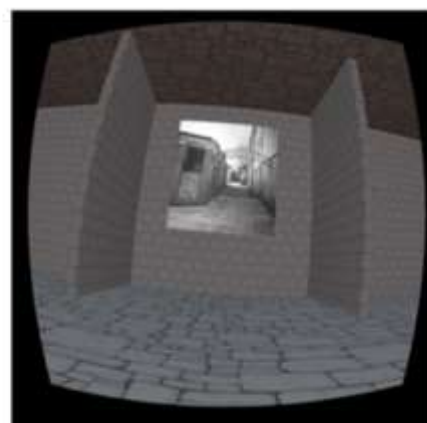


Figure 4-18: Entrance to a ghetto

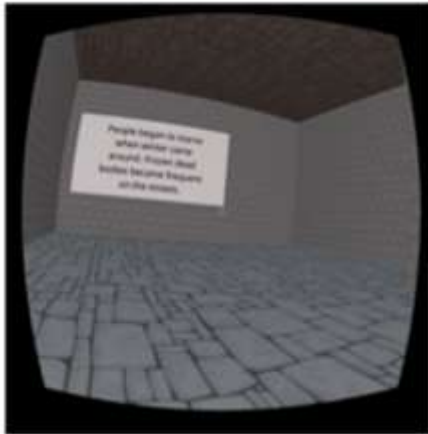


Figure 4-19: Winter in the ghettos

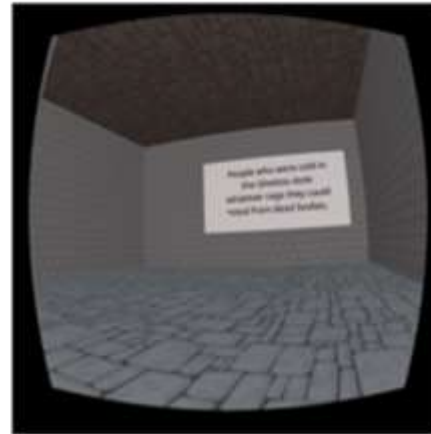


Figure 4-20: Life in the ghettos

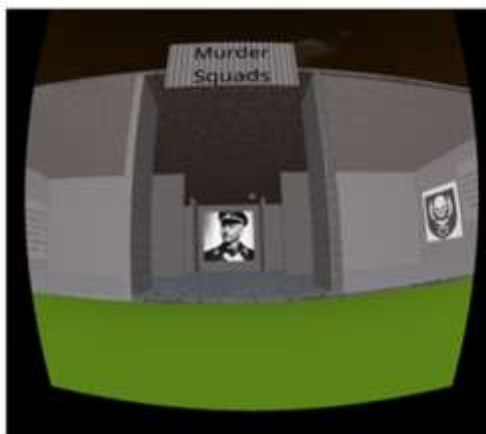


Figure 4-21: Murder Squads wing

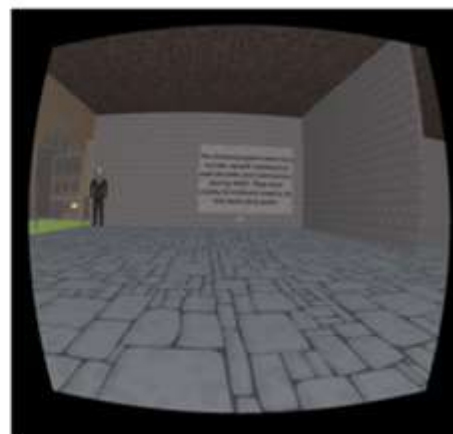


Figure 4-22: Einsatzgruppen



Figure 4-23: Einsatzgruppen and their workings



Figure 4-24: Final Solution wing



Figure 4-25: Heinrich Himmler

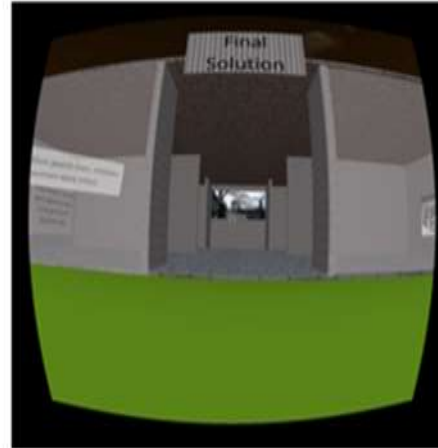


Figure 4-26: Final Solution wing

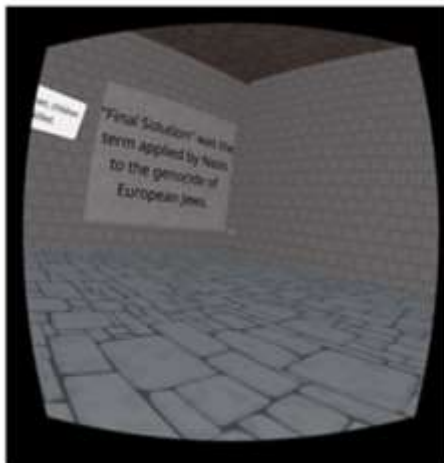


Figure 4-27: What was the final solution

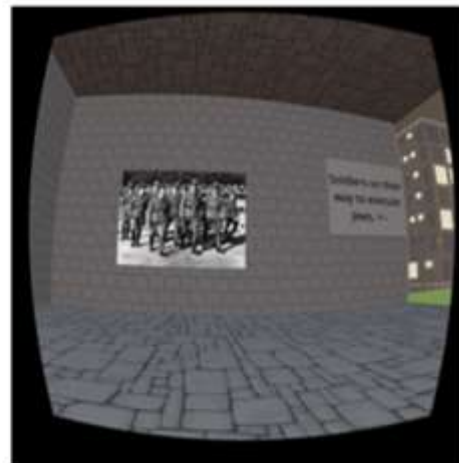


Figure 4-28: Auschwitz

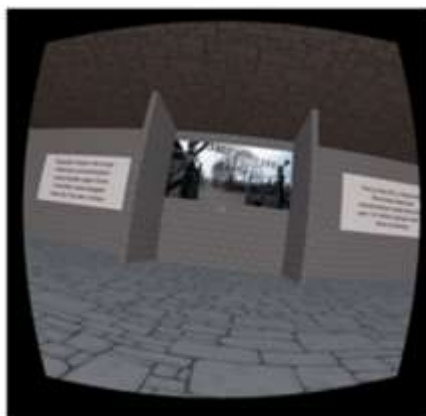


Figure 4-29: Auschwitz gate

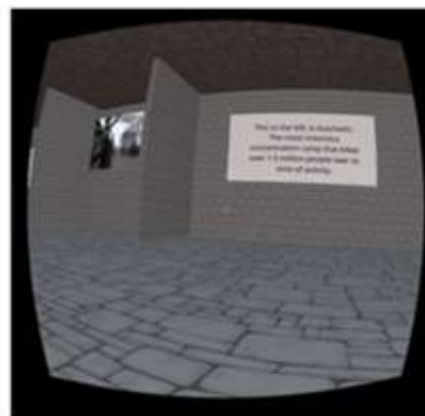


Figure 4-30: Auschwitz description



Figure 4-31: Exhibit Rudolf Höss



Figure 4-32: Museum gallery



Figure 4-33: Gallery NAZI Germany



Figure 4-34: Gallery Einsatzgruppen



Figure 4-35: Gallery layout



Figure 4-36: Jews arriving at concentration camp

Table 4-5 below serves to provide descriptions (using the exact same spelling) of the subject content found within the Virtual Holocaust Museum as not all descriptions are clearly visible in Figures (screenshots) 4.3– 4.36.

Table 4-5: Descriptions of subject content of the Holocaust Museum found within the VLE and accessed through VR-HMDs (Figures 4.3- 4.36)

Figure 4-3	<i>Welcome to the first room of the Holocaust Museum. In this first room, you'll be seeing some information about Anti-Semitism between 1933 –1939.</i>
Figure 4-4	<i>The Nazi's would take people who are not part of the Aryan race and who were Jews. However, some Jews who were of the Aryan race had a pass.</i>
Figure 4-5	<i>In 1939-1941, the Nazis sent Polish Jews (and other Jews) to concentration camps and ghettos where the Jews would normally die in.</i>
Figure 4-6	<i>Anti-Semitism was in 1936 at its greatest low for Hitler's Germany. This was due to the fact that the 1936 Olympics were going to be held in Germany. Hitler did not want any country to think that Germany was mistreating and murdering Jewish people. In the weeks preparing for the Berlin Olympics some Nazi Soldiers were removing signs that said "Jews Unwelcome" from public spaces.</i>
Figure 4-7	<i>Jews lived in ghettos between 1939 and 1941. The biggest ghetto is the Warsaw ghetto, 400 000 were crammed into a 1.3 square mile area. The first ghetto was established on 8th October 1939. Most ghettos were liquidated in 1942.</i>
Figure 4-8	<i>Life in the ghettos was usually unbearable. Overcrowding was common. One apartment might have several families living in it. Plumbing broke down, and human waste was thrown into the streets along with garbage. Contagious diseases spread rapidly in such cramped, unsanitary housing. People were always hungry. Germans deliberately tried to starve residents by allowing them to only buy a small amount of bread, potatoes and fat. Some residents had some money or valuables they could trade for food smuggled into the ghetto; others were forced to beg or steal to survive. During the long winters, heating fuel was scarce, and many people lacked adequate clothing. People weakened by hunger and exposure to the cold became victims of disease; tens of thousands died in the ghettos from illness, starvation or cold. Some individuals killed themselves to escape their hopeless lives.</i>
Figure 4-9	<i>The Nazis established more than 400 ghettos during WW2. Jews who lived in ghettos lacked food, water and living space. The ghettos were closed off by walls with barbed-</i>

	wire fences on top.
Figure 4-10	Anti-semitism.
Figure 4-11	The Jewish were soon forced to wear the Star of David.
Figure 4-12	Anti-semitism is prejudice against the Jewish, and became most infamous for the crimes done with such mindset in Germany in the 1900s.
Figure 4-13	An Anti-semitism event that happened was Kristallnacht, also known as The Night of Broken Glass. That night, riots began on the streets against Jews in Germany and Austria.
Figure 4-14	People broke into shops run by Jews, painted over Jewish signs and reported Jews to the Gestapo.
Figure 4-15	Ghettos.
Figure 4-16	Within this figure there are two bodies of textual data (i) One of the main ghettos was the Warsaw ghetto. (ii) The Nazis began to create ghettos for the Jews to stay in. This meant building walls separating cities and families.
Figure 4-17	Within this figure there are two sources of information (i) Ghettos in German Occupied Europe 1939 – 1944 (map). (ii) The conditions in the Ghettos were horrible, Jews were packed in and many were homeless.
Figure 4-18	There is no textual subject content with this figure. This figure is a picture showing the entrance to a ghetto.
Figure 4-19	People began to starve when the winter came around. Frozen dead bodies became frequent on the streets.
Figure 4-20	People who were cold in the ghettos stole whatever rags they could steal from dead bodies.
Figure 4-21	Murder squads.
Figure 4-22	The Einsatzgruppen were Nazi murder squads deployed to execute Jews and communists during WW2. They were mainly SS militants used to do the Nazis dirty work.

Figure 4-23	<i>As well as killing and torturing Jews, the Einsatzgruppen were striking fear into regular Poles and other races even if not discriminated against by Hitler.</i>
Figure 4-24	<i>He committed suicide by cyanide after he was trialled at the Nuremberg trials.</i>
Figure 4-25	<i>Heinrich Himmler was the leader of the murder squads before the Final Solution. He founded the Einsatzgruppen.</i>
Figure 4-26	<i>Final Solution.</i>
Figure 4-27	<i>"Final Solution" was the term applied by Nazis to the genocide of European Jews.</i>
Figure 4-28	<i>Soldiers on their way to execute Jews.</i>
Figure 4-29	<i>While two sources of textual information can be seen within this figure, the emphasis should be on the image that is central to the figure.</i>
Figure 4-30	<i>This to the left is Auschwitz. The most notorious concentration camp that killed over 1.5 million over its time of activity.</i>
Figure 4-31	<i>Rudolph Hoess, the most infamous concentration camp leader apart from Himmler, was hanged here for his crimes.</i>
Figure 4-32	<i>Anti-semitism is hostility to, prejudice or discrimination against Jews. A person who holds such positions is called an Anti-semite. Anti-semitism is generally considered to be a form of racism.</i>
Figure 4-33	<i>Nazi Germany during WW2</i>
Figure 4-34	<i>Einsatzgruppen were Schutzstaffel paramilitary death squads of Nazi Germany that were responsible for mass killings, primarily by shooting, during WWII.</i>
Figure 4-35	<i>There is no textual subject content for the participant to study, only images.</i>
Figure 4-36	<i>There is no textual subject content for the participant to study, only images.</i>

4.7.2.2.2 The Kahoot quiz

What follows below are Figures (screenshots) 4-37 to 4-56 from the Kahoot quiz platform that was used as a data collection instrument to measure the retention of content information from the participants after they finished their walkthrough in a virtual

NAZI-Holocaust Museum wearing their HMDs. All the 20 questions used within this e-electronic worksheet in the figures were created from the subject content found within the Virtual Holocaust Museum. The data gathered from *Kahoot* was quantitatively analysed.

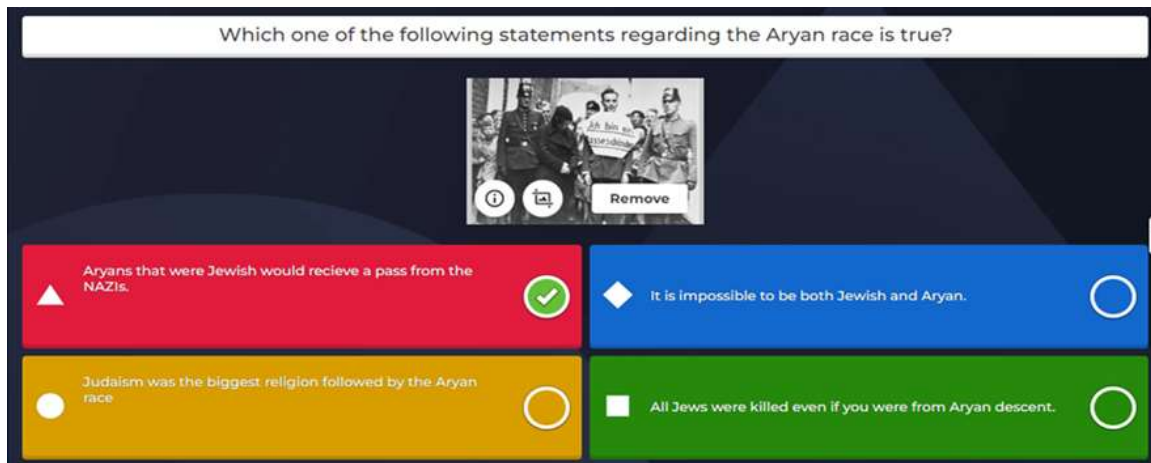


Figure 4-37: *Kahoot* question one

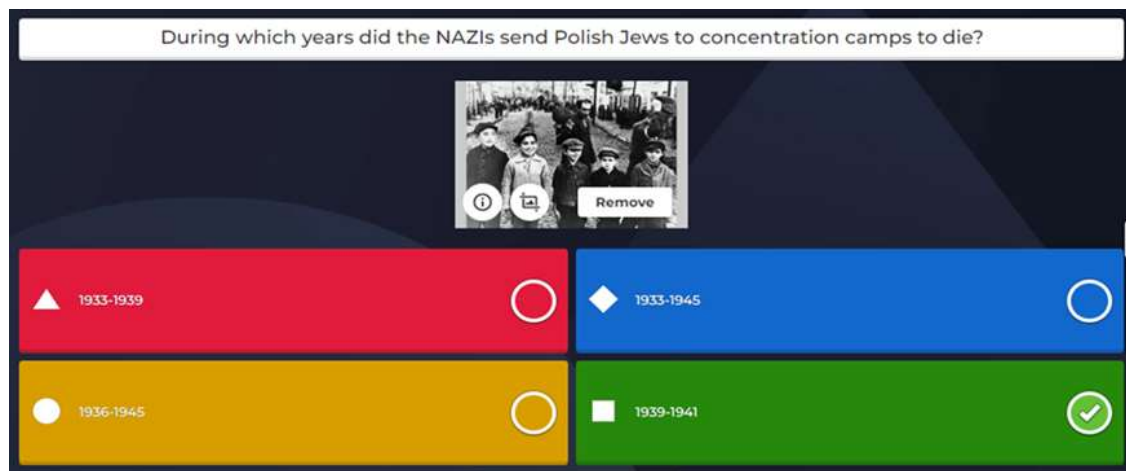


Figure 4-38: *Kahoot* question two



Figure 4-39: Kahoot question three

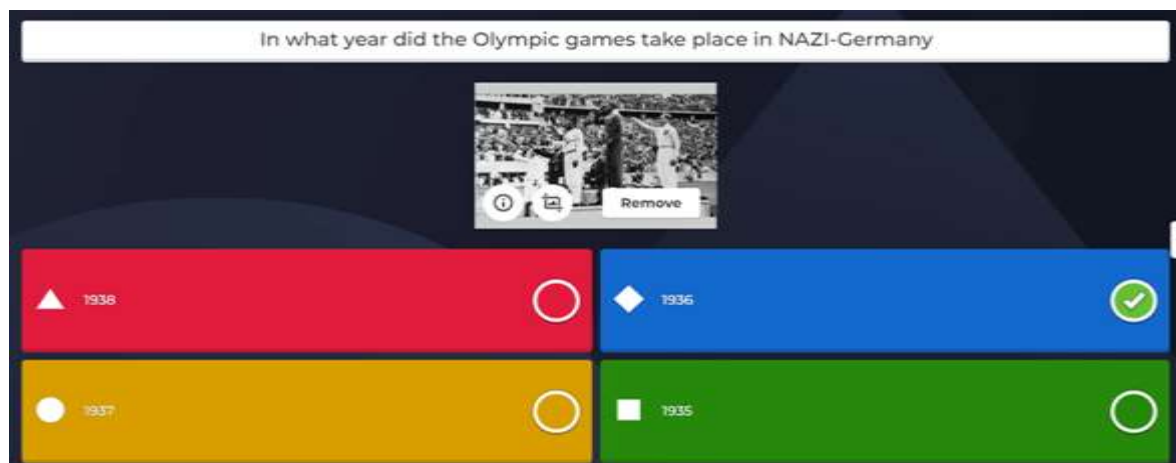


Figure 4-40: Kahoot question four



Figure 4-41: Kahoot question five



Figure 4-42: Kahoot question six



Figure 4-43: Kahoot question seven



Figure 4-44: Kahoot question eight



Figure 4-45: *Kahoot* question nine

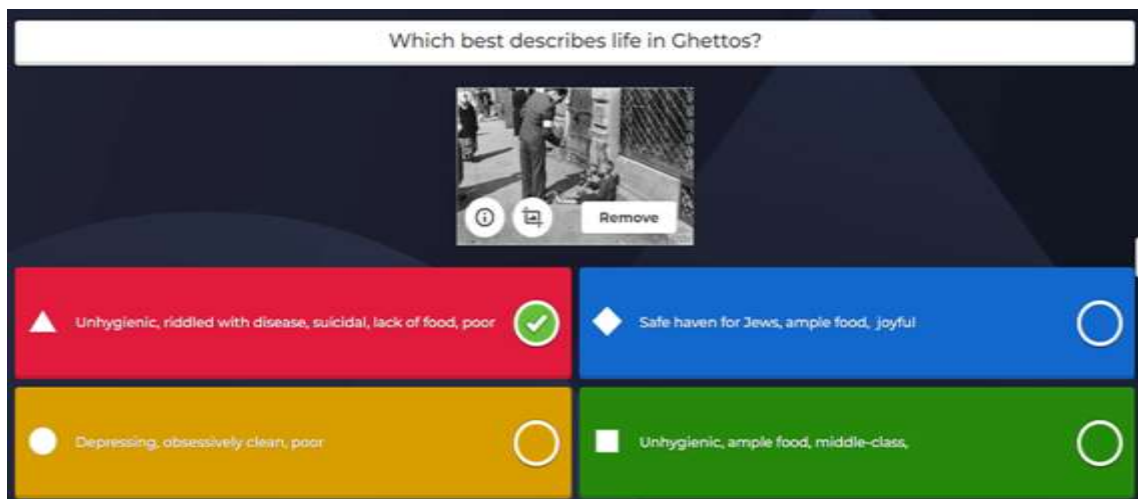


Figure 4-46: *Kahoot* question ten



Figure 4-47: *Kahoot* question eleven



Figure 4-48: Kahoot question twelve



Figure 4-49: Kahoot question thirteen

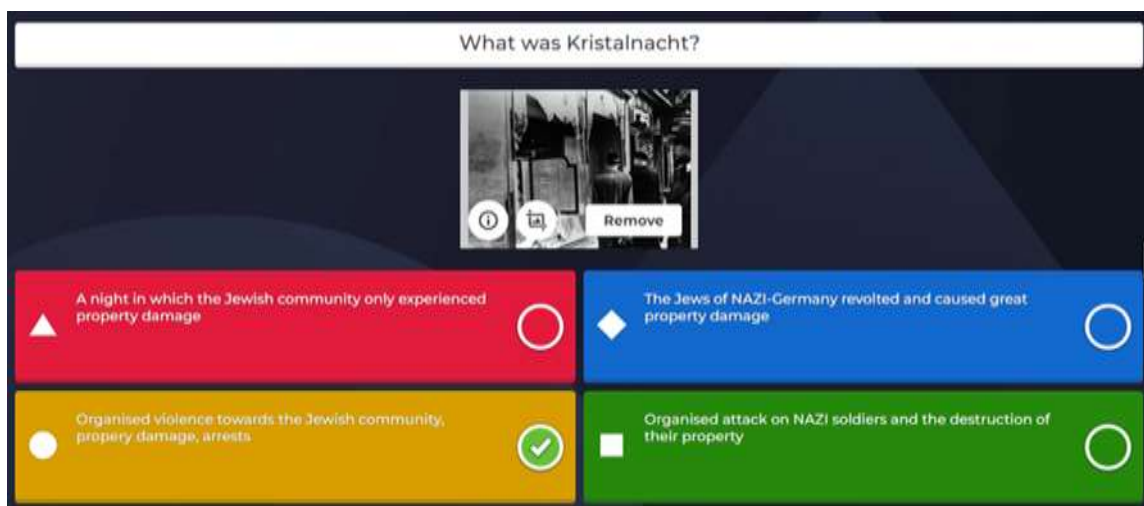


Figure 4-50: Kahoot question fourteen



Figure 4-51: Kahoot question fifteen



Figure 4-52: Kahoot question sixteen

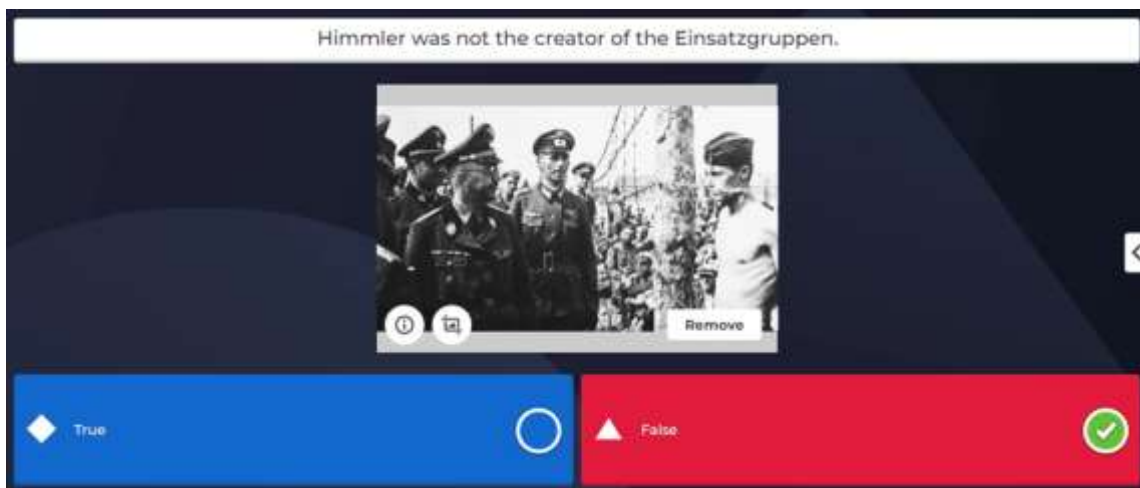


Figure 4-53: Kahoot question seventeen

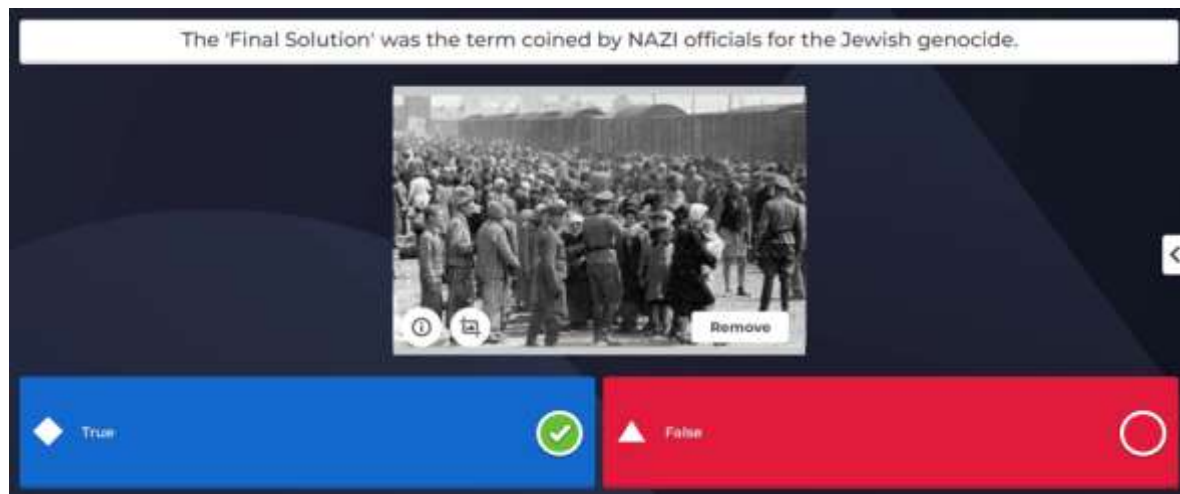


Figure 4-54: Kahoot question eighteen



Figure 4-55: Kahoot question nineteen



Figure 4-56: Kahoot question twenty

4.7.2.3 Third phase

During the third intervention phase of the data collection process, the participants were placed in a VLE that resembles a battle re-enactment of an undisclosed battle that took place during World War 2 in 1941. In addition, a visual summary of Pearl Harbour was also shown to the participants. Both these VLEs used in this phase of the data collection process were 360° videos playable through the use of the ClassVR VR-HMD and the ClassVR online portal. Furthermore, where the second phase of the data collection focused on the retention of factual information, phase three focused more on the formation of deeper meaning and understanding through bringing in questions in the paper-based worksheet that were aimed at discerning if there were a change in the way that factual knowledge was understood by the participants and, if there was a change, what caused this.

While this third phase made use of the two abovementioned VLEs, the virtual Holocaust Museum (used in phase two) was also represented in the questions that were posed in the paper-based worksheet (ANNEXURE F). At the end of this phase the participants were asked to complete the paper-based worksheet. The data gathered from this worksheet was qualitatively analysed (sec. 5.3.2). It is imperative to first determine what effect the VR-HMDs have on the individual before seeking a group consensus as was done in phase four of the data collection process.

Below are the Figures (screenshots) from the VLEs shown to the participants during the third intervention phase of the data gathering process.

4.7.2.3.1 Figures visualising a World War 2 battle re-enactment

The Figures (4-57 to 4-62) on the following page were taken from a 1941 World War 2 battle re-enactment VLE through the use of the ClassVR system.



Figure 4-57: *Trench warfare*



Figure 4-58: *Tank on the open field*



Figure 4-59: *Overturned tank*



Figure 4-60: *Tank in open battle*



Figure 4-61: *Soldiers on the move*



Figure 4-62: *Fallen soldiers*

4.7.2.3.2 Figures visualising Pearl Harbour as a summary

The Figures (4-63 to 4-66) below are screenshots from a VLE that summarises the account of a marine stationed at Pearl Harbour.



Figure 4-63: Typical American home 1941



Figure 4-64: Pearl Harbour explosions



Figure 4-65: Fires on attacked ships

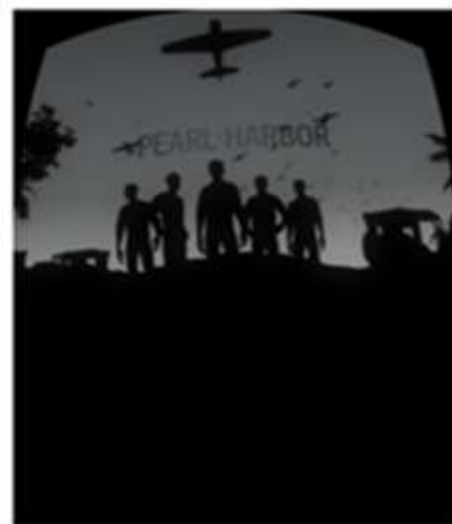


Figure 4-66: Silhouette of American soldiers

At the end of this phase the participants completed a paper-based worksheet (ANNEXURE F) to provide the participants the opportunity to show not just their factual

knowledge but also to demonstrate if a deeper meaning and understanding of the events in the VLEs was gained.

4.7.2.4 Fourth phase

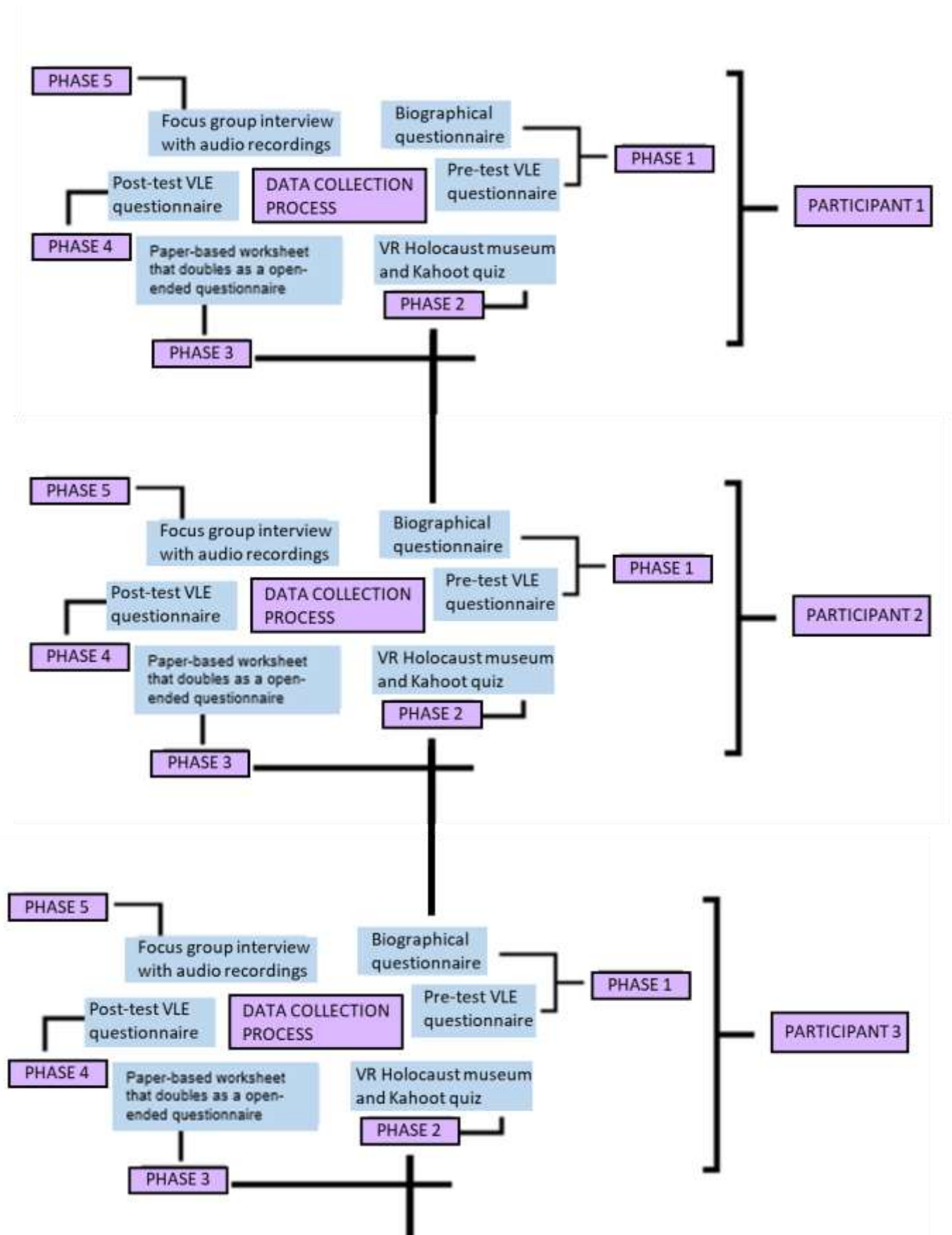
During this fourth intervention phase of the data collection process the aim was to consolidate everything that has been done up until this point. The point of difference within this phase compared to the previous phases (where it was about the retention and deeper understanding of subject content knowledge) this phase focused on how VR-HMDs and VLEs discern how higher order skills contribute to the development of SDL. For this purpose a post-test VLE questionnaire (ANNEXURE E) was completed. This questionnaire was quantitatively analysed (sec. 5.5.3).

4.7.2.5 Fifth phase

Succeeding the completion of the first four phases of the data collection process by the 15 participants, the study incorporated a fifth intervention in the form of an audio-recorded semi-structured focus group interviews. The focus groups comprised three groups of five participants apiece (ANNEXURE G).

The semi-structured interviewing process featured pre-determined open-ended and non-leading questions. According to Nieuwenhuis (2016c), the semi-structured interview aims to provide additional context to gathered data. In this regard the focus group interviews contributed to supplement and further explain the data that had already been collected in the initial first four phases of the data collection process. Through the use of semi-structured focus group interviews the researcher created audio recordings that were further supplemented by field notes to ensure the preservation of pertinent information. Furthermore, field notes and audio recordings afforded researchers the opportunity to annotate and comment on data gathered and prevents data tampering (Sutton & Austin, 2015). The semi-structured focus group interviews were qualitatively analysed (sec. 5.3.3).

Figure 4-67 below visually summarises the entire data collection process as to what has previously been described.



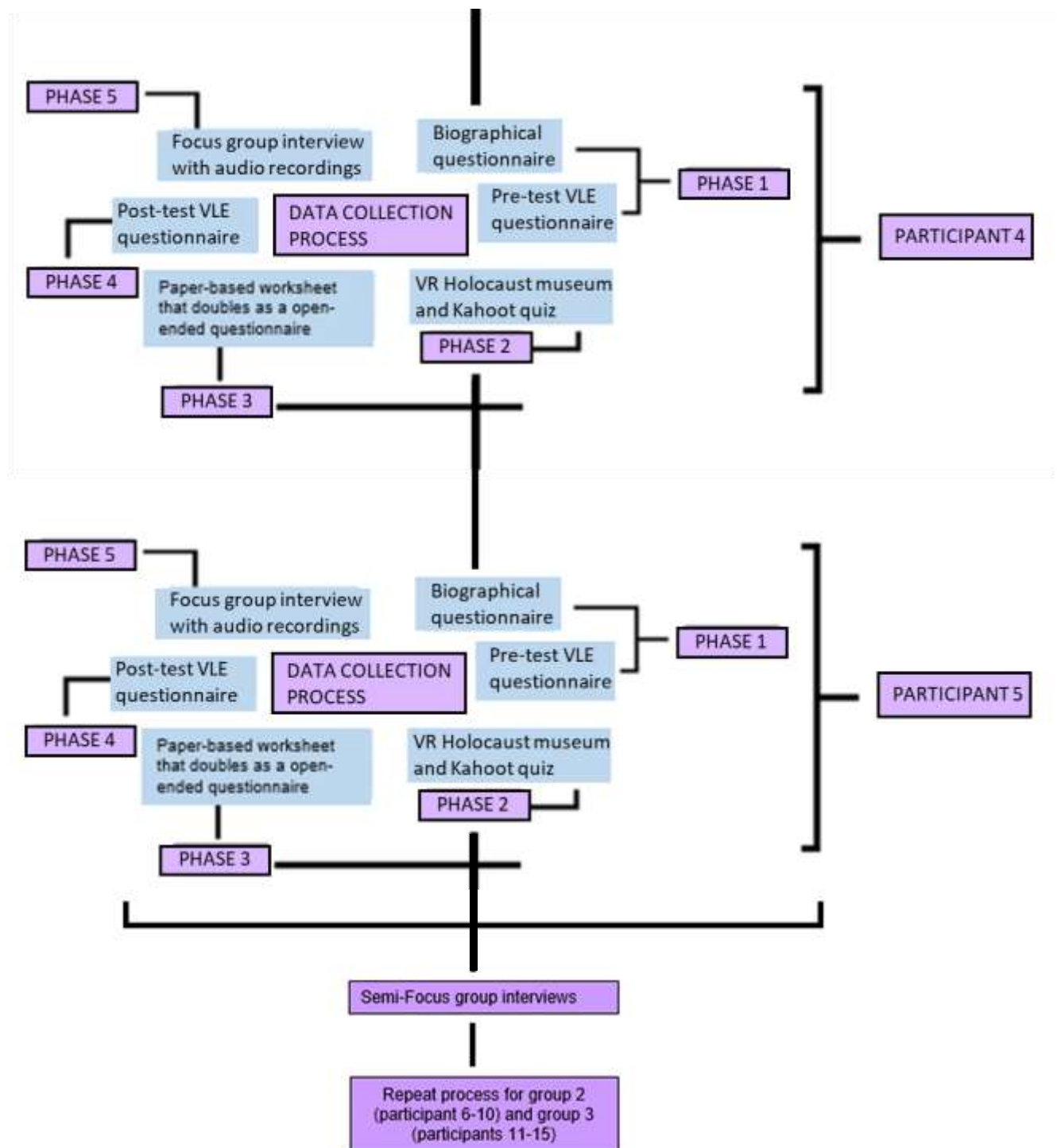


Figure 4-67: Illustration of the data collection process⁵

⁵ When referring to Figure 4-67 the full descriptive reference to biographical questionnaire is as follows: Biographical questionnaire and prior experiences and perceptions of the use of ICT's and VR- within History education. The reasoning for the omission from the figure is due to the length of the full descriptive segment.

When a participant has completed the data collection process, it restarts until all five participants from a single group have gone through it and is eventually repeated for all groups. This process in its entirety took place over a span of three weeks, with one week dedicated to each group. Moreover, phase two's end and phase three's start overlapped, coinciding with the start of phase one for the following participant.

4.8 DATA ANALYSIS

According to Bhatia (2017) data analysis is a process where raw data is scrutinised for the purpose of coming to conclusions. The main purpose of analysing data is to create a structure by converting the “available cluttered data” into a format which will be more understandable (Bhatia, 2017:166). Furthermore, Zubair (2021) is of the opinion that the purpose of data analysis is to gather and interpret the raw data by summarising and describing the collected data, drawing necessary conclusions, answering the research questions, all in order to verify and support the findings of the study. The data analysis process can thus be seen as an opportunity in sorting, analysing, interpreting and describing the data in order to come to conclusions to answer the research questions of the study.

4.8.1 Qualitative data

Nieuwenhuis (2007:109) captures the core characteristics of qualitative data analysis quite well, when he provides the following working definition: “...qualitative data analysis tends to be an ongoing and iterative process, implying that data collection, processing, analysis and reporting are intertwined”, and not necessarily a successive process.

While engaging in qualitative data analysis, the researcher should emphasise recurring characteristics, but also clarifies the various procedures that were used to analyse the data. It is with this in mind, that the statement of Best and Khan (1998) argues that the first and principal role to qualitative data analysis is the organising of data. Moreover, it requires mentioning that the organisation and analysis of data should, in theory, differ between studies, even if the same phenomena are being studied, thus allowing for the opportunity that data can be reconfigured in order to address the research questions (Schostak, 2010). Additionally, this difference in the collected data and even the analysis of data might differ due to the researcher's perspective and preconceived ideas

regarding the data. It is due to this reason and as previously discussed that the researcher used multiple interventions that made use of multiple data collection instruments.

The thematic analysis when used as the process of analysis as proposed by Butler-Kisber (2010) involves extracting verbatim rich statements from the transcribed data, which are then interpreted by the researcher to formulate meanings. It is these meanings that were consequently organised by the researcher into themes and sub-themes. A benefit of the thematic approach is its flexibility as it identifies, analysing and reporting patterns or themes from the data collected (Braun & Clarke, 2006).

Thus, it is by the belief of Braun & Clarke (2006) and Butler-Kisber (2010) that the researcher decided to make use of a thematic analysis of the predominantly qualitative data that was gathered for this study in accordance to the following four steps as laid out by Newby (2014) and as indicated in Table 4-6.

Table 4-6: The four step strategy for qualitative data analysis

Step 1 – Preparation of data
Qualitative data was collected through the use of an open-ended questionnaire, a paper-based worksheet, semi-structured group interviews and field notes. The data provided by the participants was textual in nature which first required verbatim transcription before it could be analysed according to the themes within the analytical structures. Moreover, the audio recordings used during the semi-structured group interviews, first had to be transcribed verbatim into text format in order for it to be used justifiably. Additionally, the researcher had to combine the field notes that were taken on different documents into one concise document in order to ease the analysis process thereof. The amount of transcribed data qualitatively gathered from the questionnaire, paper-based worksheet, interviews and the raw field notes added up to approximately thirty and half pages.
Step 2 – Creation of data analysis structures
After step one was completed and the data was organised and transcribed into a

typed format, the researcher deemed it necessary to reorganize the data in such a way as to extract the information that lies "hidden" within the data. In order to do this the researcher, read and re-read the transcripts several times in an attempt to get the general impression of the data.

Once the general impression regarding the data has been made the researcher divided the data into several sections in order to provide structure to the data in a meaningful way.

Step 3 – Organisation of data

During step three, concepts were grouped and regrouped to be organised into categories, which were finally grouped into themes, thus the thematic analysis approach now comes into play. In order to reach this step, the researcher had to continuously ask questions concerning the aims, research questions and data gathered within this study.

The themes identified from the qualitative data were done by means of open-coding. The open-coding method is part of the inductive approach as categories are created, and relevant information is extracted from the data (Creswell, 2014). Maree and Pieterse (2016) describe open-coding as the process during which the researcher breaks down the transcribed data into more controllable sections using symbols, codes and descriptive vocabulary. Matching words, phrases or events can be sorted into specific categories and sub-categories according to the related content or ideas to crystallise into particular themes eventually.

It is these thematic groupings which enabled the researcher to better understand the reality of what was being investigated and assist with interpretation of data in answering the research questions and the manner in which the findings and recommendations from the study were communicated.

Step 4 – Analyse and interpretation of data

The primary goal of step four is the analysis and interpretation of the data after it has been gathered and organised. It is within this step that it is of utmost importance to

keep the research questions and aims, whether they are primary or secondary, in mind. By keeping the research questions and aims in mind the researcher is guided consciously and sub-consciously in the analysis and interpretation of the data.

Moreover, to ensure that the data is analysed and communicated correctly via and in accordance to the thematic analysis this study made use of the qualitative inductive content analysis method. It is this method according to Cohen *et al.* (2011) that involves a simple process of summarising and reporting the textual data in categories and themes in order to accurately convey the meaning of the data.

4.8.2 Quantitative data

Secondary and supplementary to the qualitative data, some quantitative data was also included in this study. These qualitative data were gathered from the pre- and post- test VLE 5 point Likert scale questionnaires and the e-electronic *Kahoot* quiz application.

A method of data analysis involving descriptive statistics was used within this study in order to arrange and examine the gathered quantitative data. Descriptive statistics afford researchers various analytical procedures that include the examination and analysis of frequencies, distribution, percentages, averages, means, mode, and standard deviation (Grosser, 2016). Through the use of numerals and mean score distributions as well as percentages, the researcher successfully condensed the features of the quantitative data within the corresponding response categories of the study's variables.

4.9 ETHICAL CONSIDERATIONS

When educational research is done it should be of fundamental importance that the researcher not only recognise but comprehend the ethical implications of the research being done (Du Plessis, 2016). While the ethical standards for a study are to be determined by the researcher it was done aligned with the requirements set out by the NWU-EMELTEN-REC (ANNEXURE B) and the NWU-RDGC (ANNEXURE I) referred to earlier (sec. 4.7.1).

In addition, there are other ethical considerations that should be taken into account by the researcher and that was singled out by Dunne, Pryor and Yates (2005) as:

- Informed consent
- Voluntary participation
- Anonymity

Before the study commenced the participants were, as mentioned earlier, fully informed about the purpose, nature and scope of this study. From the participants it was expected to share their honest opinions and experiences and that there wasn't necessarily a right or wrong answer on the questions that were asked. Being fully aware of what they were letting themselves in for, the participants were asked to sign a written undertaking whereby they confirmed their willingness to participate in the study (ANNEXURE C).

The participants were further assured that taking part in the study was voluntary. As suggested by Maree (2016a), the participants were informed that they could withdraw from the study at any time without providing a reason. If decided to withdraw from the study the participants were further given the assurance that their decision will not adversely affect them in any way. None of the participants will therefore be forced against their will to complete the research study.

Lune, Pumar and Koppel (2010) believe that the most important priority of a study is the participants as these participants support the researcher's study. By keeping their opinion in mind and as suggest by De Vos, Delpont, Fouche and Strydom (2011), it was essential that the researcher instituted a series of precautionary measures to ensure that the participants were at all times protected. One of them was to ensure that the participants' identity remains anonymous at all times. Consequently, no names of any participant were mentioned or used during the study in an attempt to protect the participants' identity. To assure this in a practical way the participants were not requested to write their names on any of the data collection instruments.

Furthermore, in an effort to guarantee anonymity, the data obtained by means of the data collection instruments was electronically stored on the researcher's laptop at the completion of this study. This information will be stored for a period of five years and

protected by a password that will be known to the supervisors. The same password will also protect the data files that were loaded on to an external hard drive for safe-keeping at a place known to the supervisors.

4.10 RESEARCH QUALITY

In an attempt to ensure the quality of the study is of an acceptable standard the validity of the research study requires more clarification. Validity is an important requirement for both qualitative and quantitative research (Cohen *et al.*, 2011). Three forms of validity can be singled out that impacted on the study:

4.10.1 Content-related evidence of validity

According to Taherdoost (2016), validity is a process in which data will be assessed and eliminated based on its value to the research; thus the data gathered can be categorised as desirable and undesirable. The desirable data would then be all the relevant data gathered to be analysed in the study while the undesirable data would be data that has no relevancy to the study. Validity can furthermore be described as the process of data evaluation; the content-related validity will necessarily be reliant on the literature review and the data collected from data gathering instruments. Thus, according to Degroote DeSmet, De Bourdeaudhuij, Crombez and Van Dyck (2020), content validity is a quite essential form of validity that aims to align the content of the literature review and the data collected from the data-gathering instruments.

In an attempt to continuously evaluate the validity of content/data being portrayed, the researcher can ask the following question: Was the data regarding the viability of VR-HMDs within the teaching and learning of pre-service history teachers (the participants) collected and portrayed in a comprehensive, logically arranged, and consistent manner throughout the research study in its entirety?

4.10.2 Criterion-related evidence of validity

Criterion validity refers to the extent to which a measure is related to an outcome. Moreover, it determines the relationship between measures while predicting an outcome for another measure (Taherdoost, 2016). McAbee and Oswald (2013:533-534) describe

criterion-related validity as the direct relationship between the sources of data and the findings established through the analysis of said data.

Thus, when applying criterion-related evidence of validity to this study regarding the viability of VR-HMDs within the teaching and learning of pre-service History teachers, this form of validity will attempt to determine the degree of relationship between the literature review, the empirical data gathered from the questionnaires, worksheets, focus group interviews, field notes and its preliminary findings.

4.10.3 Construct-related evidence of validity

Construct validity refers to how well the relationship between concepts has been constructed. It furthermore deals with a specific idea or behaviour that is constructed into a functioning and operating premise which assists the researcher throughout the study (Taherdoost, 2016). For Cohen *et al.* (2010) construct validity concerns the extent to which a particular instrument of data collection confirms to the theoretical context in which it is located. While attempting to determine the construct-related validity of this study the researcher can, therefore, ask the following question: By utilising different instruments of data collection and researching the relevant literature, to what extent did the various experiences, assumptions and views of the participants regarding the viability of VR-HMD within the teaching and learning of history influence the data collection process and its findings?

4.11 THE ROLE OF THE RESEARCHER

The researcher in this study played a personal and an active role in constructing and managing the data gathering process. He acted as a research instrument by ensuring that intervention sessions were organised for the participants and that the questionnaires and worksheets were designed and provided for participants' responses to be collected. Furthermore, according to Greene (2014), if the researcher is closely involved in the data collection process it could be advantageous to the study. These advantages include, among others that the data can be collected more easily because the researcher has prior knowledge of the content; there is a first-hand interaction with the participants during the data collection process, and it is easier for the data to be kept confidential.

Due to his close involvement in the research process, the researcher was cautious not to misrepresent the data but as suggested by Šimundić (2013) to report it in a transparent, objective and honest way free from his personal bias.

4.12 CONCLUSION

Chapter 4 started with a concise overview of what could be expected from the chapter after briefly stating what was discussed in Chapter 2 and 3. Following this overview Chapter 4 revisited both the primary and secondary research questions that provided the framework for the aims and objectives of this study. After these aforementioned guiding principles of the study were examined the constructivist-interpretivist paradigm and the ontological, epistemological and methodological assumptions that underpins the study was discussed. Subsequently, the chapter outlined the qualitative and quantitative research design. Moreover, this chapter discussed the case study research method and also provided a more detailed discussion of the population and sampling for this study. This was followed by a discussion on how the data collection instruments were utilised in the five phase data collection process in order to gather data from participants. To follow was an overview in the manner of how the data will be analysed, and the ethical considerations that were taken into account for this study. In conclusion, reference was made on what was done to ensure the research quality of the study to be followed by the role the researcher played in the research study.

In Chapter 5 the gathered data is analysed and interpreted.

CHAPTER 5

DATA ANALYSIS AND INTERPRETATION

5.1 INTRODUCTION

In Chapter 1 the background to this study was at first outlined. By means of a literature study in order to establish a conceptual-theoretical framework for the remainder of the study, Chapter 2 in turn then examined the role of ICT's and SDL within the teaching and learning of History during the 21st-century while Chapter 3 focused specifically on the role of VR-HMDs as an instructional tool in education. Additionally, Chapter 4 outlined the research design and methodology that was followed when the empirical data was gathered. It is by the combination of these previous four chapters and the following two chapters that the researcher wants to discern to what extent VR-HMDs are viable within the teaching and learning of pre-service History teachers.

In Chapter 5, a brief overview is at first offered regarding the method that was followed in the organisation, analysing and interpretation of the data (sec. 5.2). Hereafter, the qualitative data (sec. 5.3) and the quantitative data (sec. 5.5) was analysed and interpreted. In section 5.4 and section 5.6 a summary is given of the analysed and interpreted qualitative and quantitative data respectively. After all the aforementioned sections have been discussed the conclusion to the chapter follows (sec. 5.7).

5.2 OVERVIEW OF THE COLLECTED DATA

As previously mentioned in Chapters 1 and 4 the participants of this study were second year pre-service History teachers from the Faculty of Education at the NWU, Potchefstroom Campus. A total of 15 participants formed part of the five phase intervention process of data collection (sec. 4.7.2) by providing their opinions, attitudes knowledge and experiences on set questionnaires, worksheets, semi-structured focus group interviews and the online *Kahoot* application. The researcher further attempted to discern the participants 'attitudes towards the study and research questions through the use of field notes created from his observations.

5.2.1 Method of data analysis

Within this section, more attention is paid to the manner in which the data was organised, analysed and interpreted. In the case of qualitative data, Flick (2014) and Creswell (2014) determine that data analysis is the classification and interpretation of linguistic and visual material in order to discern meaning from it to answer the primary and secondary research questions. Moreover, Flick (2014) states that qualitative data analysis combines the rough analysis of materials such as summaries with the detailed analysis of e.g. the development of categories with the aim to arrive at deductions that can be generalised. Additionally, when examining the concept of qualitative data analysis, Flick (2014) further asserts that as a qualitative researcher the need will arise to study not only the linguistic material but also that which is said “between the lines” as it’s within this midpoint-way between what is said and what is implied where data that is of interest also grows. The interpretation of data can be thought of as the core activity during the analysis of qualitative data (Flick, 2014) as interpretation leads to the researcher’s ability to understand and explain the data that was gathered.

In order to analyse the qualitative data that was gathered, a thematic approach has been followed. A thematic approach to data analysis according to Saldaña (2013) assists in the analysis process of a phenomenological and interpretivist study similar to this study. Likewise, Butler-Kisber (2010) explains the thematic analysis as a process that involves the extracting of verbatim data in order to accurately transcribe important statements which will then in turn assist the researcher in discerning meaning and put into words the findings of the study. The unravelling, conceptualising and interpretation of the data began through an open-coding process where data was transcribed into meaningful divisions and assigned a code by means of descriptive designations (Nieuwenhuis, 2016a). As suggested by Saldaña's (2013) code-to-theory model, these different codes were then divided into larger categories to be organized into sub-themes and finally into themes. In Figure 5-1 the consecutive steps are illustrated in which the qualitative data was organised, analysed and interpreted.

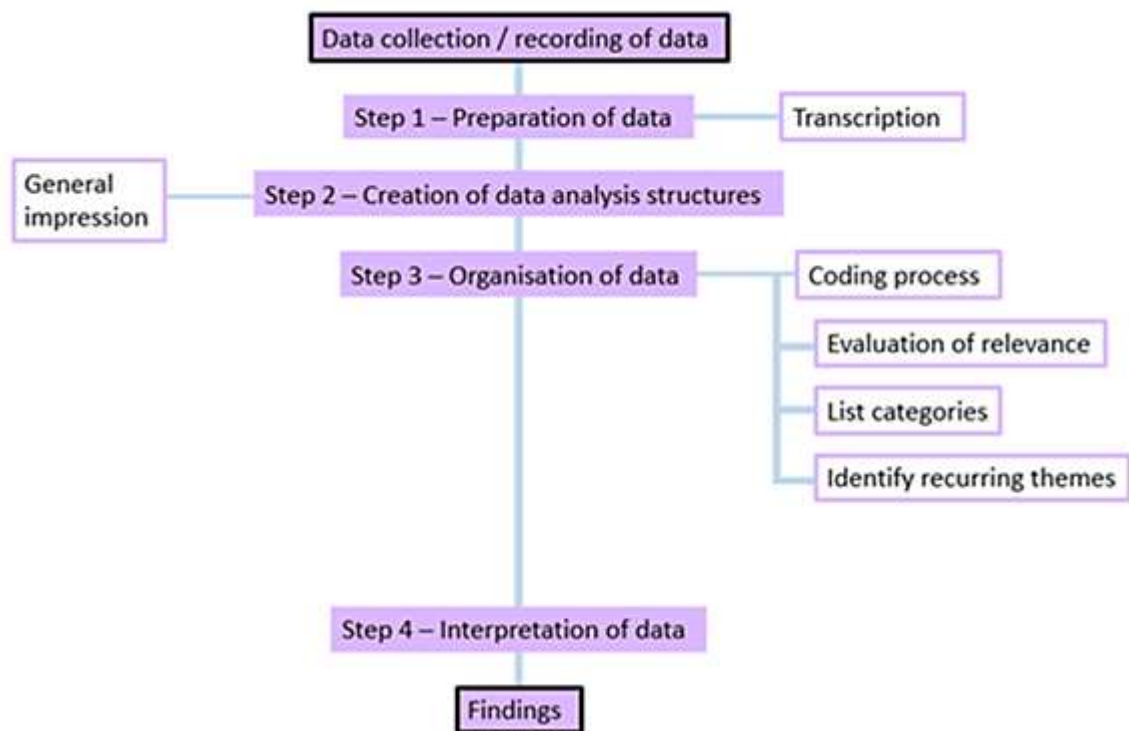


Figure 5-1: Illustration of the qualitative data collection process

Complimentary to the predominantly qualitative data that was collected and analysed, numerical quantitative data was also gathered to a limited extent. A descriptive statistics procedure was used to organise and analyse the quantitative data. According to Grosser (2016) descriptive statistics allow for procedures such as frequencies, distribution, percentages, means, median, modus and standard deviation. By applying means and percentages the researcher was able to summarise the characteristics of the numerical data in the respective response categories of the variables of this study.

5.3 QUALITATIVE DATA

The qualitative data in this study was gathered by means of an open-ended questionnaire, a paper-based worksheet, focus group interviews and field notes.

5.3.1 The open-ended questionnaire

The aim of the open-ended questionnaire (ANNEXURE D) that was completed during the first intervention phase of the data collection process (sec. 4.7.2) was first to obtain some biographical information from the participants. The biographical data showed ages (with the majority of participants being either between the ages of 19 to 21), genders (six participants identified as female while nine participants identified as male), races (five participants were Caucasian, eight participants were African and two participants identified as Mixed-race / Coloured). As a result of their diverse cultural backgrounds it would in theory impact on their pre-conceived ideas, attitudes and perceptions regarding the holistic use of ICT's in History education and VR-HMDs in particular.

The open-ended questionnaire further attempted to gather some baseline information concerning the participants prior knowledge of ICT's in History education and also to discern their knowledge, experiences, and attitudes towards VR as a pedagogical tool within the teaching and learning of History. The researcher is of the opinion that for the successful integration of new ICT's (e.g. VR-HMDs) into the teaching and learning of History will, among other things, be determined by the participants' prior knowledge, experience and attitude towards the use of ICT's.

In Table 5-1 a summary follows of the main and sub-themes that were generated from the qualitative data collected from the open-ended questionnaire.

Table 5-1: Themes and sub-themes from open-ended questionnaire

Prior knowledge on ICT's and attitude towards VR		
Theme 1 - General exposure to ICT	Sub-Theme 1:	To a great extent
	Sub-Theme 2:	ICT resources exposed most to
Theme 2 - Nature of experiences with ICT	Sub-Theme 1:	Positive experiences
	Sub-Theme 2:	Negative experiences

	Sub-Theme 3:	Impartial experiences
	Sub-Theme 4:	Lack of experiences
Theme 3 - Willingness in the utilisation of ICT's most exposed to	Sub-Theme 1:	Eager to use
	Sub-Theme 2:	No interest
Theme 4 - Utilisation of a different ICT	Sub-Theme 1:	Positive attitude
Theme 5 - Knowledge regarding VR	Sub-Theme 1:	Lack of knowledge
	Sub-Theme 2:	Hearsay knowledge
	Sub-Theme 3:	Application knowledge / Practical knowledge

5.3.1.1 Theme 1- General exposure to ICT

This first theme determined to what extent participants were exposed to ICT within their training as potential History teachers. This exposure could potentially shape their thoughts on the remainder of the study while also identifying their initial thoughts on the study.

5.3.1.1.1 Sub-theme 1: To a great extent

An overwhelming majority of the participants indicated that they were exposed to ICT's within their pre-service training with both participants 1 and 2 declaring that they had "great" exposure to ICT's: (P1) *"To a greater extent ..."*. (P2) *"I have been exposed to the ICT to a greater extent ..."*. Additionally, the majority of participants indicated that their exposure takes place on a daily basis: (P4) *"We almost must use ICT's everyday (sic) during our lessons in class"*.

When most saw Covid-19 as a hindrance, one participant was of the opinion that it is due to Covid-19 that the inclusion of ICT's within History education has progressed as far as it has: (P7) *"As a second-year student we fell tight into Covid-19 lockdown, where we were exposed to ICT's on a daily basis when it came to academics. To make distant learning possible and to keep everyone safe. Covid-19 have teached us that this is possible with different hardware and software ..."*.

There was, however, a solitary participant that alleged that he has never been exposed to any form of ICT before: (P5) *"... I have never been exposed to ICT's during my pre-service time"*.

5.3.1.1.2 Sub-theme 2: ICT resources exposed most to

The majority of participants highlighted the fact that the ICT that they are most familiar with is a laptop (computer) and their use of this ICT usually includes Microsoft software with Microsoft Teams (zoom) being the most used of the various Microsoft applications. Additionally, the participants indicated that they recognise that their cell phones could be considered to be ICT's, but within a learning environment most indicated that they have had more exposure to laptops. While laptops (computers) were identified as the ICT most commonly used, the data gathered indicates that cell phones were the second most common ICT used. Other ICT's that participants indicated they had been exposed to before are: radio, television, pre-recorded lessons, emails, Efundi (a management system for learning used by the NWU) and Power Points.

Only one participant mentioned that he has had no exposure to ICT's before: (P5) *"Absolutely nothing"*.

From the above responses it is thus clear that the majority of the participants were regularly exposed to ICT's in their training as pre-service teachers. The Covid-19 pandemic also played a vital role in the participants' exposure and use of different ICT's. This experience of the participants is consistent with the research of Krassadaki, Tsafarakis, Kapenis and Matsatsinis (2022) that showed that during the pandemic lecturers at universities in western and developed countries managed to adjust and proceed their work by means of remote online teaching using different ICT's. The participants of this study who were enrolled at the Faculty of Education of the NWU,

Potchefstroom Campus were no exception. During the Covid-19 their teaching and learning were also dependent on various online teaching strategies involving different ICT's that served as a stand-in methodology for the conventional face-to-face classes (Bunt, 2021). The participants further indicated that they were most exposed to ICT's such as laptops (computer). Other ICT's that were used by the participants were cell phones, Microsoft Teams, radio, television, pre-recorded lessons, emails, Efundi and Power Points.

5.3.1.2 Theme 2 – Nature of experiences with ICT

In an effort to determine the general nature of experiences that the participants had with their use of the different ICT's the following sub-themes were extracted from the data.

5.3.1.2.1 Sub-theme 1: Positive experiences

The overwhelming majority of the participants described their experience with ICT as positive. Reasons for their positivity were based on the fact that it provided them with a tool with which they could communicate with their lectures; it had student friendly features which not only made their learning pleasant and interesting but also easier: (P1) *"... It has assisted me with forms of communication with lectures, it is much more easier to receive important information ..."*. (P3) *"Must be Zoom, because during lockdown school was conducted virtually as well as church and I found it to be the easiest experience form of ICT ..."*. (P4) *"ICT makes learning easier ..."*. (P6) *"... I've been exposed to Efundi the most and it is easily explorable with student friendly features"*. (P7) *"I did not only learn a lot about this, but it also made learning interesting"*. (P15) *"Generally my experience was pleasant. I quite enjoyed the use of PowerPoints as it visualised History for me"*.

The participants' positive experience with ICT in the past may add to their willingness to in future experiment with any other new and emerging technologies such as VR-HMDs. In this regard Sindhwani (2021) believes that prospective teachers' attitudes in the use of ICT will in the end depends on the success in which it will be implemented in class rooms.

5.3.1.2.2 Sub-theme 2: Negative experiences

A few of the participants viewed their experiences with ICT as negative due to mostly technical challenges they encountered of which load shedding and unstable internet connections appeared to be the most important. One participant further mentioned that the reading on a screen brought some strain on the eyes: (P2) *“Laptop and cellphone (sic). I use both... though there are disadvantages because it is not easy to access the internet which there’s loadshedding or network problems”*. (P4) *“I use laptop everyday (sic) to learn hence sometimes it’s difficult to read due to low (sic) shedding and the screen also affect my eyes”*. (P7) *“There were some obvious problems ...”*.

5.3.1.2.3 Sub-theme 3: Impartial experiences

Impartial experiences differ from both the positive and negative experiences. It emphasises both the positive and negative aspects of an experience in equal parts as the participant does not noticeably choose a side of the line to stand on. (P7) *“My experience with this technology was satisfactory”*. (P8) *“My experience with the ICT Ive (sic) been exposed to has been both good and bad”*.

5.3.1.2.4 Sub-theme 4: Lack of experiences

Participant 5 was the only one that decisively stated that he has had no experience with ICT’s before: (P5) *“I was not exposed to ICT’s”*.

5.3.1.3 Theme 3 – Willingness in the utilisation of ICT’s most exposed to

In this theme the degree of willingness of the participants is shown in the use of ICT’s that they were most exposed to during their training as pre-service teachers.

5.3.1.3.1 Sub-theme 1: Eager to use

An overwhelming majority of participants indicated that they would be eager to use the ICT that they have had the greatest amount of exposure to within their lessons as pre-service teachers. The general consensus of these participants was that they would like to use laptops, cell phones and Power Points etc. The reasons for their eagerness were based on the participants’ belief that as a teaching and learning tool ICT’s are

productive and effective as it adds to more learner engagement and making learning faster, interesting and more enjoyable.

With the exception of all but three, the participants 1, 2, 3, 4, 6, 7, 9, 10, 11, 12, 13 and 15 indicated that they would want to use ICT's like the ones they have most been exposed to within their training: (P1) *"This makes lessons more interesting and makes learners to want to learn and engage more on the lessons"*. (P2) *"This makes the lesson to be easy..."*. (P3) *"Teaching using technology has to be fun and it alleviates a lot of unnecessary paper work"*. (P6) *"With improving artificial intelligence (sic) and technology I think it would be easy and interesting to use ..."*. (P7) *"Technology should be seen as an instrument that helps the process of education, making it effective and productive"*. (P9) *"I'd use my laptop for lesson because it allows you to create many fun ways of learning"*. (P10) *"I did because it makes work faster and it is better than making use of the chalkboard..."*. (P11) *"I want my learners to be exposed to technology at an early age so the best way to do that is to include it in my lesson one day"*. (P12) *"Yes I have thought of using a laptop through Zoom and Microsoft teams to conduct classes because it makes ones job easier, and it promotes active learning in the classrooms since children are familiar with the ICT's"*. (P13) *"I have thought of using my cellphone (sic), as well as my laptop during my own lessons..."*. (P15) *"...The use of ICT's in our pre-service training has further visualised it and I would definitely use it"*. Additionally, participant 4 showed interest in using ICT's, but also did not shy away from sharing his reservations regarding the use of ICT's: (P4) *"Yes, was taught on how to use it but ... I have challenges on using laptop..."*.

A possible reason why the majority of the participants indicated their keenness to integrate those ICT's they were most exposed to in their future teaching and learning activities can be ascribed to the fact that the use of these technologies was modelled to them by their lecturers whilst receiving training as pre-service teachers. The participants might have felt that this exposure was enough experience to equip them with knowledge and skills to confidently integrate technology into their future teaching and learning activities. In this regard Tiba and Condry (2021) reported that pre-service teachers experience various barriers that prevent them from effectively adapting technology in their future classrooms. One of the obstacles is the lack of consistent and

effective modelling by their lecturers during their training on how to teach by integrating different technologies.

5.3.1.3.2 Sub-theme 2: Lack of interest

While the majority of the participants showed a clear interest in the use of ICT's that they were most exposed to, there were three others that were of different opinion. Participant 5 merely indicated that he hasn't given the use of ICT's within his own teaching much thought, but he did not elaborate on his answer. Participant 8 lack of interest was his belief *"...that it would take a lot of time to prepare and it is also a fact that not everyone might enjoy technology in the classroom"*. Participant 14 indicated that he, similarly to participants 5 and 8, did not give the use of ICT's much thought. However, the participant showed reservations on the use of certain ICT's for an educational setting: (P14) *"I do not think that a cellphone (sic) would be useful or necessary in the classroom setting, but using educational apps like Kahoot, is a useful learning tool in the classroom"*.

With regard to these three participants who showed a low interest in the integration of ICT's as an instructional tool Kumar and Vigil (2011) caution that educators of pre-service teachers should not think that all their students are open to the use of ICT's. The fact that these pre-service teachers who are often describe as "digital natives" or the "Net generation" (Kumar & Vigil, 2011:144) is no warranty in itself to assume that they will always be able and willing to effectively use technology as an instructional tool.

5.3.1.4 Theme 4 - Utilisation of a different ICT

This theme deals with the participants' willingness to use a different ICT that they were less exposed to in their pre-service teacher training. The participants showed an overwhelming keenness to use different and additional ICT's in their future lessons. They believed that this was necessary as it will improve the teaching and learning of History in making lessons easier, interesting and more active and visual.

5.3.1.4.1 Sub-theme 1: Positive attitude

As in theme 3 there was an overwhelming response in the participants' willingness to incorporate any other different ICT that they were not previously exposed to in their

future lessons. Moreover, the opinions expressed by participants 1, 2, 3, 5, 6, 7, 10, 13, 14, and 15 all indicated that they are willing to use other forms of ICT's within their own lessons. They perceived the use of various ICT's as valuable as it will lead to the acquisition of more technological knowledge and simultaneously contribute to active and collaborative learning that will not only improve learning but also making it more interesting and easier: (P1) *"Because it establishes a more active collaboration of learners and the simultaneous acquisition of technological knowledge"*. (P2) *"...learners will get to see the lesson videos or any type of useful resources"*. (P3) *"Yes. It would be easy and not have any paper work"*. (P5) *"I want to improve better learning"*. (P6) *"I've thought of using emails as mode of communication and the Microsoft tools like word for assessment writing"*. (P7) *"As someone who have been exposed to almost every type of ICT I can confidently say that software like zoom with the help of hardware such as a laptop etc, can definitely help teacher become more effective and reach student who are at home"*. (P10) *"It makes work easier and the learners become more interested in the lesson"*. (P13) *"I have thought of using my laptop one day in my classroom to play powerpoint slides to the learners, as well as immersive videos so the learners will be able to immerse themselves in the work ..."*. (P14) *"It is extremely useful to bring different kinds of learning tools in the classroom"*. (P15) *"... I think ICT's are needed to keep interest in History as a subject"*.

Participants 9 and 12 provided no response to this question, while participant 11's response clearly indicated his interest in using various ICT's, but he did not elaborate on his "Yes" answer.

In summary of the above responses, the majority of the participants showed not only an eagerness to use ICT resources (such as laptops through Zoom and Microsoft Teams) that they were most exposed to at the time when they received their training, but also indicated an overwhelming positivity towards incorporating other ICT tools in their future lessons as well. This keenness can be ascribed to their belief that using ICT technology will make their future lessons more enjoyable, interesting, and facilitate easier learning. Moreover, some participants expressed that it will make lessons more interactive and collaborative, promoting a deeper level of learning. These beliefs and motivations align with the TPACK framework as these pre-service History teachers are able to see the connections between ICT's, subject knowledge, and the manner in which they want to

use it. Realising these benefits when incorporating ICT technology, according to Pozas and Letzel (2023) and Gyamfi (2017), are important indicators in the training of pre-service teachers. These scholars' research indicated that the way pre-service teachers perceive the use of ICT technology will ultimately influence their willingness to incorporate it into their future teaching practices. Additionally, Fu (2013) postulates that while teachers' attitudes towards using ICT are strong predictors for technology integration, their beliefs and confidence in using ICT also play a crucial role. The participants of this study who believed that ICT technology will foster a more interactive, collaborative, and deeper learning experience were those who supported a more constructive teaching philosophy. According to Sang, Valcke, Braak, and Tondeur (2010), it is these pre-service teachers' beliefs that will drive their stronger intentions to incorporate ICT into their future teaching and learning activities.

A few of the participants experienced the ICT resources that they were exposed most to during their training not as indefinite positive or negative. Apart from these participants a very small minority participants indicated that their experiences were negative. This was the result of mostly technical challenges such as load shedding, unstable internet connections and the screens that brought discomfort to the eyes. According to Alamäki, Dirin, Suomala and Rhee (2021) it is challenges like these that can be responsible to weaken the way students feel about their future use of ICT resources.

5.3.1.5 Theme 5 - Knowledge regarding VR

Theme five deals with the participants' knowledge regarding VR. While VR is a relatively modern tool for educational purposes a reasonable number of the participants confirmed that they have no knowledge on VR, while some indicated that they at least heard of it before. Two of the participants indicated that their VR knowledge extends further than just what they have heard about it. Despite not practically experience VR themselves before, these two participants were informed about the application value of VR technology when it comes to games and movies. Only two participants specified that they have practically experienced VR before.

5.3.1.5.1 Sub-theme 1: Lack of knowledge

A reasonable number of participants indicated that they have no knowledge of VR or at least no recollection thereof. Participants 1, 2, 4, 5, 6 and 11 all indicated that they have a lack of knowledge surrounding VR. Participants 1, 2, 4 and 6 indicated that they have not heard of VR before, but did not elaborate on their response as to why they think they have not heard of it before. Participant 5 merely stated that he has no exposure to VR and that contributed to his lack of knowledge regarding VR: (P5) *"I think I did not get any opportunity to be exposed to such"*. Participant 11 said that he was unsure of whether or not he has heard of VR before and therefore said that he has no knowledge of VR: (P11) *"I actually don't know if I have heard of it or not"*.

5.3.1.5.2 Sub-theme 2: Hearsay knowledge

While a reasonable number of the participants indicated that they have no knowledge of VR, there were others who signified that their impressions of VR rely on hearsay knowledge. Participants 3, 8, 13, 14 and 15 all indicated that they have heard of VR before, but not have had any experiences with VR previously: (P3) *"I have heard that VR is living on the screen, with full experiences and seeing that you witness everything"*. (P8) *"I have heard a lot about how it is starting to be used within modern gaming"*. (P13) *"I have heard of it in the gaming context before..."*. (P14) *"I have heard that it is an exciting and cool new way to play video games..."*. (P15) *"I've heard of VR before as a tool for gaming, especially on the playstation 4 ..."*.

5.3.1.5.3 Sub-theme 3: Application knowledge

Two of the participants indicated that their knowledge on VR extends further than just what they have heard about it. Despite not practically experience VR themselves before, these two participants were informed about the application value of VR technology to video games and movies: (P9) *"One can use VR to play games"*. (P10) *"I have seen people on the movies and Youtube videos made use of VR and they felt that the VR was a great experience as it makes things look like the reality"*.

5.3.1.5.4 Sub-theme 4: Practical knowledge

Only two participants indicated that they have practically experienced VR before: (P7) *“I have been exposed to VR on multiple times. I have my own set of VR headset. I use this on a weekly basis to play games on my computer”*. (P12) *“Yes, I have experienced Virtual Reality throughout my educational journey for lectures and teachers use them to spark interest”*.

The above responses showed that a large number of the participants had a very restricted hearsay to no basic knowledge of VR and its application. Only two participants indicated that they had some knowledge on the practical application of VR. The participants' unfamiliarity of VR knowledge and the practical application thereof as a relatively modern tool for educational purposes can possibly be ascribed to the fact that they never had the opportunity to be exposed to this ICT during their training as pre-service teachers and as a result have not fully been immersed within the TPACK framework throughout their academic journey. A reason for this might be that lecturers did not have the knowledge and/or confidence to integrate VR into their teacher training programmes due to a lack of scholarly research on this technology that can serve as a frame of reference. To this effect Radianti, Majchrzak, Frommb and Wohlgenannt (2020) contested that not enough systematic research has been done when the utilisation of VR and HMDs in higher educational institutions comes into question.

5.3.2 Paper-based worksheet

During the third intervention phase of the data collection process (sec. 4.7.2), the participants were placed in a VLE that resembles a battle re-enactment of an undisclosed World War 2 battle that took place in 1941. In addition, a visual summary of Pearl Harbour was also shown to the participants. Both these VLEs used in this phase of the data collection process were 360° videos playable through the use of the ClassVR VR-HMD and the ClassVR online portal.

A paper-based worksheet (ANNEXURE F) was used to gather qualitative data during this phase of the data collection process. Apart from questions on the participants' experience on the VR-HMDs and VLEs on the World War 2 battle and Pearl Harbour, this worksheet also posed questions on their experience with the virtual Holocaust

Museum that formed part of the second intervention phase of the data collection process (sec. 4.7.2.2).

The aim of the researchers' decision to use a paper-based worksheet was an effort to discern if a deeper meaning and understanding was given to the factual content knowledge that the participants were confronted with, and if it was the case/not the case, to establish possible reasons for the phenomenon. Thus, by using this specific worksheet as a method of data collection the researcher thus attempted to determine whether or not an improved and deeper understanding of subject content was gained through the use of VR-HMDs and VLEs. This worksheet, while connecting to the VLE, attempted to lodge an inquiry into participants' understanding of the subject content found within the VLE in such a way as to determine if participants were able to effectively engage with a learning environment that differs in experience from that which they were accustomed to. Participants provided descriptive answers to the questions in the worksheet. These answers enabled the researcher to gain a greater understanding of the participants' subject knowledge and their opinions regarding said subject content after they had experienced the VR-HMDs in the VLEs.

Table 5-2 provides a summary of the main and sub-themes that generated from the qualitative data collected from the paper-based worksheet.

Table 5-2: Themes and sub-themes from the paper-based worksheet

History-based VR-HMD research activity		
Theme 1 – Extension of subject content knowledge	Sub-theme 1:	An enhanced learning experience
	Sub-theme 2:	Deeper understanding
Theme 2 - Emotions experienced	Sub-theme 1:	Positive
	Sub-theme 2:	Negative
Theme 3 -	Sub-theme 1:	Realisation of historical reality

Participation in visual battle re-enactment	Sub-theme 2:	Evoked feelings of historical empathy
	Sub-theme 3:	Development of a historical consciousness
Theme 4 - Participation in 360° Pearl Harbour VLE	Sub-theme 1:	Better understanding
	Sub-theme 2:	Reality value
Theme 5 – Virtual Holocaust Museum and the 360° 1941 battle re-enactment	Sub-theme 1:	Enjoyable experience
	Sub-theme 2:	Enhanced learning through better retention skills
	Sub-theme 3:	History came alive

The first question on the paper-based worksheet was an attempt to determine the extent of the participants' experiences of the virtual Holocaust Museum, the 360° 1941 battle re-enactment video and the 360° Pearl Harbour. The following themes and sub-themes presented from the data.

5.3.2.1 Theme 1 – Extension of subject content knowledge

The overall consensus from most of the participants regarding question one was their believe that the exposure to the virtual Holocaust Museum, the 360° 1941 battle re-enactment video and the 360° Pearl Harbour added to their existing pool of subject content knowledge in the following manner:

5.3.2.1.1 Sub-theme 1: An enhanced learning experience

Some participants found that the visual format of learning was an enhanced learning experience that extended their knowledge on the indicated topics. (P2) “... *I attained*

knowledge from the virtual experience...". (P3) "The Virtual Holocaust experience was great...". (P4) "Well it really helped me because now I could visual (sic) see what was happening back then...". (P10) "I was able to see it visually and experienced it as if I was there myself". (P14) "The virtual Holocaust Museum showed me interesting facts about the Holocaust that I did not know". (P15) "The VR-HMDs allowed me to have an enhanced experience..."

5.3.2.1.2 Sub-theme 2: Deeper understanding

More than half of the participants indicated that their experiences with the VR-HMDs contributed to a deeper understanding of the subject content: (P1) *"...I got to see the evidence of everything I have read..."*. (P5) *"...they linked together and helped me learned better about history"*. (P6) *"...now I can relate to what I've read on the other topics"*. (P7) *"The information given has not only give me new knowledge, but it has also given the learner visual representation that can give you as a learner better context"*. (P8) *"I believe it has made me much more aware regarding the serious happenings and the intensity with regards to each occurrence (sic)"*. (P11) *"I gained a deeper understanding of the events that took place"*. (P12) *"It added to my existing knowledge by giving me a chance to actually expirianced (sic)..."*. (P13) *"It gave me an amazing insight to these historical experiences ..."*

5.3.2.2 Theme 2 - Emotions experienced

The second question attempted to discern whether or not VR-HMDs were able to assist in evoking an emotional response from the participants. The following sub-themes presented from the data.

5.3.2.2.1 Sub-theme 1: Positive

The majority of the participants were in agreement that the VR-HMDs when using VLEs evoke emotional responses based on the visual stimuli that they experienced as reflected by the following verbatim responses: (P1) *"...the information taken into reality makes us feel bad..."*. (P2) *"The Holocaust Museum made me sad..."*. (P8) *"Yes to a degree, I was sadend (sic) by the information but I belived (sic) if more pictures were shown depicting the horrible conditions, it would have been even more emotional"*. (P10) *"It did, because I felt sorry for them ..."*. (P12) *"Yes...It was like an experiance*

(sic) *in their shoes*". (P13) *"Yes, it definitely did...it really helped me to immerse myself..."*. (P15) *"Yes it did. To see and experience VR-HMDs helped me to make an emotional connection with the content"*.

Both participant 4 and participant 6 agreed that the use of VR-HMDs does evoke emotion, but did not indicate whether or not it had an emotional effect on them in person. Other participants were of the opinion that the VR-HMDs were generally spoken successful in its goal of evoking emotions: (P5) *"Yes, the Virtual Holocaust Museum succeeded the goal (of evoking emotions)"*. (P7) *"Adding visuals in learning will mostly make you feel these emotions"*. (P15) *"So, I would say that the Virtual Holocaust Museum does succeed in its goal to induce emotion within people"*. (P9) *"I think it succeeded in this goal (of evoking emotions)"*. (P11) *"Yes, it did because the images depicted and evoked how the lives of Jews were suffering..."*.

5.3.2.2.2 Sub-theme 2: Negative

Only participants 3 and 14 rejected the notion that VR-HMDs evoked emotional responses: (P3) *"No it did not, mainly because I've seen many other video's (sic) of the Jews Holocaust ..."*. (P14) *"...did not provoke feelings of emotions..."*.

5.3.2.3 Theme 3 - Participation in visual battle re-enactment

In the third question the researcher wanted to establish how the World War 2 battle re-enactment of 1941 changed the participants' perceptions of war. The participants believed that the visualisation of the war through the use of VR-HMDs allowed them a better perspective about what a war in general all entails. It further evoked feelings of empathy and also contributed in a limited way to developing a sense of historical consciousness in "lessons" that can be learned from the past. It is this realisation by the participants which is indicative of a deeper learning and understanding of the historical content. Unfortunately, participants 4 and 12 did not record a response for this question and the accompanying themes and sub-themes. Participant 10's response did not clearly indicate his opinion on the matter. The following sub-themes were extracted from the data.

5.3.2.3.1 Sub-theme 1: Realisation of historical reality

According to more than half of the participants the VR-HMDs helped them to understand and experience the battle re-enactment of 1941 in more realistic way: (P1) *"I got to see how people were fighting and got to learn that it was not easy for them...I got a bit understanding..."*. (P3) *"It's the fact that we got the feel of what it was like..."*. (P6) *"That war is actually deadly and that it is more dangerous in wars than I thought"*. (P8) *"...it made me realise how chaotic war can truly be..."*. (P9) *"It also changed my perspective..."*. (P11) *"It changed my view of how the war impacted the Jews..."*. (P14) *"It showed me a first hand picture of the real world events"*. P(15) *It showed me the harsh reality of war..."*.

5.3.2.3.2 Sub-theme 2: Evoked feelings of historical empathy

Some of the participants indicated that their visualisation of the war through the use of VR-HMDs triggered feelings of empathy: (P2) *"The 360° battle has made me realise how the Jews were killed without any remorse"*. (P7) *"To put yourself in the shoes..."*. (P13) *"...It truly (sic) let me immerse myself..."*. (P15) *"...made me feel sorry for soldiers on both sides of the war"*.

5.3.2.3.3 Sub-theme 3: Development of a historical consciousness

Historical consciousness refers to the understanding of the temporality of a historical experience. It is the representation of a process by which people are able to make and understand connections between the past, present, and future (Zanazanian & Nordgren, 2019; Glencross, 2015). Historical consciousness is the ability to show insight in the manner how the past has influenced the present which in turn will affect how the future will be viewed (Swedish National Agency for Education, 2018).

For two of the participants in their experience with the visualisation of the 1941 battle re-enactment taught them that "lessons" can be learned from the past which should be taken to heart for the future: (P5) *"People where (sic) killed like animals and they did not value other people's life...We all should stop the war thing..."*. (P15) *"It made me realise that war is not the answer to any problem and that we should avoid it at all costs"*.

5.3.2.4 Theme 4 - Participation in 360° Pearl Harbour VLE

Question four expected the participants to describe in what way (if any) they think the 360° Pearl Harbour VLE has added to their understanding of the event.

The majority of participants were of the opinion that the 360° Pearl Harbour VLE through the use of the ClassVR VR-HMD improved not only their content knowledge but also further their understanding regarding the historical event in question. This experience of the participants is indicative of a deeper learning that took place.

Participants 3 and 6 provided responses, but the responses were either incoherent or lacked substance in regards to the theme and sub-themes. Participant 14 was the singular participant who did not believe that the VR-HMD and VLE regarding the 360° Pearl Harbour added to his broader field of information and understanding of the topic. The following sub-themes presented it after the participants experienced the 360° Pearl Harbour VLE.

5.3.2.4.1 Sub-theme 1: Better understanding

There were several of the participants who believed that the 360° Pearl Harbour VLE contributed to better understanding of this topic responded as follows: (P1) *“(A) good manner because I got to understand more and more better...”*. (P2) *“The 360° has made me understand the event to a greater extent...”*. (P4) *“360° Pearl Harbour gave me much understanding...”*. (P5) *“It made things easier...”*. (P9) *“The experience... made it easy to understand...”*. (P11) *“Pearl harbour was much more creative and interesting, and it made me want to know more”*.

Participant 10 reported that his VR-HMD experience within the 360° Pearl Harbour VLE was his first time learning about Pearl Harbour.

5.3.2.4.2 Sub-theme 2: Reality value

For some of the participants the 360° VLE on Pearl Harbour had reality value and as such contributed to an even deeper understanding of the historic events that took place long ago. For Participant 7 the events at Pearl Harbour were *“...dramatic and horrible...”*. (P8) *“It gave me a better idea of how the attack took place...”*. (P12) *“It*

added to my knowledge by actually taking me to the event...". (P13) "The VLE helped me, as a student, to place myself in the position of a marine...". Participant 15 could sympathise with the American house hold when "...listening and seeing the traditional American home at the start of the VLE gave me a more heartfelt experience".

5.3.2.5 Theme 5 - Virtual Holocaust Museum and the 360° 1941 battle re-enactment

In the last question of the paper-based work sheet the researcher wanted to establish what fact or visual stood out for the participants within the VLEs they experienced. It was also expected from them to motivate their answers. With the exception of one participant (P1), the majority of participants identified the Virtual Holocaust Museum and the 360° 1941 battle re-enactment as stood out experiences for them as it was a combination of visual and textual information. Their motivation for why they have chosen these VLEs are detailed in the sub-themes below. The following sub-themes presented it after the participants experienced Holocaust Museum and the 360°1941 battle re-enactment.

5.3.2.5.1 Sub-theme 1: Enjoyable experience

Some of the participants described their experience with VR-HMDs and VLEs in the above events as an enjoyable event. Participant 7 was of the opinion that *"the visuals and the interaction between the learner and the info made it fun and rememberable"* (sic). Participants 11 and 13 also enjoyed the experience *"seeing that History can very easily become boring or stagnant on paper..."*, and *"... this has been very innovative"*. Participant 14 enjoyed *"the picture of Heinrich Himmler (that) stood out the most..."*

5.3.2.5.2 Sub-theme 2: Enhanced learning through better retention skills

A number of the participants believed that their experience contributed to improving their retention skills and in doing so, enhanced their learning. Participant 11 was of the opinion that *"the facts provided information, that were also accompanied by images and it made, it much more easier to remember"*. P4 *"...when you want to access information you just click in it and then it will open for further information"*. For participant 5 *"watching the VLEs made me realise that we can learn better by using this VLE "*, while participant 6 express the belief that *"it is easier to grasp the information and easy to remember the events using Virtual learning"*. Participant 9 was impressed with the

cryptic manner in which information was transferred: “...*facts stood out for me that had a limited amount of information*”.

5.3.2.5.3 Sub-theme 3: History came alive

There were also participants who felt that after their exposure to VR-HMDs and VLEs in the events stipulated above, it created some sense of reality of what actually happened during the time of the historical event. Experiencing this “realness” enabled the participants “to live in the moment” which empower them to give more meaning to what happened. In itself, this contributed to a better understanding of the historical events in question.

What stood out for participant 2 was “*the visual of Ghettos, this made me understand the living conditions... I can reflect to this in our day and age...*”. What was evident for participant 3 “... *was that we were given the opportunity to see and feel how war is actually executed...*”. For participant 8 “*the vast devastation (sic) within the war reenactment (sic), people always imagine how war would be...*”. The re-enactment of the 1941 war stood out for participant 10 “...*because it made the war felt very real...*”. Participant 13 responded: “...*this really helped me to imagine the reality of this historical (the 1941 battle re-enactment) event...*”. Without giving any reason for his response, participant 12 was of the opinion that “...*the war between the two parties really stood out for me...*”. (P15) “*Visually, the VR-HMDs made me feel as if I was a part of History in a way no text book has before*”.

In summary of the data gathered from the paper-based worksheet most of the participants pointed out first that their experience through the use of VR-HMDs and VLEs was one of a positive nature and falls within the parameters of technological knowledge and content knowledge of the TPACK framework. These participants believed that the visual format of learning enhanced their learning by extending their knowledge on the indicated topics. This experience of the participants resonates with the findings of Yildirim *et al.* (2018). After exposing undergraduate education students to VR-HMDs, Yildirim *et al.* (2018) wanted to establish their opinions towards its general application and possible implementation in History education. The participants of this study were generally positive and keen to use to VR-HMDs in history education as they believed it will further increase interest in the learning material.

Second, most of the participants were of the opinion that VR-HMDs and VLEs created a sense of reality to the events which provided a greater context in which the historical events could be better understood. The result hereof was that it not only helped the participants with their retention skills, but also enabled them to make more connections between historical events. To do this acquired the skills of organising and interpreting information which in turn enhanced the participants' learning by showing a deeper understanding of the historical content. According to Taranilla *et al.* (2022:609) VR stimulates deeper understanding of content due to the connection between information and experience.

In the process of making more meaning in the judgment and assessment of the historical events, information was constructed and reconstructed to create new knowledge. This enhanced experience of learning when VR-HMDs are used as an immersive ICT tool is in accordance with the research findings of Campos, Hidrogo and Zavala (2022) after they studied the impact of VR on the learning of university students. Furthermore, by assessing historical information in a critical manner, new knowledge was constructed to finally "own" the content. In the process it led to the acquisition of cognitive, affective and other skills which in turn boosted the development of their self-directed skills (Fu, 2013).

Third, as the VR-HMDs and VLEs created a sense of realness to the historical events it evoked feelings of empathy on the side of some of the participants. Their experience of empathetic feelings is in accordance with the research findings of Hayoung, Yumi, Teemu, Laine and Eunha (2023) and Han, Shin, Ko and Shin (2022) who all argued that the visual stimuli offered by VR impacts positively on the affective domain of students.

Fourth, a number of the participants also indicated that the VR-HMDs and VLEs enabled them to link the past, present and future. Being able to make meaningful inter-relationships between the past, present and future the participants showed their competence to critically construct and deconstruct historical narratives. In this process of seeking to make meaning from the historical events, the participants developed a historical consciousness where "lessons" were learned from the past. For allowing a historical consciousness to developed, involves skills such as to think critically about the past and assessing and interpreting information where judgements about the actions of

others are made. In the process, and as earlier indicated, the participants were, for example, able to developed empathy for the different points of view that influenced historic decisions. This ability to think critically about historical events when using VR are according to the findings of Dick (2021) who claims that VR has the potential to developed critical thinking skills when applied in higher education settings. By its own standing critical thinking is also an important feature of a self-directed student (Du Toit-Brits, 2017).

5.3.3 Focus group interviews

The collection of qualitative data from the semi-structured focus group interviews formed part of the fifth intervention phase of the data collection process (sec. 4.7.2.5). It was conducted with pre-determined open-ended and non-leading questions (ANNEXURE G) in an attempt to further substantiate the data that was collected. From the semi-structured focus group interviews reactions, motives and emotions of the participants were thoroughly investigated. The focus group interview offers the researcher a further opportunity to elicit responses from participants on questions about which more clarity is sought (Engelbrecht, 2016).

In this study the focus groups comprise of three separate groups of five participants each. Choosing a small group size was an effort to involve everyone in rich discussions where no one in the group will feel left out. Despite the researchers' intention to keep the focus groups small to create an opportunity for everyone to become involved, it should be mentioned that the interviewing process was at times hampered by the lack of full participation by the participants. Some of the participants sit in on the interviews but didn't necessarily contribute in the answering of all the questions that were posed to the group.

The data collected from the three separate groups (of five participants each) is presented as one unit in the analysis and interpretation thereof. The following reference codes were used in succession of the verbatim quotations. P1G1, for example, indicates the first participant of the first focus group interview, and P4G3 refers to the fourth participant of the third focus group interview.

In Table 5-3 a summary is given of the themes and sub-themes that presented from the qualitative data collected from the semi-structured focus group interviews.

Table 5-3: Themes and sub-themes from the focus group interviews

Focus group interviews after experiencing the VLE through the use of a VR-HMD		
Theme 1 - VR-HMDs experiences	Sub-theme 1:	Enjoyable, exciting and interesting
	Sub-theme 2:	A sense of reality
	Sub-theme 3:	Pedagogical content knowledge, skills and learner motivation
Theme 2 - Assessing VR-HMDs in an History educational context	Sub-theme 1:	Benefits
	Sub-theme 2:	Limitations
	Sub-theme 3:	Application in schools
	Sub-theme 4:	Application in tertiary institutions
	Sub-theme 5:	Tools for teacher training
Theme 3 – VR-HMDs and SDL	Sub-theme 1:	Goal setting and monitoring of performance
	Sub-theme 2:	Critical thinking and making meaning to new information
Theme 4 – Motivation for regular and future application of VR	Sub-theme 1:	Professional development
	Sub-theme 2:	Repeated utilisation

5.3.3.1 Theme 1 - VR-HMDs experiences

The first three questions of the interview dealt with the participants' general experience of VR-HMDs as a pedagogical tool; the contribution it possibly had on their empathic understanding of history, and to what extent it was able to make connections between content knowledge and learner motivation.

5.3.3.1.1 Sub-theme 1: Enjoyable, exciting and interesting

The majority of the participants indicated that they found their first exposure to and experience of VR-HMDs enjoyable and interesting which shows a positive attitude towards this ICT. The participants' responses presented as follows:

- *“To me it was a nice experience. It really took me away from where I was and like it's better than answering or reading something more paper”*. (G1P1)
- *“...I think it was exciting that even to combine history with the present”*. (G1P2)
- *“This is going to be fun and also in using technology”*. (G1P4)
- *“...sparks an interest...”*. (G2P6)
- *“It's fun. You are having fun while learning”*. (G2P8)
- *“I think it was very interesting...”*. (G3P11)
- *“A lot more interesting...”*. (G3P12)
- *“It's fun, but it's also helpful”*. (G3P13)
- *“I also think that was a nice experience, hence you learn, not by reading something”*. (G3P14)

Describing their experience with VR-HMDs as enjoyable, exciting and interesting the participants' feelings were in accordance to what Nadan *et al.* (2011) found after their students experienced the immersed virtual environment in the first person not having to learn through their lecturers. Nadan *et al.* (2011) reported that their students were more excited about learning in a virtual environment as they experience it to be more fun. In

support of Nadan *et al.* (2011) and after VR-HMDs technology was experienced by undergraduate students, Yildirim *et al.* (2018) reported in their research that the students found the learning environment more enjoyable and the learning content to be more interesting.

5.3.3.1.2 Sub-theme 2: A sense of reality

From the responses several of the participants highlighted the fact that VR-HMDs helped them to experience a sense of reality by feeling present in the historic moment. This feeling of reality aided them in not only a better understanding of the content but also contributed in developing their emphatic feelings towards the historical events. The participants were thus of the opinion that the use of VR-HMDs can be advantageous in invoking emotional connections to the subject content of the VLE.

The participants responded in the following way:

- *“That bringing the history of the things that happened into reality makes it more understanding and easy to grasp”.* (G1P4)
- *“For me when I read some of the facts. Of how the Jews were treated, I immediately felt like I had sympathy or empathy towards them because I was put in a situation with what if it was my family?”.* (G1P2)
- *“I am reliving history I could feel, or I could put myself in the shoes of those people”.* (G2P6)
- *“I would like to mention that the in the video said how the children had suffered, so I think that in the future for papers, if you could see what we experienced, I think it will help them realize. The past readings that it really happened and how the children that were in the video is treated”.* (G2P6)
- *“...you didn't necessarily like (love) that situation, but it helps you to imagine you and your family going through that experience and it really helps you to make an emotional connection to the work...”.* (G3P12)

- *“...I think it's really, really helpful because now you can engage of what was happening back there until now. So it's really easy for you to understand that content”. (G3P13)*

Participant 11 of the third focus group was the only participant who showed some reservations regarding the ability of VR-HMDs to form emotional connections. For this participant it was necessary to experience the event first hand before real emotional connections can be made. According to this participant it is *“(V)ery difficult to show empathy for pictures and pieces of information that are put onto walls because you can't. I think every individual is also different, but I can't relate to what they went through because I never saw first-hand what they exactly participated in...”*. (G3P11)

The participants' feelings of being present in a historical event and experiencing emotions of empathy is in accordance with the findings of the study of Calvert, Abadia and Tauseef (2019). After the students in the mentioned study experiencing the Kokoda campaign during World War Two by means of VR, more empathetic feelings were shown by them.

5.3.3.1.3 Sub-theme 3: Pedagogical content knowledge, skills and learner motivation

Half of the participants were clear in their belief that VR-HMDs are useful in assisting them to draw connections between pedagogical content knowledge, develop certain skills and boost their intrinsic motivation. The responses of the participants were:

- *“It will motivate students more to love the subject...”*. (G1P2)
- *“I think it has a good balance between all of those things (content knowledge and motivation) because you get visual, you can sometimes have audio...”*. (G1P4)
- *It does make connection between content, knowledge, learning, motivation and personal experiences. Because it gives content knowledge and it motivates one to want to know more and learn more”*. (G2P6)
- *“...able to acquire a lot of skills from it, and you can read through the information and grasp it”*. (G2P6)

- *“I think what everybody has said before and what they've experienced and the potential of to have things changed as well within VR headsets is definitely there to change the dynamics of studying history...”. (G3P11)*
- *Like if I found something interesting, I automatically wanted to learn about it and wanted to know more”. (G3P14)*

From the above responses the participants indicated that their exposure to the VR-HMDs led to a feeling of greater involvement in the learning process as it enabled them to draw connections between pedagogical knowledge, content knowledge, developed their skills and fostered their intrinsic motivation. It is these connections that serve to further cement the study's inclusion of the TPACK framework. This experience of the participants where they felt more involved and motivated to engage in the learning process are supported by the findings of Da Silva and Pohlmann (2019) and Nadan *et al.* (2011). Nadan *et al.* (2011) postulates that a reason why there is a greater feeling of engagement when using immersive VR-HMDs can be ascribed to the students experiencing the learning material intuitively and in the “first person”. VR environments help students to become more involved in their learning where they are willing to spend more time on their learning tasks. This made learning more enjoyable and motivates them to learn more (Nadan *et al.*, 2011). Moreover, the VR-HMDs have proven to be a very powerful learning tool as the participants indicated that they were able to draw connections between pedagogical content knowledge and the development of certain skills. This experience ties in with the research of Agün and Atici (2022) who affirm that immersive VR environments regulate, monitor, assess and develop students' cognitive, psychomotor and affective processes and skills. In the process VR contributed to the participants' self-regulated skills in becoming life-long learners (Sakdavong, Burgues & Huet, 2019).

5.3.3.2 Theme 2 - Assessing VR-HMDs in an History educational context

Interview questions four to eight related to the participants' beliefs and attitudes regarding the benefits and shortcomings of VR-HMDs in assessing its utilisation in schools and tertiary institutions, as well as its value when incorporated as an ICT into the training of pre-service History teachers.

5.3.3.2.1 Sub-theme 1: Benefits

Many participants pointed out various benefits that they believed were advantageous to the teaching and learning of history should VR-HMDs be incorporated in the pedagogy. These benefits lie within its being interactive and the visualisation of historic events that has the ability to transport students out of the classroom and into VLEs that simulates time periods and places that they would normally not have access to. Other benefits mentioned were the fact that History can be re-lived that is helpful in the recalling of historical content. One participant further indicated that the advantage of VR-HMDS lies in the fact that it saves academic time. The participants shared the following opinions:

- *“Definitely, definitely it’s interactive...”. (G1P4)*
- *“...but using the VR it’s more like a graphical, so they would like to enjoy having to learn through the visuals of the VR”. (G1P4)*
- *I also think that since we all know that some learners have different learning styles, some really it’s kind of sticks and it’s visual. So I think if they visualize everything. For them to remember”. (G2P6)*
- *“It makes things more simpler (sic). It’s better than a pen and a paper. It makes you relive the history ... It actually gives you a clear picture of what really happened”. (G2P8)*
- *I think when you physically interact with the information, you can automatically understand it better and remember it longer”. (G3P12)*
- *“And it cannot be easy to forget. You know, once you see something... It’s going to be helpful”. (G3P13)*
- *“I think one of the benefits that it saves time”. (G3P14)*

The participants’ acknowledgement of the interactiveness that the immersive VR-HMDs environment brought can according to Yildirim *et al.* (2018) be ascribed to the feeling of reality that it brings of being present in the historical past. This sense of reality enables students to be part of the learning environment that allows them the opportunity to

actively engaged and participate in it (Agün & Atici, 2022; Armstrong, Greaney & McDermott, 2016). Moreover, the participants believed that another benefit of the VR-HMDs in the teaching and learning of History is its ability to support them in remembering historical content. This experience of the participants is supported by Renganayagalu, Mallam and Nazir (2021) and Jensen and Konradsen (2018) that confirm that VR-HMDs is useful in the development of cognitive skills that relates to remembering and the understanding of visual and spatial information.

5.3.3.2.2 Sub-theme 2: Limitations

While being astutely aware of the advantages that VR-HMDs hold for History teaching and learning, more than half of the participants did not shy away from indicating the obstacles to VR-HMDs incorporation. The following are the responses from the participants about what they consider as limitations when incorporating VR-HMDs into the teaching and learning of History:

- *“...something like time is one of the shortcomings”. (G1P1)*
- *A problem and for learners with poor eyesight, all who have glasses that don't have contact lenses. It can also be a problem because they can't see the facts properly”. (G1P2)*
- *“...children that is not used to using technology...”. (G1P2)*
- *“And the battery life also”. (G1P2)*
- *“Yeah, I also think it. Can be time consuming...”. (G1P5)*
- *The first limitation can be that if you are a person who has eye problems, it can impact you very negatively because you are exposed to a lot of light, which might make your eyes hurt and want to stop the experience”. (G2P6)*
- *The negative is that sometimes maybe it's because of my eyes. Sometimes it will like become blurry”. (G2P6)*

- *“If you are in an environment where you don’t have a stable Internet connection that can also be an obstacle, because if the Internet connection, if there are technical glitches, then it stops the whole class”. (G2P7)*
- *“I think that there are more limitations than there are more advantages because we are currently experiencing load shedding which comes and goes in different hours, which are the school hours during the working days”. (G3P6)*
- *“We have another problem, which is chances of the equipment getting stolen is like very high”. (G3P10)*
- *“Funds”. (G3P12)*

From the above responses it is clear that apart from the possible physical deficiencies on the part of the student, such as bad eye-sight, for example, the participants were also aware of financial challenges where technology cannot be afforded and the losses incurred where equipment is stolen. Not being used to VR as an educational tool was considered as another possible limitation.

Apart from these physical and the financial considerations, the participants further referred to systemic challenges in a country such as South Africa where load shedding is the order of the day and which will have an influence on the battery life of the VR-HMDs and on a stable internet connection. Another limitation reported and which resonates with the research findings of Riner (2021) was the belief that the utilisation of this ICT can be a time-consuming activity. A possible reason why VR-HMDs was seen as a technology that consumes time, can possibly be ascribed to the fact that the majority of the participants were never before been expose to this relative new technology, and judge that it will take quite some time to learn the technical skills to effectively utilised it in the History class.

Referring to the participants above responses on eye problems when using VR-HMDs, the study of Kaleci *et.al.* (2017) (as cited in Agün and Atici, 2022) are in agreement that users of VR can experience health issues such as blurred eyes and feelings of nausea, dizziness and anxiety. In the same vein, Agün and Atici (2022) contest that experiencing

VR-environments can lead to health issues and technical problems which can consume important teaching and learning time.

5.3.3.2.3 Sub-theme 3: Application in schools

Apart from the above-mentioned obstacles that South Africans face on a daily basis, many of the participants had further reservations in their opinion on the application of VR-HMDs in the teaching and learning of History, especially in schools. These reservations included poor schools with an infrastructure that does not allow for the protection and/or integration of new technology devices; teachers resistance to any change in their pedagogy; schools not considering it as important enough to invest money in this new technology; mistrust in the way that this technology will be managed by the Department of Basic Education.

The participants listed the following obstacles in their responses:

- *There are situations where there's poor, poor schools. They say that they don't have technology. For instance, some schools are underneath trees...". (G1P1)*
- *Some teachers that come from 1990s are also like resistant to change". (G1P4)*
- *"Can you trust anyone, people or the Education Department to make it a successful process that continues year in and year after without problems, for example mismanagement and misuse of the devices?". (G3P11)*
- *"And also you know the protection of this kind of equipment because it is very, very expensive...". (G3P11)*
- *"...schools spend they don't like to waste money on several things and they might not think that this is important enough to invest money in it". (G3P13)*

Only two of the participants were less pessimistic about the learner's exposure to VR-HMDs in schools. For them it deserves a place in schools because they believed that it will add to more learner engagement which will encourage them to learn more and responded in the following way:

- *"Schools make the learners to engage more and to want to learn more". (G2P7)*

- *Schools as well, the most uninterested being in the world is high school learner and I think if you can do anything to get them interested in the content and engaging with it (VR-HMDs) is great". (G3P12)*

5.3.3.2.4 Sub-theme 4: Application in tertiary institutions

The mentioned obstacles in schools however did not deter some of the participants in their belief that VR-HMDs can be more effectively be utilised at tertiary institutions for History education. They were of the opinion that this technology will allow students to be instructed in a new and different way; its application will promote the teaching and learning of History as a subject discipline as it will one day expose in-service teachers to new technology that will enable them to use it more confidently. The participants responded as follows:

- *It gets harder and harder each year or each four years for teachers to like get and keep learners attention to their books, so finding new ways to educate students would be probably be the only answer". (G1P2)*
- *"For now, I think for universities only...". (G1P3)*
- *"Yes, I think it should be... it will be more easier (sic) if now student teachers become more exposed to VR and other educational technology..." (G1P3)*
- *"I think so to promote teaching and learning of History". (G2P6)*

5.3.3.2.5 Sub-theme 5: Tools for teacher training

When confronted with the question if VR-HMDs should be used in teacher training and especially pre-service History teacher training the answers received were resoundingly positive. Participants 12 and 13 agreed with participant 11's responses where the role of VR-HMDs as an online ICT are also emphasised:

- *"100% Yes, I think definitely the training of teachers to be able to use the technology correctly. We have to acquire the skills". (G3P11)*
- *"Most definitely because especially I would say since the beginning of COVID it has become more useful with regards to other kinds of technology like*

cellphones (sic), because now we're able to use learning, integrated learning through games like". (G3P11)

From the above responses it is clear that the participants had more reservations when it comes to the application of VR-HMDs in schools than it was the case at tertiary institutions. The reasons for their reservations were: Insufficient school funds that do not justify the purchase of VR-HMDs; the poor infrastructure of some schools that does not allow for the protection and/or integration of new technology devices; History teachers' resistance to change and who show little or no interest to integrate a new ICT such as VR-HMDs in their pedagogy. Moreover, the Department of Basic Education was also implied as a scape goat. The participants doubted the Departments' ability to effectively manage the incorporation of this contemporary ICT into the South African schooling system.

In Padayachee's (2017) research on the state of integration of ICT in South African schools, she agrees with the indicated reservations of the participants about the incorporation of a new ICT such as VR-HMDs in schools. She found that the incorporation of ICT remains low as a result of operational and strategic challenges schools are experiencing. Padayachee's (2017) further indicated that teachers (and by implication also History teachers) are uncertain when it comes to the incorporation of e-learning in their classrooms which is aggravated by barriers such as a poor school infrastructure and their lack of technology skills.

While the limitations mentioned by the participants are serious problems that South Africans face daily it did however not deter some of the participants' belief that VR-HMDs can be successfully utilised at tertiary institutions. They further argued that it is essential that pre-service teachers in History education are introduced to this technology during their training. The participants believed that by doing so, history education will benefit as they will learn the necessary skills to effectively implemented VR technology when they become teachers in schools. The participants' view that the application of VR technologies will be more suitable in tertiary institutions than in schools is in accordance with the findings of Freina and Ott (2015). They reported that the tendency is that VR technology is more often used in tertiary education than it is the case with secondary education.

5.3.3.3 Theme 3 – VR-HMDs and SDL

Questions nine to twelve of the interview dealt with the participants' attitudes and beliefs on the role of VR-HMDs as a viable ICT in the promotion of SDL skills. Although most of the participants believed that VR-HMDs contributed to their SDL skills development, there were some of the participants who disagreed. When determining whether or not VR-HMDs are tools in the promotion and development of SDL the participants once more answered as a group but were at times reluctant to elaborate on their answers, but did maintain the opinion that VR-HMDs would be able to assist in the development of SDL skills such goal setting, monitoring of performance, critical thinking and making meaning to information.

5.3.3.3.1 Sub-theme 1: Goal setting and monitoring of performance.

There were participants who believed that VR-HMDs did contribute to the development of their SDL skills of goal setting and to monitor their performance for signs of progress being made. To learn with intention (by setting goals) and to manage one's own learning (by assessing what has been learnt) are characteristics of a self-directed learning (Malison, 2018). The participants responded in the following manner:

- *“Putting all the goals...”*. (G1P2)
- *“... being able to assess what you learned...”*. (G3P11)

5.3.3.3.2 Sub-theme 2: Critical thinking and making meaning to new information

A number of participants further indicated that their experience with VR-HMDs contributed to the development of their SDL skills of critical thinking and making meaning to new information. By dealing critically with the learning material, knowledge is made meaningful where new information is gathered and organised with the prior knowledge that has already been stored in the memory (Yilmaz, 2011). The self-directed learner is thus task-oriented and has the ability to collect, analyze and integrate information in an active and cognitive way in order to be able to apply it in a variety of situations (Ertmer & Newby, 1996). The participants responded as follow:

- *Analyse more, like it will help you analyse because seeing the picture with the fact next to it, how to look at the picture, create your own idea and then read the facts to sort of correct the idea that you had". (G1P2)*
- *"...once you have the Goggles on you can make links in between the stuff that you learned and the new stuff that you're learning last". (G1P3)*
- *"I think it's the one that collects information". (G2P7); "I think the collection of the information...". (G3P11) [and to infer meaning from the information]*
- *"Definitely change people's perspectives of what they think... and I think that would be very, very important for them to the learning process as well". (G3P11)*
- *And help you to make connections between information and like, it's really hard to get a whole picture of something you're just reading about it". (G3P12)*

Those participants who had contrasting ideas on VR-HMDs contribution to the development of the above-mentioned SDL skills responded as follows:

- *"It's relative to the fact what the information gives you because there's certain parts of history that gives you more information ... Americas perspective you never see the other countries perspectives, so for something in the South African context, because sources are quite limited...It depends from topic to topic.". (G1P4)*
- *"I totally disagree because not everything is captured in history and then we've always been taught that there's always more. Yeah, let me just say I'm not sure". (G1P5)*

In summary, those few participants who were not convinced that VR-HMDs contributed to the promotion of their SDL skills were based on the belief that History is a subject with a vast amount of content and therefore not all information can be captured within a VLE. Due to the fact that not all information can be captured accurately within a VLE these participants believed that this causes information to be inaccurate and subjective that is guided by the ideas and ideologies of others.

However, most of the participants were convinced that their SDL skills were developed and promoted after being exposed to VR-HMDs. The skills in question included setting goals, the selective monitoring of performance for signs of progress being made, critical thinking where new information was collected, analysed and debated in order to make meaning of it. All the skills mentioned are characteristic of self-directed students in regulating their own learning (Hasan *et al.*, 2023; Hiemstra, 2013; Moseki & Schulze, 2010). While these skills essentially underpin the study's research into SDL, it also serves to accentuate the benefits of the TPACK framework if incorporated.

5.3.3.4 Theme 4 – Motivation for regular and future application of VR

From the last two questions that were asked during the interviews the researcher firstly wanted to establish to what extent the participants as pre-service History teachers will be motivated should they be given the opportunity to regularly experience VR in their teaching and learning. Secondly, the researcher wanted to know if the participants would be willing to use VR in a lesson if ever given the opportunity.

5.3.3.4.1 Sub-theme 1: Professional development

There were participants who felt that pre-service History teachers would generally be more motivated for the teaching and learning process when given the opportunity to regularly experience VR-HMDs in their training. Reasons singled out for their conviction was that it would benefit the learning process and also contribute to their professional development. The participants provided the following responses:

- *“So I think it's definitely a responsibility not to put the focus on exactly ourselves, but on the learners and something like this would definitely help”. (G1P4)*
- *“A great experience because it did help assist us in our teaching and learning...”. (G3P12)*
- *“...change people's perspectives of what they think...important for them to the learning process...”. (G3P11)*

- *“I never would have thought if you asked me five years ago that this would be possible, that they would even do a study about this or try to integrate this. So, it personally motivated me to work a little harder and try to see what I can do in this field of education to make it better...”. (G3P12)*

5.3.3.4.2 Sub-theme 2: Repeated utilisation

In their responses the participants stated that they themselves would like to use VR-HMDs within their lessons if they are ever afforded the opportunity in future. In some instances, reasons were given for their answers which ranged from enjoyment, a willingness to familiarise oneself with a new ICT that will be a helpful resource for teaching and learning. The participants responded in the following manner:

- *“I would definitely”. (G1P1)*
- *“...Yeah, it actually is really fun”. (G1P2)*
- *“Students love trying something new”. (G1P2)*
- *“I think as long as it goes on you familiarize yourself with something...”. (G1P4)*
- *“...for me it would be a benefit because not all of us love to read or study and as teachers, I think this should be the route”. (G1P5)*
- *“You know when you can just implement this, everyone will just concentrate and be there to do this thing. It's fun, but it's also helpful”. (G3P13)*

The participants' attitude of feeling motivated on the prospect to include VR in their training is supported by the research of Mouw, Fokkens-Bruinsma and Verheij (2020) who found that pre-service teachers were positive towards making VR technology part of their training programmes. In showing their enthusiasm to use VR-HMDs as a feasible pedagogical tool in their future teaching practices, the participants' attitude resonates with the research done by Theo (2014, 2009). In his research pre-service teachers – in contrast with in-service teachers - showed a greater willingness to use technology when it suits their teaching and learning practices. In addition, and in more contemporary research Pozas and Letzel (2023) asserted that the two main

prognosticators for pre-service teachers' future utilisation of ICT are their attitude and their perceived ability to incorporate technology in their teaching and learning practices.

5.3.4 Field notes

The field notes dotted down by the researcher was based on his observations that were made throughout the data collection process, especially so when the participants started to engage with the VR-HMDs. Below are the determined themes that emerged from the data: (i) Initial engagement, (ii) increased motivation for learning and (iii) an enjoyable experience.

5.3.4.1 Initial engagement

To follow my observations after each of the participants started to engage with the VR-HMDs.

Initially participant 1 was hesitant to move around within the VLE, but still engaged with all the subject content available within the VLE. While using the VR-HMDs to access the VLE this participant took her time to take in the experience. Participant 2 was a lot less hesitant within the VLE and moved around more freely and thus immersed herself more into the VLE. Participant 3 was receptive towards the use of VR-HMDs and easily engaged with it as she was quite eager to use it. Initially participant 4 was a little dizzy, fearful of standing and at first required a bit more assistance in order to properly navigate the VLE. Participant 5 was very eager to engage with the VLE, but did struggle to see the visuals due to bad eyesight. Participant 6 constantly asked questions and moved freely within the VLE and within the physical space where the data was collected. Participant 7 also walked around, thus blurring the lines of Virtual Reality and the Physical Reality. Participant 8 moved through the VLE at a rushed pace which could possibly have distracted the participant from acquiring additional knowledge from the VLE. Participant 9 moved within the VLE quite easily and did not require a lot of assistance after gaining confidence within the VLE. Participant 10 moved and engaged with the content at his own pace. Participant 11 was very eager to enter the VLE through the VR-HMDs. While using the VR-HMDs to access the VLE participant 12 was very reserved and asked minimal questions, rather choosing to remain silent for the majority of the intervention. In turn Participant 13 was quite eager to participate in the

study and to use VR-HMDs, this exposure to a new ICT and a new idea on how to teach History appeared to intrigue participant 13. Participant 14 was eager to engage with the VR-HMD due to having interest in gamification. Participant 15 quite enjoyed the exposure to VR-HMDs within an educational setting and believed that the use of VR can only make History a more enjoyable subject of study.

5.3.4.2 Increased excitement and motivation for learning

By means of my observations and also from the participants' impromptu side comments during their experience with the VR-HMDs, the researcher was able to establish that for some of the participants it promoted an excitement and motivation to learn.

Participant 2 appeared to the researcher to be quite excited and motivated to soak up the entire experience as she took her time to experience every visual found within the VR-HMD. An encouraging sign was when participant 4 asked questions which indicated a more than adequate level of interest and possible motivation. Participant 7 appeared to be very motivated to engage with the VLE and were of the opinion that the VLEs might be advantageous to learning. Participant 9 went as far as stating that the visualisation of History through the use of VR-HMDs assisted in remembering the factual information and prefers this method of gathering information to traditional textual information gathering techniques. Participant 10 was motivated to engage with the VLE and even highlighted the fact that he is excited to use VR again when given the opportunity. Participant 15 appeared to be very excited and motivated to fully engage with all subject knowledge within the VLE and highlighted his wish to one day also make use of VR in some way or from.

5.3.4.3 Enjoyable experience

The researcher in his observation sense that all the participants were eager to participate and was fully engaged in the VR-HMD environment that most of them found an enjoyable experience. What follow is examples of the ways some of the participants expressed their enjoyment.

While participant 1 was initially hesitant to move around, the combination of the VR-HMD with the History subject content experienced resulted in her enjoying the process. Due to participant 2's adamant assessment of her own subject knowledge retention and

due to the fact that she moved more freely within the VLE the assumption can be made that the process was generally speaking of an enjoyable one. Participant 4 enjoyed the visual aspects of learning through the VR-HMDs and was especially thrilled about the fact that she had a 360° view. Participant 7 really enjoyed the VLE by asking a lot of questions while participant 9 enjoyed the visuals found within the VLEs by commenting that he preferred the use of VR-HMDs to gather information.

From the field notes and in summary, it can be concluded that the participants showed mix reactions to their first acquaintance with VR-HMDs and VLEs. Some were hesitant and took their time to experience the VLEs while others were comfortable, more receptive and eager to become engaged in the VLE through the VR-HMDs. Some of the participants had to be supported while others were able to find their own way. There were participants who asked questions to learn more about the operation of the VR-HMDs, while others preferred to experience it in silence. One participant experienced dizziness and showed an anxiety whilst using the VR-HMDs. Another participant had problems with his eyes that prevented him to experience the virtual reality environment to its fullest. To this effect the study of Renganayagalu *et al.* (2021) validates that eye problems can potentially be a limited factor while the studies of Tsai, Yeh, Huang, Wu, Cui and Zheng (2018) and Kaleci *et al.* (2017) (as cited in Agün and Atici, 2022) verify that feelings of dizziness and anxiety can be triggered when experiencing a VR-environment. A reason, according to Sang, Valcke, Van Braak and Tondeur (2010) why participants might experience anxiety when being exposed to VR-HMDs can be ascribed to low levels of self-efficacy towards the integration of ICT. In support of Sang *et al.* (2010), Dong, Xu, Chai and Zhai (2020) postulate that educators who experience high levels of self-efficacy will show less signs of anxiety when ICT incorporation comes into play.

Conforming to the findings of Da Silva and Pohlmann (2019) and Lund and Wang (2019) the field notes further showed that there was a clear interest and excitement for the use VR-HMDs which gave rise to an increased motivation for learning. This is confirmed by the willingness of the indicated participants to use this technology again should the opportunity arise in future. The fact that VR-HMDs contributed to a better retention rate of historical facts further added to the interest shown and motivation experienced when it comes to the use of this technology. Moreover, mostly all of the

participants found the VR-HMD experience to be fun. This can possibly be ascribed to the novelty of this technology in teaching and learning. The fact that participants could now experience the feeling of being present in the virtual environment through the first person created the opportunity to learn in a constructive way by navigating, exploring, and inspect objects in the virtual environment. In this way the participants become more excited, interested and engaged in the learning process that increased their motivation for further investigation in the expansion of their knowledge (Renganayagalu *et al.*, 2021; Jensen & Konradsen, 2018).

5.4 SUMMARY OF THE QUALITATIVE DATA

In the next section a summary of the results of qualitative data will follow that was gathered from the open-ended questionnaire, the paper-based worksheet, the focus group interviews and field notes.

In an effort to determine the extent to which the participants were exposed to ICT within their teaching and learning as potential History teachers an overwhelming majority indicated that regular opportunities presented themselves where ICT were integrated into their training. The participants at first indicated that in their training as pre-service teachers they were mostly exposed to ICT's such as their laptop, cell phone and the software Zoom and Microsoft Teams. Last mentioned were mainly used for video conferencing especially in the time of the Covid-19 outbreak. A very small number of the participants were of the opinion that they had bad experiences when using these ICT's during their training. These negative experiences were mostly the result of external technical glitches such as load shedding, unstable internet connections and the screens that brought discomfort to the eyes. Despite these negative experiences, the participants still showed a willingness to continue to use the ICT's (laptop, cell phone, Microsoft Teams, pre-recorded lessons, emails, Efundi and Power Points) that they have had the greatest amount of exposure to within their training as pre-service History teachers. In addition, all the participants were very positive to further incorporate any other ICT's that they were less exposed to in their training as well. The participants based their willingness to accept new and alternative ICT technology on the belief that it will help them to make future lessons more interesting, easier and enjoyable. Moreover,

it will ensure more active learner engagement that will make learning more meaningful in promoting a deeper level of understanding.

These opportunities to engage with ICT's, as communicated by the participants, supports the theoretical grounding that the TPACK framework provides to this study which accentuates the need for balance between the use of ICTs, subject knowledge and teaching methodologies within the classroom. These participants further emphasised that the Covid-19 outbreak aided in the use of ICT's in order for them to continue their studies, but they also did not shy away from putting emphasis on the fact that there were some technical issues that needed to be overcome. These technical issues did however not deter them from attempting to engage with the TPACK framework, even if they did not know it by name, through their willingness to be exposed to new ICT's such as VR-HMDs that could in theory and by their own admission add value to the teaching and learning experience.

With reference to their prior knowledge of VR only two participants were of the opinion that they had some knowledge on the practical application of VR. Most of the participants indicated they do not have any concrete knowledge on the practical application of this technology as it was largely based on hearsay. The above responses showed that a large number of the participants had a very restricted hearsay to no basic knowledge of VR and its application. Reasons for their ignorance can be attributed to factors such as the relative novelty of VR in the arena of teaching and learning which deprived the participants of possible opportunities to a first-hand experience of this technology during their training as History teachers. Moreover, lecturers may feel uncomfortable to incorporate VR into their training programmes, due to their lack of knowledge and skills on how to implement it, and which is further exacerbated by the scant research on its application in an educational setting (Abbitt & Davis, 2021).

In their first engagement with VR-HMDs the participants' reactions varied from feeling hesitant to being comfortable with this new technology. One participant experienced feelings of dizziness and an anxiety upon first being introduced to the VR-HMDs, whilst another participant had trouble with blurry eyes. However, most of the participants were excited and eager to use the VR-HMDs again should the opportunity arise in future.

After their exposure to VR-HMDs and VLEs the majority of the participants reacted in a positive manner describing the experience as enjoyable and informative and one that enhanced their learning as they felt a greater involvement in the learning process. Moreover, the participants were of the opinion that the experience with VR-HMDs added to a better understanding of the historical content. The participants were of the view that the VR-HMDs enabled them to establish links between content knowledge, learning motivation and their personal experiences. They expressed the belief that the virtual Holocaust Museum, the 360° 1941 battle re-enactment video and the 360° Pearl Harbour added to their understanding and existing pool of knowledge on these three topics. With the exception of only one participant the majority of participants identified the Virtual Holocaust Museum and the 360° 1941 battle re-enactment as stood out experiences for them due to the combination of visual and textual information.

Most of the participants agreed that their experience with VR-HMDs as an immersive ICT tool created a sense of realness to the events that provided a greater and better context in which the historical events could be judged and understood. By experiencing the learning material intuitively and in the “first person” it encouraged the participants to participate and become actively involved in their own learning. By being more involved in their own learning motivated the participants to spend more time on their learning tasks. Their involvement also stimulated their cognitive processes of a better memory in the recalling of information and their ability of making connections between historical events. In the process of connecting historical moments/events the participants were able to apply the knowledge and skills of organising, interpreting and assessing information which in turn enhanced their learning by showing a deeper understanding of the historical content. By applying these knowledge and skills it supported active and individual learning where information was constructed and reconstructed in a self-regulated way to create new knowledge, and making more meaning of the historical events. In this way the VR-HMDs proven to be a very powerful learning tool as the participants indicated that they were able to draw connections between pedagogical content knowledge and the development of certain SDL skills.

The sense of feeling present in the historic event while being in the immersive VR-environment also impacted on the affective domain of the participants. A great number of the participants reported that the visual stimuli evoked emotions of empathy. In a

limited way these feelings of empathy further contributed to the participants' development of a historical consciousness. In developing a historical consciousness, the participants were able to make meaningful connections between the past, present, and future. In doing so, they prove the ability to critically construct and deconstruct historical narratives, seeking to make more meaning from the historical events. In this way the participants added to their understanding of history by learning "lessons" from the past. It is this realisation by the participants that is indicative of a deeper learning and understanding of the historical content.

Most of the participants strongly believed that the enhanced experience of learning that the VR-HMDs provided, added to the promotion and developed of their SDL skills. The skills in question included setting goals, the selective monitoring of performance for signs of progress being made, think critically of the past where new information was collected, analysed and debated in order to make meaning of it. All of these skills are characteristic of self-directed students in regulating their own learning.

There were however, also a very few participants who were not so convinced that VR-HMDs necessarily contributed to the promotion of their SDL skills. Their assumption was grounded in their belief that History is a subject with a vast amount of content and therefore only snippets of information can be captured within a VLE at a specific time. This caused these participants to believe that information cannot be holistically captured accurately in a VLE which they consider are necessary before there can be any question of SDL skills development.

Various benefits were pointed out by the participants should VR-HMDs be incorporated in the pedagogy of History teaching and learning. These benefits lie within its being an interactive platform where the visualisation of historic events has the ability to transport students out of the classroom and into VLEs that simulates time periods and places that they would normally not have access to. The feeling of being present in the historical moment allows for individual and active experiential learning that has a positive effect on increasing student motivation which in turn promote self-directedness.

Other benefits mentioned by the participants on why VR-HMDs should be incorporated in the pedagogy of History teaching and learning was the belief that by re-living the historic past in an immersive virtual environment helps in the recalling of historical

content and to understand visual and spatial information. One participant further indicated that the advantage of VR-HMDs lies in the fact that it saves academic time.

While being astutely aware of the advantages that VR-HMDs hold for History teaching and learning, more than half of the participants did not shy away from indicating the obstacles to VR-HMDs incorporation. Challenges such as physical deficiencies, (e.g. bad eye sight) on the part of the student user and financial considerations, (e.g. the affordability of VR technology and the damage that it can cause in case equipment will get stolen) together with VR being a time-consuming activity, were all factors that were singled out as stumbling blocks. The participants were also of the view that because VR is a relative new and emerging ICT tool in education, it will take some time to gather the knowledge and technical skills to effectively incorporate it in History education. To this can be added the systemic challenges in country such as South Africa where infrequent load shedding schedules negatively affects the battery life of the VR-HMDs and a stable internet connection.

It was due to these barriers that some of the participants had more reservations on the application of VR-HMDs in the History classes of schools over tertiary institutions. These participants also pointed out operational and strategic challenges in schools that are aggravated by factors such as insufficient funds to afford VR-HMDs, a poor infrastructure, a negative attitude towards innovative ICT's and History teachers lack of knowledge and skills to effectively incorporate VR-HMDs in their classrooms. The Department of Basic Education's ability to effectively incorporate this contemporary ICT into the South African schooling system was another concern raised by the participants.

Despite these reservations of some of the participants when the incorporation of VR-HMDs comes into question in schools, others believed that there is room for this ICT to be used at tertiary institutions. They argued that it is essential that pre-service teachers in History education should be introduced to this emerging technology during their training. This will empower them to gain the necessary knowledge and skills to effectively incorporate VR technology in their future classes at schools. The participants were further of the opinion that when pre-service History teachers are given the opportunity to regularly experience VR-HMDs in their training, it will add to their professional development that will motivate them to apply this technology in their

classes at schools. In conclusion the participants were motivated to use VR-HMDs within their lessons if they were ever afforded the opportunity in their future teaching practices. They believed it will add to the enjoyment of the learning process and at the same time increase learner concentration.

5.5 QUANTITATIVE DATA

The quantitative data in this study was gathered in the first and fourth intervention phases of the data gathering process where a pre-test VLE and post-test VLE questionnaire were used respectively (sec. 4.7.2.1 and sec. 4.7.2.4). An e-electronic quiz on the *Kahoot* application was also utilised in the second intervention phase of the data collection process to gather more quantitative data (sec. 4.7.2.2). The raw data gathered from the *Kahoot* application and pre- and post-test VLE questionnaires were quantitatively summarised by grouping the different categories of the variables within tables and through percentages and mean scores.

5.5.1 Pre-test VLE questionnaire

The aim of the pre-test VLE questionnaire (ANNEXURE E) was to determine the participants' prior knowledge and ability use ICT's within the SDL mind-set, while the post-test VLE questionnaire (ANNEXURE E) wanted to established how the exposure to VR-HMDs influenced the participants' beliefs and attitudes regarding the relationship between VR, ICT's and the development of SDL skills. The pre-test VLE questionnaire was given to participants to complete after they received preliminary information at the start of the study regarding ICT's and VR-HMDs (ANNEXURE H).

In an attempt to add to the comprehensibility and interpretability of the quantitative data, the tabular representation in Table 5-4 below will incorporate the key questions employed in the data gathering process, accompanied by the participants' self-assigned scores within a range of 1 to 5. Subsequently, these scores will undergo additional analysis and be presented through the calculation of a mean score.

Table 5-4: Pre-test VLE questionnaire quantitative analysis

Key questions	Strongly	Disagree	Neutral	Agree	Strongly	Mean
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	disagree		agree			Score
	(Very weak)	(Weak)	(Adequate)	(Good)	(Great)	
Score	1	2	3	4	5	
1. I understand what is meant by SDL skills.	0	1	0	8	6	4,3
2. I understand what is meant by ICT.	0	0	1	7	7	4,4
3. I understand what is meant by VR, VR-HMD and VLE.	0	1	7	5	2	3,5
4. I am in favour of using ICT's within the teaching and learning of pre-service History teachers.	0	0	1	5	9	4,5
5. I have the ability to question, inquire and problem solve.	0	1	1	9	4	4,1
6. I have the ability to keep an open mind to other points of view.	0	0	1	7	7	4,4
7. I have the ability to scan data and the identification of relevant information.	0	0	3	9	3	4,0

The following paragraphs aim to clarify the above Table 5-4 in an attempt to provide a more detailed explanation of the presented data. The first three key questions in this questionnaire are three concepts that are examined throughout the literature review on a recurring basis. Key question 1 focused on SDL, key question 2 focused on ICT while key question 3 focused on concepts of VR, VR-HMDs and VLEs. Notably, eight participants indicated in question 1 that they had comprehension of what is meant by SDL skills, while an additional six participants strongly affirmed that they understood what was meant by SDL skills, thus indicated that they have, at least, some knowledge of SDL. Similarly to the findings in key question 1, key question 2 revealed through a mean score of 4,3 that the participants were of the belief that they possessed an understanding regarding the conceptualisation of ICT's.

Key question 3 presented the lowest mean value of 3,5. It does, however, require mentioning that although this question showcased the lowest mean score, the score of 3,5 can still be considered as a positive outcome (Pornel & Saldaña, 2013). The score of 3,5 thus showcased that the participants had at least an ample understanding regarding the conceptualising of VR and its accompanying sub-categories of VR-HMDs and VLEs. Moreover, key question 3 shows that the majority of participants (7) had an adequate understanding towards VR and the accompanying concepts mentioned in question 3. While 7 participants stated that they had an adequate understanding of VR an additional 5 participants had a good understanding of VR and its sub-categories.

A reason why question 3 showed the lowest mean response in comparison to the other questions in this questionnaire can possibly be ascribed to VR-HMDs being a relative new ICT for the participants within the teaching and learning environment. Following the lowest mean score of 3,5, key question 4 achieved the highest mean score of 4,5. This achievement of question 4 underscores the favourable disposition shown by participants toward the inclusion of ICT's within the teaching and learning of pre-service History teachers.

Key question 5 presents a subtle shift within the focus of inquiry presented through questions 5 to 7. Whereas key questions 1 through 4 addressed participants' knowledge and perceived abilities regarding their individual understanding of concepts, key questions 5 to 7 moves towards the line of questioning where participants share their

beliefs and attitudes regarding their own SDL abilities. In response to key question 5, 9 participants affirmed that they possess proficient (good) SDL skills in questioning, inquiry, and problem-solving. Key question 6 examined the participants' ability to keep an open mind to other points of view, a skill integral to the study of history as it requires a critical attitude towards the past. Subsequently, this key question yielded the second-highest mean score of 4,4, with 7 participants indicating that they are quite good in the use of this SDL skill with 7 other participants asserting their excellent (great) mastery of the SDL skill to keep an open mind to other points of view. Similar to the previous 6 questions, the final question (question 7) displayed a favourable mean score of 4,0 with a large majority of 9 participants asserting that they had a good grasp of the SDL skill of scanning data and the identification of relevant information.

5.5.2 E-electronic Questionnaire – Kahoot

The online *Kahoot* application was used during the second phase of the data collection process (sec. 4.7.2.2) to assess if the participants retained any subject content after a walkthrough through a virtual NAZI-Holocaust museum. The correct answers for these *Kahoot* questions can be found in sub-section 4.7.2.2.2. Additionally, these questions found on the *Kahoot* application were a combination of *true or false* and *choose the correct answer* type questions. The scores were analysed and presented through the calculation of percentages as illustrated in Table 5-5.

Table 5-5: Kahoot results per participant

Question	Incorrect	Out of Time	Correct
1. Which one of the following statements regarding the Aryan race is true?	6 (P5, P6, P7, P10, P12, P13)	3 (P1, P2, P4)	6 (P3, P8, P9, P11, P14, P15)
2. During which years did the NAZIs send Polish Jews to concentration camps to die?	5 (P4, P5, P9, P14, P15)	1 (P12)	9 (P1, P2, P3, P6, P7, P8, P10,

			P11, P13)
3. In 1935 which set of laws did NAZI-Germany introduce to the German society?	6 (P4, P5, P6, P8, P9, P13)	0	9 (P1, P2, P3, P7, P10, P11, P12, P14, P15)
4. In what year did the Olympic games take place in NAZI-Germany?	9 (P2, P3, P4, P6, P8, P9, P10, P12, P14)		6 (P1, P5, P7, P11, P13, P15)
5. Why was Anti-Semitism at its greatest low in 1936 in NAZI-Germany?	1 (P8)	1 (P11)	13 (P1, P2, P3, P4, P5, P6, P7, P9, P10, P12, P13, P14, P15)
6. Before the commencement of the 1936 Olympic Games in NAZI-Germany you could see NAZI soldiers remove propaganda.	6 (P1, P4, P5, P8, P9, P13)	0	9 (P2, P3, P6, P7, P10, P11, P12, P14, P15)
7. What was the name of the biggest Ghetto in which the Jews lived?	7 (P4, P5, P7, P8, P9, P12, P13)	0	8 (P1, P2, P3, P6, P10, P11, P14, P15)
8. When was the first Ghetto area created in NAZI-Germany?	9 (P3, P4, P5, P7, P9, P11, P12, P13, P14)	0	6 (P1, P2, P6, P8, P10, P15)
9. How many Jews lived in the	4	0	11

Warsaw Ghetto?	(P4, P8, P12, P14)		(P1, P2, P3, P5, P6, P7, P9, P10, P11, P13, P15)
10. Which best describes life in Ghettos?	1 (P7)	0	14 (P1, P2, P3, P4, P5, P6, P8, P9, P10, P11, P12, P13, P14, P15)
11. How many Ghettos were established by NAZI-Germany?	8 (P1, P2, P3, P4, P7, P8, P9, P14)	0	7 (P5, P6, P10, P11, P12, P13, P15)
12. What was the symbol that Jews were forced to wear called?	8 (P2, P3, P4, P5, P7, P9, P12, P14)	0	6 (P1, P6, P8, P10, P13, P15)
13. Anti-Semitism is the prejudice and ill-will aimed at the Jewish population.	1 (P13)	0	14 (P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P14, P15)
14. What was Kristalnacht?	9 (P1, P2, P5, P6, P7, P8, P9, P12, P13)	0	6 (P3, P4, P10, P11, P14, P15)
15. Which NAZI faction made use of the following emblem?	3 (P1, P3, P12)	0	12 (P2, P4, P5, P6, P7, P8, P9, P10, P11, P13, P14,

			P15)
16. Who is this man?	2 (P3, P7)	0	13 (P1, P2, P4, P5, P6, P8, P9, P10, P11, P12, P13, P14, P15)
17. Himmler was not the creator of the Einsatzgruppen.	2 (P4, P6)	0	13 (P1, P2, P3, P5, P7, P8, P9, P10, P11, P12, P13, P14, P15)
18. The 'Final Solution' was the term coined by NAZI officials for the Jewish genocide.	1 (P4)	0	14 (P1, P2, P3, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15)
19. The most notorious concentration camp was Auschwitz due to the murder of ... people at this camp.	6 (P2, P3, P7, P10, P11, P14)	0	9 (P1, P4, P5, P6, P8, P9, P12, P13, P15)
20. Rudolph Hoss, one of the most infamous concentration camp leaders, was hanged at Auschwitz.	2 (P4, P10)	0	13 (P1, P2, P3, P5, P6, P7, P8, P9, P11, P12, P13, P14, P15)
TOTAL: /300	96 (32%)	5 (1,67%)	199 (66,33%)

Table 5-5 provides a clear idea of what subject content participants were able to absorb within the VLE while also indicating what questions participants generally struggled with. Overall, based on observation the table does lean towards a positive learning outcome with questions 5, 10, 13, 15, 16, 17, 18 and 20 leading the way with an overwhelming majority answering these questions correctly. Questions 5 and 13 both dealt with the concept of Anti-Semitism while questions 13, 17, 18 and 20 were true or false in inquiry. Moreover, these questions above (5, 10, 13, 15, 16, 17, 18 and 20) all fell within the parameters of the revised Bloom's taxonomy level of *remembering* (Rifki, 2013).

There were however certain questions that posed somewhat of a problem with the majority of participants answering the following questions incorrectly, e.g. questions 1, 8, 11, and 14. For answers two of these questions asked for the identification of a date (question 8) and a number (question 11). According to Hasan *et al.* (2023) it is not always easy for history students to memorise dates due to the strong emphasis that educators still place on rote learning. By taking these scholars conviction into account and the fact that the virtual experience of the Holocaust Museum asked for a great deal of information to be absorbed, can serve as possible reasons why the majority of participants got the answers of questions 8 and 11 wrong. In the four options for questions 1 and 11 little distinction was made in the answer content to choose from that might serve as a reason why the participants struggled with these two questions.

For questions 2, 3, 4, 6, 7, 9, 12 and 19 the majority of participants answering it correctly while also having a notable amount of participants answering it incorrectly and can thus be considered to be the middle ground between participants' retention of the content knowledge obtained through the use of VR-HMDs and VLEs. These aforementioned questions mostly fell within the parameters of the revised Bloom's taxonomy level of *remembering* as well (Rifki, 2013), which, at its core, was the primary goal of this data gathering intervention as memory (information) retention was tested.

The demonstration of information retention was apparent amongst participants, as each of the 15 participants was required to respond to 20 questions, resulting in the recording of a total of 300 possible answers. The participants recorded 66,33% correct answers

which clearly indicate that participants did show promising signs of memory (information) retention.

5.5.3 Post-test VLE questionnaire

As inferred above, a post-test VLE questionnaire was given to the participants in the fourth phase of the data collection process (sec. 4.7.2.4) to complete. The primary goal of this questionnaire was to determine the participants' attitudes and beliefs whether or not VR-HMDs as an ICT could be a tool to foster and develop SDL skills within History education. Moreover, this questionnaire is to be considered the expected progression from the pre-test VLE questionnaire and provides the study with an additional set of quantitative data. The analysis of the data will be presented through the calculation of a mean score as illustrated in Table 5-6.

Table 5-6: Post-test VLE questionnaire quantitative analysis

Key Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean Score
	(Very weak)	(Weak)	(Adequate)	(Good)	(Great)	
Score	1	2	3	4	5	
1. According to you does the use of ICT's develop SDL skills?				6	9	4,6
2. Could VR-HMDs be considered to be a viable option for teaching and learning of pre-service History			1	4	10	4,6

teachers?						
3. Could the use of VR-HMDs form part of SDL?				8	7	4,5
4. Does VR-HMDs and VLEs effectively convey content knowledge?			1	6	8	4,5
5. Do you believe that VR HMDs had any influence on your SDL skills?			3	6	6	4,2
6. In your opinion do you think that VR-HMDs and VLEs could be used at educational institutions besides tertiary institutions?		1	1	3	10	4,5

Table 5-5 predominantly draws attention to, through the use of mean scores, the participants' favourable attitudes and beliefs regarding the incorporation of VR-HMDs as a possible sub-set to ICT's within the framework of SDL towards History education. Key questions 1 and 2 shares the highest mean score of 4,6 indicating a noticeable disposition among the participants as pre-service History teachers to integrate ICT's, including VR-HMDs, for the development of SDL skills. Moreover, key question 2 (in accordance with the results produced by the qualitative data) specifically emphasises a strong desire by majority of participants (10) to include VR-HMDs within the teaching and learning of pre-service History teachers. Various benefits were pointed out by the participants in the qualitative data why they thought VR-HMDs should be incorporated in the pedagogy of History teaching and learning. These benefits included being an interactive platform where the visualisation of historic events has the ability to transport students out of the classroom and into VLEs that simulates time periods and places that they would normally not have access to. Also the feeling of being present in reality

where the past can be re-lived in an immersive virtual environment that assisted in the recalling of historical content and a deeper understanding of the events.

Furthermore, key question 3 with a mean score of 4,5, validates the participants' belief that VR-HMDs should be categorised as a subset of ICT's, and that the use of ICT's should form part of SDL process. These findings from key questions 1 to 3 thus collectively suggest that participants not only recognise the connection between VR-HMDs, ICT's and SDL, but also acknowledge the importance thereof for History education. This acknowledgment by the participants as pre-service History teachers have to be considered as particularly significant for the study of History. This is due to the fact that History as an academic discipline is often overlooked within discourse regarding the subject's need for ICT's within an educational context, but that it still finds itself in an ever-evolving educational and societal landscape that places emphasis on the inclusion of technology (Hasan *et al.*, 2023).

These beliefs and attitudes shared by participants within questions 1 to 3 are further enforced by the responses of participants in questions 4 to 6. Key question 4 emphasises with a mean score of 4,5 an encouraging belief by participants that the use of VR-HMDs and VLEs have the ability to effectively convey content knowledge. Not only were the participants of this aforementioned belief, but they were also of the opinion (question 5) through a mean score of 4,2 that their exposure to VR-HMDs and VLEs did influence their SDL skills positively. This opinion by participants can be considered a promising sign for the inclusion of VR-HMDs within History education. In conclusion key question 6 further shows that a majority of participants (10) were of the belief that VR-HMDs and VLEs could be used at educational institutions besides tertiary institutions. Despite certain challenges mentioned by the participants in the results of qualitative data, some were of the opinion that VR-HMDs and VLEs can, for example, be introduced in schools.

5.6 SUMMARY OF THE QUANTITATIVE DATA

The following section will provide a concise overview of the results of the quantitative data, derived from both the pre-and post-test VLE questionnaires, along with participants' results recorded through the *Kahoot* application.

The data gathered by the pre-test VLE questionnaire emphasised a positive trend in support of the qualitative data. With mean scores averaging above 4, out of a possible 5 (except one mean score of 3,5) participants confirmed their knowledge and understanding of SDL skills, ICT's and VR-HMDs. Furthermore, this questionnaire indicated participants' desire to include ICT's within the teaching and learning of pre-service History teachers. Moreover, this data gathering instrument highlighted participants' beliefs on their ability regarding their SDL skills, e.g. to question, to inquire, to problem solve, to keep an open-mind to other points of view, scanning data and the identification of relevant information.

When looking at the *Kahoot* results promising signs did emerge. With 199 questions out of a possible 300 (66,33%) questions answered correctly a clear sign of memory (information) retention was showcased after the participants' exposure to the Holocaust Museum found within the VLE and accessed through VR-HMDs. This finding is supported by the results of qualitative data of this study.

The post-test VLE questionnaire is a thematic continuation of what was briefly touched upon during the pre-test VLE questionnaire. When looking at specific questions used to construct an understanding of the quantitative data such as question 2: *"Could VR-HMDs be considered to be a viable option for teaching and learning of pre-service History teachers?"* and question 4: *"Does VR-HMDs and VLEs effectively convey content knowledge?"* we find a direct association not only between the qualitative and quantitative data gathered from participants, but also with information found within the literature review of this study (Chapters 2 and 3). With special mention to question 2 from the post-test VLE questionnaire as example, it can be seen that not a single participant is in opposition to the idea that VR-HMDs are viable to the teaching and learning of pre-service History teachers. This collective opinion from the participants is further supported by the opinions expressed by Van Boxtel and Van Drie (2018).

The participants further indicated in this questionnaire (and supported by the qualitative data) that VR-HMDs is a viable ICT tool to promote and develop their SDL skills that include those previously mentioned in the pre-VLE test questionnaire. This encouraging development found within the data, and which is inferred upon in Chapter 2 can be considered crucial for future educational development (Mumcu, 2017; Bagheri, Ali,

Abdullah & Daud, 2013). The promising signs showcased by the analysis of the quantitative data support the idea that the use of ICT's and by extension due to the nature of this study, VR-HMDs, aligns with the dimensions of the TPACK framework while also remaining true to the teaching and learning process by affording students the leniency to build their knowledge through SDL.

5.7 CONCLUSION

In this chapter the data collected was analysed and interpreted. At first an overview was given on the method that was followed in the organisation, analysing and interpretation of the qualitative and quantitative data respectively. This was done in the first place by following a thematic approach in the analysis and interpretation of the qualitative data collected from the data collection instruments (open-ended questionnaire, worksheets, interviews and field notes) during the different intervention phases of the data collection process. In an attempt to consolidate this rich qualitative data a summary was made of the main results. In support of the qualitative data the analysis and interpretation of the quantitative data followed where the pre-VLE test questionnaire, the *Kahoot* application and the post-test VLE questionnaire were used to gather data. By means of the method of descriptive statistics the quantitative data was analyzed, after which, as with the qualitative data, a summary of the main results followed.

In Chapter 6 a summary of the study is given and the findings and recommendations are made in an attempt to clearly represent the purpose of this study.

CHAPTER 6

SUMMARY, FINDINGS AND RECOMMENDATIONS

6.1 INTRODUCTION

In the previous chapter (Chapter 5) the data collected during the study was analysed and interpreted. This chapter first deals with a summary of the study (sec. 6.2), after which will follow the findings that were made in terms of the research questions that were posed (sec. 6.3). Hereafter, recommendations are made arising from the findings of this study (sec. 6.4). In succession the limitations of the study are discussed (sec. 6.5) and suggestions for further studies are made (sec. 6.7). The chapter closes with a concluding observation (sec. 6.7).

6.2 SUMMARY OF THE STUDY

The purpose of this section is to provide an overview of the study as it unfolded in the various chapters.

Chapter 1 established the framework that guided the study in its entirety and serves as an overview of what is to be expected. Commencing with an introduction and orientation (sec. 1.1), this chapter provided a comprehensive background for the research. Furthermore, the problem statement and rationale (sec. 1.2) identified gaps in existing research, emphasising the imperative nature of the study. Following the aforementioned sections, the primary research question and secondary research questions (sec. 1.3), along with the research objectives (sec. 1.4) were delineated. The subsequent sections delved into the research design, methodology and method of data collection and analysis (sec. 1.5). Moreover, the researcher explained the measures put in place to ensure ethical considerations of the study (sec. 1.6 and sec. 1.7). Finally, the chapter affirmed the contribution of the study (sec. 1.8), after which a chapter outline for the remainder of the study (sec. 1.9.) and conclusion (sec. 1.10) was provided.

By means of a literature review and to establish a solid conceptual and theoretical framework for the study Chapter 2 examined the related aspects of ICT and SDL within the confines of the modern History teaching and learning environment of the 21st -

century. To provide a comprehensive exploration of these themes, the chapter started with a concise introduction (sec. 2.1) to the utilisation of ICT's and SDL within the context of History education. Succeeding the introduction, Chapter 2 further examined the relationship between 21st-Century Skills, the P21 Framework, the 4IR (sec. 2.2), and SDL (sec. 2.3). Having addressed the P21 Framework, the 4IR, ICT's, and SDL, Chapter 2 shifted to an analysis of the expectations and challenges encountered by South African schools in their attempts to incorporate ICT's. This examination (sec. 2.4) seamlessly led to an in-depth look of the practical application of ICT's within the teaching and learning of History as an academic discipline, while an evaluation of the potential benefits (sec. 2.5) relating to the incorporation was also presented. Moreover, for reflective analysis of the advantages of utilising ICT's in History education the focus was shifted to the integration of ICT's in the training of pre-service History teachers at tertiary educational institutions (sec. 2.6). A conclusion to Chapter 2 (sec. 2.7) brought the chapter to an end.

Chapter 3 provided a review of the scholarly literature in relation to VR-HMDs as an ICT instructional tool not only in education in general but also in History education in the specific that further adds to the theoretical and conceptual framework of this study. Followed by the introduction to the chapter (sec. 3.1) the chapter commenced by clarifying and defining the concept of VR (sec. 3.2.). Successively, this chapter delved into an investigation of VR-HMDs and their historical development that aligned to the ever evolving technological society. Chapter 3 also devoted large sections to the establishment of the advantages (sec. 3.3.) and potential limitations (sec. 3.4) regarding the incorporation of VR-HMDs within an educational setting. Hereafter the chapter moved its effort to a global overview of how VR-HMDs (sec. 3.5) have been utilised as a pedagogical tool in education to be followed by an examination of the specific ways in which VR and VR-HMDs have been and could potentially be employed in the teaching and learning of History (sec. 3.6). A conclusion (sec. 3.7) announced the end of the chapter.

Following the introduction (sec. 4.1), Chapter 4 revisited both the primary and secondary research questions (sec. 4.2) as these questions provided the foundational framework for the study's aims and objectives (sec. 4.3). After examining these guiding principles as outlined within the questions, aims and objectives, Chapter 4 explored the

research paradigm (sec. 4.4), which specifically focused on the constructivist-interpretivist paradigm, while further exploring the ontological, epistemological, and methodological beliefs found within the study. Moreover, Chapter 4 outlined the qualitative research design employed in the study (sec. 4.5), clarifying the relationship between qualitative and quantitative data and how the latter supports the former. Additionally, Chapter 4 examined the application of the case study as the chosen method of analysis (sec. 4.6) to be followed by a comprehensive discussion of the population, the sample taken and the use of the data collection instruments such as questionnaires, paper-based and electronic worksheets, semi-structured focus-group interviews and field notes (sec. 4.7). A detailed depiction of the five-phase data collection process was also presented in this chapter, which featured figures that illustrated the various scenes participants experienced within VLEs through the use of VR-HMDs. Subsequent to the aforementioned, an overview of the data analysis approach was provided (sec. 4.8). Lastly, this chapter focused on ethical considerations surrounding the study (sec. 4.9.), the research quality (sec. 4.10) and the role of the researcher (sec. 4.11) and came to an end with a conclusion (sec. 4.12).

Chapter 5 started off with an introduction (sec. 5.1) to the chapter where after emphasis was placed on the way in which the data was analysed and interpreted. In (sec. 5.2) the method employed to organise, analyse, and interpret both the qualitative and quantitative data were specifically outlined. First in line was the thematic and inductive analysis and interpretation of the qualitative data that was obtained from the various data collection instruments across the different intervention phases (sec. 5.3). This was followed by a summary of the results of the analysed qualitative data (sec. 5.4) that was gathered and generated from the open-ended questionnaire, paper-based worksheet, focus group interviews and field notes. To follow was the analysis and interpretation of quantitative data, utilising the pre-test VLE questionnaire, the *Kahoot* application, and the post-test VLE questionnaire for data collection (sec. 5.5). Descriptive statistical methods (mean scores and percentages) were employed for the analysis of the quantitative data after which a summary of the quantitative data was presented (sec. 5.6). A conclusion (sec. 5.7) announced the end of Chapter 5.

6.3 GENERAL FINDINGS OF THE STUDY

The findings of the study will be answered on the basis of first the secondary research questions and then the primary research question. The findings of this study are based on the information gained from the research in the literature overview of Chapters 2 and 3 as well as the empirical data that was analysed and interpreted in Chapter 5.

6.3.1 Answering the first secondary research question

The first secondary question asked for this research study was:

How can VR-HMDs as instruction technologies effectively be integrated into the teacher training of pre-service History teachers?

Addressing this examination regarding the manner in which VR-HMDs can be effectively integrated into the pre-service History teacher training a nuanced study of not only the desire, but also the disposition of pre-service History teachers required assessment. While the majority of the participants expressed a positive desire and disposition towards the use of innovative technology such as VR-HMDs in pre-service history teacher training (sec. 5.3.1.2.1) it would still be - as suggested by Fan and Tan (2019), - a gross generalisation to assume that their experience with this ICT during the duration of this study will spontaneously allow them to incorporate it effectively.

A primary issue regarding the effective incorporation is in the first place institutionally embedded. It is these imbedded problems when looked at through the lens of this study that the following requirements have been determined in order to effectively incorporate VR-HMDs into the training of pre-service History teachers:

- Accessibility

A primary requirement for the effective incorporation of VR-HMDs into pre-service History teacher training is the increase of accessibility that can only take place when higher education institutions invest in this technology. However, higher education institutions are not always particularly enthusiastic to invest as there is a prevailing idea in regards to ICT's that more should be done with less (Wyat, 2023). Thus, it can be argued that it is essential that pre-service teachers in History education should have access to this emerging technology. The majority of participants in this study

underscored this argument as they believed access to VR-HMDs will empower them to gain the necessary knowledge and skills to effectively incorporate this technology in their future classes at schools (compare sec. 5.4). This access provided to pre-service History teachers by higher education institutions will provide enhanced teaching and learning experiences while also adding to their professional development (sec. 5.3.3.4.1) that in turn will prepare them for the digital age. Additionally, irrespective of background, this accessibility affords every pre-service History teacher an equal opportunity to engage with historical content and knowledge through activities like virtual excursions. VR-HMDs will allow pre-service history teachers to discover and develop new teaching methods and affording them the opportunity to experiment with different VR hardware and software. This ongoing professional development through the accessibility of VR-HMDs can equip pre-service History teachers better to meet the demands of their students and adapt to the evolving educational environment created by the 4IR (compare sec. 2.4).

- Institutional policy

A primary obstacle to the effective incorporation of VR-HMDs into the teaching of pre-service History teachers is embedded within higher education institutions and how they are constructed policy wise. Institutional policies are considered a crucial aspect in the manner which e-learning is adopted at higher institutions (Czerniewicz & Brown, 2009). Thus, it is crucial to accentuate that institutional and educational policies continuously require revision and adaption. While the use of VR-HMDs could be considered beneficial it does not guarantee success on its own but in order to adapt institutional policy to include VR-HMDs as an ICT teaching and learning tool the following needs to be done (Shwedeh, 2024):

- Existing policies relating to the integration of ICT's, e.g. VR-HMDs, teacher training, and curriculum development need to be reviewed. This process of revision includes but is no limited to the examining of guidelines, standards and regulations as set forth by educational authorities at national level.
- Necessities and goals regarding the incorporation of VR-HMDs need to be identified. Higher education institutions need to consider and determine the how and why surrounding the incorporation of VR technologies, e.g. VR-HMDs and

VLEs. This is necessary in order to effectively align VR-HMDs with educational objectives in order to facilitate the development of pre-service History teachers through possibly enhanced teaching and learning experiences.

- A framework specifically aimed to incorporate VR-HMDs has to be created as simply creating a blanket policy to include all possible ICT's. This specifically aimed outlined framework could then include guidelines for curriculum development and design, VR-HMD implementation and teaching and assessment practices. Moreover, these frameworks should unambiguously communicate the expectations, responsibilities and procedures before and after VR-HMDs are in use. After policy makers and pre-service History educators can concur on where VR-HMDs can be used within the curriculum, alignment needs to take place between the subject content (key topics of historical events), pedagogical knowledge and use of ICT's.
- Technical and knowledge support

It can be expected that a modern technology such as VR-HMDs can experience opposition, and especially so by those who have not been properly trained on how to use it effectively within their teaching and learning pedagogy (Lee *et al.*, 2016). For this reason technical and knowledge support are important considerations to ensure the effective incorporation of VR-HMDs into pre-service History teacher training. The importance of support were confirmed by some of the participants of this study who viewed their experiences with the incorporation of ICT's as negative due to mostly technical challenges that they encountered (sec. 5.3.1.2.2). The participants were further of the opinion that VR-HMDs are a fairly new and emerging ICT teaching and learning tool, and for this reason it will take some time to gather the necessary knowledge and technical skills to effectively incorporate it in History education (compare sec. 5.4). This attitude of the participants should be seen as an important deliberation for the effective incorporation of VR-HMDs in their training as pre-service History teachers.

The facet of technical and knowledge support however, goes beyond just accessibility and includes the purchasing of both VR hardware and software, training for faculty members (educators) and students on how to use VR-HMDs effectively. Higher

education institutions could collaborate with all possible stakeholders (faculty members, educators, ICT specialists, students and policymakers) in an attempt to ensure that policy documents and resources are comprehensive and reflective of the best practices for educational stakeholders of the 4IR. The collaboration between stakeholders could possibly involve lobbying feedback, the hosting of workshops that could in turn create a teaching and learning environment that places emphasis on innovation.

- Educator and student motivation

A seamless integration of VR-HMDs into pre-service teacher training relies heavily on genuine desire and receptivity from both history educators and their students. Without these essential prerequisites, any technological incorporation will face challenges in realising its projected objectives. The motivation of educators to incorporate VR-HMDs is crucial as the utilisation of this technology could potentially add to their teaching experience and their skills to transfer knowledge. Moreover, educators who show signs of being enthusiastic regarding incorporating VR-HMDs into pre-service History teacher training will serve as possible role models and sources of inspiration for future teaching. The importance of the educator as a role model is emphasised by Tiba and Condy (2021) who reported that one of the obstacles that pre-service teachers encounter is the lack of consistent and effective modelling by their educators on how to teach by integrating different technologies. The enthusiasm of these educators can in turn further spark student curiosity among pre-service History teachers, motivating them to explore the potential of VR-HMDs while incorporating VR-HMDs into their future teaching practices. Throughout the teaching and learning process educators can assist pre-service History teachers in building their ICT confidence by developing their ability to incorporate VR-HMDs. Reasons for pre-service History educators not to incorporate VR-HMDs can be contributed to various contextual factors, including but not limited to upbringing and their educational qualifications regarding their proficiency with ICT's (compare sec. 2.5).

As in the case with the educators, education students also need to show a desire and receptivity to incorporate new ICT's into their training as pre-service History teachers. Prospective teacher's attitudes in the use of ICT are the strongest prognosticator for the incorporation and success in which it will be implemented (Sindhwani, 2021). The pre-

service History teachers in this study showed an overwhelming keenness to use different and additional ICT's as instruction technologies (sec. 5.3.1.4). They believed that the incorporation of VR-HMDs was necessary as it will enhance the teaching and learning of History in different ways (sec. 5.3.2.1). For this reason, and after succeeding interventions where a more thorough understanding of the concepts surrounding VR-HMDs were gained, the participants was of the belief that it is essential for VR-HMDs to be incorporated in their training (secs. 5.3.3.2.5 and 5.5.3). Thus the manner in which pre-service History teachers perceived the potential benefits of technology serves as an important requirement and indicator for the effective incorporation of an ICT such as VR- HMDs into their training (Pozas & Letzel, 2023; Gyamfi, 2017).

By carefully considering the requirements above in order to effectively incorporate VR-HMDs into the training of pre-service History teachers, emphasise the importance of, History education students, educators and policy makers to continue advocating for institutional support in terms of funding, infrastructure, and professional development that will provides pre-service teachers' with opportunities to familiarise themselves with VR-HMDs during their training.

6.3.2 Answering the second secondary research question

The second secondary question asked for this research study was:

What are the primary advantages when VR-HMDs are integrated with the teaching and learning of pre-service History teachers?

The research data indicates that incorporating VR-HMDs in the teaching and learning of pre-service History teachers will create an immersive, engaging, and personalised learning experience. Additionally, it fosters an enhanced understanding of historical subject content and prepares students for the societal and educational challenges of the 21st-century. The following primary advantages emerged from the data:

- Immersive learning experiences

Following the participants' exposure to VR-HMDs and VLEs, the majority responded favourably, going as far as describing the VR experience as enjoyable, informative and beneficial while providing improved learning opportunities, as they felt more immersed

in the learning process. These immersive learning experiences afforded the participants learning experiences in which participants had an increased feeling of autonomy over the teaching and learning process (sec. 5.4).

- Student motivation

VR-HMDs afforded the pre-service history teachers a transformative learning experience where the success of VR-HMDs is further determined by the heightened participant engagement. Due to the fact that the use of VR-HMDs were responsible for more immersive and interactive experiences, it captured the participants' attention and motivation to participate. The participants indicated that their exposure to the VR-HMDs led to a feeling of greater involvement in the learning process as it enabled them to draw connections between pedagogical content knowledge, developed their skills and fostered their intrinsic motivation. By incorporating various senses, immersive experiences and personal learning paths, VR-HMDs allow pre-service History teachers to enjoy the learning process which could motivate them to become life-long learners (secs. 5.3.3.1.3 and 5.3.4.2).

- Multi-sensory learning

In order to appeal to students' desire to learn and thus increase their motivation VR-HMDs also offer a multi-sensory learning experience that incorporates visual, auditory, and sometimes perceptible stimuli. The uses of VR-HMDs created immersive experiences that border the realm of reality due to the fact that VR-HMDs are multi-sensory in nature. The use of VR-HMDs as a multisensory approach to the teaching and learning process of History pre-service teachers further enhances memory retention and the overall learning experience as articulated by participants (sec. 5.5.2. and 5.3.2.1.1). These multisensory experiences as a result, fostered SDL (sec. 6.3.4).

- Personalised learning paths

Through experiencing historical learning materials intuitively from a "first-person" perspective, the participants of this study were motivated and interested to actively take part in their learning experiences within the VLEs. These VLE learning experiences supported active and personalised learning, where historical information and memory was constructed in a self-regulated manner (secs. 5.3.3.1.3 and 5.3.4.3). Moreover, with

these learning experiences allowing for multisensory teaching and learning it afforded personalised VR learning experiences which in turn allowed student participants to explore the vastness of History at a pace that is comfortable to them. Thus, this personalised path of learning permits students to interact with the historical virtual environments that are of interest to them. Adding to the personalised experience that students are afforded, VR-HMDs transcend geographical and time barriers by allowing them to virtually visit these places of historical interest (sec. 5.3.3.2.1). The fact that participants could now experience the feeling of being present in the virtual environment through the first person created the opportunity to learn in a constructive way by navigating, exploring, and inspect objects in the virtual environment (secs. 5.3.3.1.3 and 5.3.4.3).

- Simulation of historical events that creates the reality of being present

VR-HMDs afford its user a level of immersion that traditional teaching methods such as the chalk and talk cannot. By critically examining and deconstructing the historical narratives found within the VLEs, the participants were able to extract a deeper understanding from the historical events they were exposed to. Participants enhanced their understanding of History by being present within History. Moreover, the ability of VR-HMDs to transcend the barriers set out by time and geography are further enforced by the realistic simulation of historical events by affording students' first-hand experiences (secs. 5.3.3.1.2 and 5.5.3).

- Grounded in the constructivist learning theory

The integration of VR-HMDs into the teaching and learning processes of pre-service History teachers can be considered to be grounded in the constructivist learning theory, which emphasises and advocates for the active construction of knowledge through hands-on learning experiences. Furthermore, VR-HMDs carry with them the ability to seamlessly be incorporated within pedagogical approaches, such as, for example problem- and inquiry-based learning. VR-HMDs as an instructional tool provide immersive and interactive environments where pre-service History teachers actively explore and interact with historical events and artefacts. Instead of passively receiving and transforming information from textbooks or educators, they can actively navigate virtual historical sites, participate in simulations, and manipulate virtual objects, fostering

a deeper learning experience and understanding (sec. 5.3.1.4.1). Constructivist learning theory further emphasises the significance of providing students with authentic and real-world experiences that are relevant to their educational and personal interests and goals (Adom, Ankrah & Yeboah, 2016).

- Adaptation to diverse learning styles

VR-HMDs also allows the use of various learning styles in an attempt to cater to visual, auditory, kinesthetic, reading/writing and multimodal students, which accentuates the flexibility of VR-HMDs (compare secs. 2.6 and 5.3.3.2.1). This flexibility links to what has been mentioned above regarding the personalised learning paths as well. Moreover, this flexibility of VR-HMDs affords educators the opportunity to tailor their teaching approaches to meet the diverse needs of their students. When mentioning visual learners, VR-HMDs can offer vivid and vibrant visual experiences, which enables exploration of historical events, places and artefacts. Furthermore, auditory learners can benefit from narration and sound effects that provide historical accounts and dialogue within virtual environments that improve the immersiveness of VLEs. Kinesthetic learners in turn can physically be engaged by interacting with virtual objects and simulations that require movement. For learners more inclined to reading/writing, textual elements like historical documents and annotations can be integrated into VR environments. VR-HMDs as a teaching and learning tool thus offer the benefit of multisensory-multimodal learning which appeals to diverse preferences in learning styles to diverse students.

- Preparation for technologically advancing world

Not only is the inclusion of VR-HMDs as an ICT teaching and learning tool beneficial to the History teaching and learning process, but also prepares pre-service History teachers for the 21st century's technological development. This exposure that pre-service History teachers experience could potentially assist them in preparing their future learners for the societal and technological requirements of the modern society. Familiarity with emerging ICT's further prepares teachers to incorporate innovative pedagogical tools into their teaching repertoire.

- Support memory retention and of development of critical thinking skills

Participants' active involvement within the VLEs triggered cognitive processes which lead to enhanced memory retention recall and developed the skills to draw connections between historical events. This ability to draw connections between events when prior knowledge content that has already been stored in the memory is being recalled directly links back to critical thinking skills being developed. As participants attempted to connect historical moments/events, they applied multiple skills such as organising, interpreting, and assessing information in their attempts to decipher meaning from historical content (secs. 5.3.2.5.3 and 5.3.3.3.2). The development of these critical skills is in accordance with the suggestions of the P21 Framework (sec. 2.2.1) that also aligns with the TPACK (sec. 2.3.1).

- A deeper level of understanding of historical events

The participants articulated that their exposure to VR-HMDs improved their understanding of historical events. The majority of the participants were in agreement that their exposure to VR-HMDs provided the historical events found within the VLEs with a sense of realism “to live in the moment” which in turn provided an enriched and deeper understanding of historical events (secs. 5.3.2.1.2 and 5.3.2.5.3).

- Enhance feelings of empathy

The sense of realism found within the historical VLEs through the use of VR-HMDs by participants correspondingly impacted positively on the participants' emotional intelligence. A great number of the participants indicated that the visual stimuli experienced evoked feelings of empathy (sec. 5.3.2.3.2).

- The development of historical consciousness

Though limited, the empathetic responses from some of the participants further contributed to their development of historical consciousness in “lessons” that were learned from the past. These participants were able to facilitate and development meaningful connections between the past, present, and future, and by doing so, insight was shown in the manner how the past has influenced the present which in turn will affects how the future will be seen. Moreover, for a historical consciousness to developed, involves skills such as to think critically about the past and assessing and

interpreting information where judgements about the actions of others are made. It is this realisation by the participants, and as earlier referred to which is indicative of a deeper learning and understanding of the historical content (sec. 5.3.2.3.3).

- An enjoyable learning experience

After their exposure to VR-HMDs and VLEs the majority of the participants reacted in a positive manner describing their experience as enjoyable, exiting that made the learning experience more interesting. These participants believed that VR-HMDs and VLEs enhanced their learning as they felt a greater involvement in the learning process. Moreover, the participants were of the opinion that the experience with VR-HMDs added to a better understanding of the historical content. (secs. 5.3.2.5.1, 5.3.3.1.1 and 5.3.4.3).

6.3.3 Answering the third secondary research question

The third secondary question asked for this research study was:

What are the challenges when VR-HMDs are integrated with teaching and learning of pre-service History teachers?

Integrating VR-HMDs into the teaching and learning experiences of pre-service History teachers may offer numerous benefits, but it is not without its own set of challenges. From the data collected from the literature review in Chapters 2 and 3 and the empirical data in Chapter 5 the following challenges / limitations emerged:

- Cost and affordability

First and foremost, it requires mentioning that while financial implications such as cost and affordability always require consideration it must said that there can be no cost attached to effective education and the innovation thereof. Some of the participants in this study were also well aware of the financial challenges surrounding VR technology (secs. 5.3.3.2.2 and 5.4). With VR-HMDs nowadays more affordable (sec. 3.2.2) the first investment in VR hardware and software such as VR-HMDs, computers with sufficient processing power, and VR content can still be substantially large. Additional ongoing expenses such as maintenance, upgrades, and licensing fees for VR

applications is another factor that must be taken into account in the VR-HMDs budget. For institutions with limited budgets these costs could become prohibitive as they realistically are to be considered a barrier for smaller institutions.

- Technical issues

Technical issues can present noteworthy barriers to the incorporation of VR-HMDs into pre-service history teacher training. These issues may include but are not limited to: hardware malfunctions; software glitches; compatibility issues between different devices and difficulties in set-up and calibration (Graeske & Sjöberg, 2021). Additionally, and as confirmed by a few of the participants VR hardware and software often require high-performance computing systems and reliable internet connections, both of which could be a substantial problem within South Africa due socio-economic issues such as load shedding (sec. 5.3.1.2.2).

Additionally, the complexity of VR hardware and software could possibly require specialised technical expertise and maintenance, which can pose challenges for educators and IT support staff who may not be comfortable using VR-HMDs. These technical issues could potentially disrupt classroom activities, thus diminishing the effectiveness of VR-based lessons. These issues could potentially deter educators from fully embracing VR-HMDs as teaching tools. Moreover, ensuring that all students and educators have equal access to VR hardware and software may be challenging which could potentially create disparities in the teaching and learning experiences (compare secs. 5.3.3.2.2 and 5.3.3.2.5).

- Content development

While VR-HMDs have immense potential for creating immersive and engaging learning experiences, there is a lack in availability of high-quality historical content tailored to educational objectives. Developing VR content with educational value requires expertise in both history and virtual reality design, two skills that may not necessarily be present among educators and content creators. Moreover, the process of creating historically accurate VLEs can be time-consuming. Thus, pre-service history teachers could potentially struggle to find suitable VR content that aligns with their curriculum and educational goals (Jaya, Sunaryathi, Suhaeb & Ponta, 2022). Without access to a

diverse range of Historical VR content, VR-HMDs might not reach its full potential within educational settings.

- Health concerns

Prioritising health and safety is vital when considering the incorporation of VR-HMDs. The prolonged use of VR-HMDs could result in discomfort, including motion sickness, eye strain, or headaches (sec.3.4). Individual participants in this study experienced trouble with eye strain and anxiety due to motion sickness. To address these issues, incorporating breaks during the use of multisensory technology is highly recommended. Renganayagalu *et al.* (2021) and Mon-Williams (2017) emphasises this concern, highlighting the potential challenges arising from the perceived disparity between what the user's brain observes and what they truly see as reality.

6.3.4 Answering the fourth secondary research question

The fourth secondary question asked for this research study was:

When incorporating VR-HMDs what will the influence thereof be on pre-service History teachers' various domains of SDL abilities?

The influence of VR-HMDs had a positive effect on the promotion and development of certain SDL skills. Through a mean score of 4,2 most of the participants' belief was proven to be true that VR-HMDs had an influence on their SDL skills (sec. 5.5.3). This study showed that the SDL skills that were developed and promoted after being exposed to VR-HMDs were: the setting of goals (that will eventually have a roll over effect into the application of their future teaching strategies), the selective monitoring of performance for signs of progress being made, critical thinking (the skills to question, inquire, analyse and to debate) and to keep an open mind to scan and collect new and relevant information in order to make meaning of it. By monitoring their progress the participants were reflective on their progress and in this way regulating their own learning by taking responsibility for it (sec. 5.3.3.3).

Another SDL skill that was alluded to within participant responses pertained to the retrieval of information. With a recorded score showcasing 66% correct answers it is clear to see that memory (information) retention is a SDL skill that was promoted

through the use of VR-HMDs (sec. 5.5.2). Long term memory retention of what they have been learnt is characteristic of SDL learners where they can demonstrate the ability to apply the knowledge when doing problem-solving (Mahlaba, 2020). The feeling of being present in the historical moment through the use of VR-HMDs catered for individual and active experiential learning. This allowed the participants to feel more engaged in the teaching and learning process that served as a reason why they reported that using the VR-HMDs was more fun and interesting that increased their motivation for learning (sec. 5.3.3.1.3). By its own standing motivation is considered to be a strong driving force behind SDL (Du Toit-Brits & Van Zyl, 2017).

6.3.5 Answering the primary research question

The primary research question asked for this research study was:

What is the viability of VR-HMDs when incorporating it into the teaching and learning of pre-service History teachers?

During the course of the literature review in addition to the data collection and analysis of the empirical data this study established a want for modernity within the teaching and learning process of History education. It is based on this assertion that the researcher conducted this inquiry into the viability of Virtual Reality HMDs in the teaching and learning of pre-service History teachers. The researcher is of the belief that the advantages of VR-HMDs outweigh its limitations and obstacles (see sections 6.3.2 and 6.3.3 respectively) by far and is therefore viable and should be included into the pre-service History teacher's pedagogical and methodological repertoire. In fact, with a mean score of 4,5 the majority of the participants in this study expressed a keenness to be introduced to VR-HMDs at a tertiary institution like the one they are affiliated to (sec. 5.5.3). Some of the participants felt that they would generally be more motivated for the teaching and learning process when given the opportunity to regularly experience VR-HMDs. Moreover, the participants believed that exposure to VR-HMDs will not only benefit the teaching and learning process in general, but will at the same time contribute to their own professional development. Regular exposure to VR-HMDs was considered important as it will motivate and empower them to gain the necessary knowledge and skills to effectively incorporate VR technology in their future history classes as in-service History teachers (sec. 5.3.3.4.1).

Additionally, when looking at Chapters 2 & 3 it can be stated that there has been a push to develop VR, VR-HMDs and VR-software for educational purposes across multiple academic subjects such as History and Social Sciences. This push to develop these forms of VR technology is indicative of social changes where society at large has started to place more value on ICT driven teaching methodologies in the 21st century. While this push to incorporate VR-HMDs within society at large and more specifically within education has yielded positive results, it was obvious to notice that there are still limitations to the incorporation of VR-HMDs as discussed in section 6.3.3. These obstacles should however not deter South African tertiary institutions with adequate funds and facilities to incorporate VR-HMDs in the teaching and learning of pre-service History teachers.

6.4 RECOMMENDATIONS

While this study showed that VR-HMDs are viable to the teaching and learning process of pre-service History teachers, it is not without recommendations. The following recommendations can be made arising from the findings of the study:

- Collaboration between all academic stakeholders (policy makers, researchers, pre-service History teachers, and History education lecturers) should be a priority in order to effectively incorporate VR-HMDs into the method of History education. Keeping in mind that collaboration between all academic stakeholders should be a priority the researcher advocates for the creation of workshops/training courses where pre- and in-service History teachers can also be exposed to skills training to ensure that VR-HMDs will be incorporated in a meaningful way when lessons are designed. These workshops/training courses can either be run by the Department of Basic Education, Department of Higher Education and even tertiary institutions with research practices in mind.
- Educator cluster groups which will create platforms where they can share VR-content and ideas surrounding the teaching and learning methods in which VR-HMDs are used.
- More historical VR content has to be made accessible in order to fully fulfill the potential of this VR-HMDs. In continuation of this recommendation the researcher puts it forward that institutions should provide both pre-service History teachers and

content creators with the opportunity to collaborate across academic fields and create more History-based VR content.

- For their practical component pre-service History teachers are to be placed at schools that have VR-HMDs within their science and technology centres as this will afford them the opportunity to develop their teaching and learning skills in this technology.
- The Department of Basic Education should assist all high schools in their attempts to expose learners, especially those in underprivileged areas, to ICT's such as VR-HMDs. The researcher is of this opinion as he believes this exposure could potentially benefit these learners when they eventually reach tertiary institutions.

6.5 LIMITATIONS

The following limitations were experienced during the course of the study:

- One of the most difficult obstacles to overcome was the acquisition of VR-HMDs and VR-software that would be of benefit to the study. If this study was to be successful the most basic form of low-end VR would not have been sufficient and therefore, ClassVR was approached to provide the HMD and software. By using these resources provided by ClassVR the study was able to make use of VR-HMDs and VR-software that afforded the study a data collection process that was more interactive than what a low-end VR-HMD could provide.
- Another limitation that arose as the study progressed was the mounting cost of the VR-HMDs required for the study. Not only was the cost for the HMD problematic but there were costs involved for the software being used as well. ClassVR assisted with this financial obstacle as well by borrowing a VR-HMD to the researcher while also providing access to the software required to conduct this study. ClassVR also provided alternative options to get access to multiple VR-HMDs, but those costs would have been unsurmountable for the researcher to cover.
- Additionally, the researcher made use of 15 participants from one year group from one university which could be considered a limitation to some as it may potentially not cover the wider perceptions of pre-service History teachers. This

limitation should however not be seen as detrimental as it now provides opportunities for future wider studies to take place.

6.6 SUGGESTIONS FOR FURTHER RESEARCH

While the researcher is of the opinion that this study succeeded in its goal to determine the viability of VR-HMDs within the teaching and learning of pre-service History teachers there are still other avenues to investigate wherein VR-HMDs could benefit History education. The researcher recommends the following for future research:

- To engage a larger population of pre-service History teachers from more than one tertiary education institution in South Africa. This will allow researchers, for example, to determine the role of institutional culture on the integration of VR-HMDs.
- A population comprising of both pre-service History teachers and in-service History teachers. If these groups of participants can be enlarged more data can be gathered to provide additional guidelines as to how, where and when VR-HMDs should be incorporated into History education.
- VR-HMDs integration in History teaching and learning in combination with constructive student-centred learning approaches such as, for example inquiry learning and problem-based learning.
- The challenges that in-service History teachers experience when VR-HMDS are integrated and apply to specific teaching and learning strategies and outcomes.

6.7 CONCLUSION

This chapter started off by focusing on a summary of each of the chapters of this study. Stemming from the findings that were made, the secondary research questions and ultimately the primary research question were addressed. Subsequently recommendations were made which were then followed by the limitations the researcher encountered during his study. In conclusion suggestions were made for further studies.

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ANNEXURE A – PROOF OF ETHICS TRAINING



Private Bag X5001, Potchefstroom
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Research Ethics Committee of the Faculty of
Education (EduREC)

Faculty of Education

Tel: 018 265 2076
Email: Jako.Olivier@nwu.ac.za

4 September 2020

PROOF OF ATTENDANCE AND ASSESSMENT

Dear Juan-Carlo Homan

This letter certifies that the abovementioned individual attended a 1-day online workshop on 29 August 2020 and completed online assessment on:

Research Ethics for Education

The workshop was presented Prof. Jako Olivier, Chairperson of the Research Ethics Committee of the Faculty of Education (EduREC).

This letter of attendance, as proof of ethics training and assessment, is valid for 3 years and expires on 29 August 2023.

Yours sincerely

Prof JAK Olivier

Chairperson: Research Ethics Committee of the Faculty of Education (EduREC)

ANNEXURE B – ETHICAL CLEARANCE



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South Africa 2520

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Web: <http://www.nwu.ac.za/>

North-West University Education, Management
and Economic Sciences, Law, Theology,
Engineering and Natural Sciences Research
Ethics Office (NWU-EMELTEN-REC)

Tel: +2718 259 4707
Email: luke.meyer@nwu.ac.za

8 February 2021

Dear Dr Warnich

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the North-West University Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences Research Ethics Committee (NWU-EMELTEN-REC) on 8 February 2021, the NWU-EMELTEN-REC hereby approves your study as indicated below. This implies that the NWU-EMELTEN-REC grants its permission that, provided the general and specific conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: The Viability of Virtual Reality Head-Mounted Displays in the teaching and learning of pre-service History teachers																														
Principal Investigator/Study Supervisor/Researcher: Dr Pieter Warnich																														
Student: Mr Juan-Carlo Homan																														
Ethics number:	<table border="1"><tr><td>N</td><td>W</td><td>U</td><td>-</td><td>0</td><td>2</td><td>0</td><td>6</td><td>6</td><td>-</td><td>2</td><td>0</td><td>-</td><td>A</td><td>2</td></tr><tr><td colspan="3">Institution</td><td colspan="3">Study Number</td><td colspan="3">Year</td><td colspan="3">Status</td></tr></table>			N	W	U	-	0	2	0	6	6	-	2	0	-	A	2	Institution			Study Number			Year			Status		
N	W	U	-	0	2	0	6	6	-	2	0	-	A	2																
Institution			Study Number			Year			Status																					
<i>Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation</i>																														
Application Type: Single study	Risk:	Medium Risk																												
Commencement date: 16/12/2020																														
Expiry date: 14/12/2021																														
Approval of the study is provided for a year, after which continuation of the study is dependent on receipt and review of a six-monthly monitoring report and the concomitant issuing of a letter of continuation.																														

General conditions:
While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:
• The principal investigator/study supervisor/researcher must report in the prescribed format to the NWU-EMELTEN-REC: – six-monthly on the monitoring of the study, whereby a letter of continuation will be provided annually, and upon completion of the study; and – without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study. • The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the principal investigator/study supervisor/researcher must apply for approval of these amendments at the NWU-EMELTEN-REC, prior to implementation. Should there be any deviations from the study proposal

ANNEXURE C – PARTICIPANT INFORMATION AND CONSENT FORM



Private Bag X1290, Potchefstroom

South Africa 2520

Prof Pieter Warnich

Deputy Director: School for Commerce and
Social Studies in Education

Email: pieter.warnich@nwu.ac.za

Tel: 018 299-4728/0836509566

PARTICIPANT INFORMATION AND CONSENT FORM FOR THE RESEARCH STUDY

ETHICS APPROVAL NUMBER

NWU-02056-20-S2

TITLE OF THE RESEARCH STUDY

The viability of Virtual Reality Head-Mounted Displays in the teaching and learning of pre-service History teachers

PRINCIPAL INVESTIGATOR
RESEARCHER

/ Mr Juan-Carlo Homan (25033794)

CONTACT NUMBER

078 485 9375

EMAIL

25033794@student.q.nwu.ac.za

Dear second year pre-service History teacher/s

You are invited to take part in a research project conducted by Mr J Homan to be submitted in fulfilment of the requirements for the degree MEd in Education Curriculum Studies with emphasis placed on the subject History. Please take time to read the following information presented below and on the following page/s, which will aim to clarify the specifics of this research study. Please ask the researcher regarding any part of the study you do not fully understand. It is very important that you are fully satisfied and that you clearly understand what this research is about and how you could be involved. Also, your participation is entirely voluntary and you are free to decline participation. If you say no, it will not affect you negatively

in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been accepted and approved by the NWU-EMELTEN-REC committee and will be conducted according to the ethical guidelines and principles of the North-West University (NWU). It might be necessary for the supervisor, Prof PG Warnich to ensure that the researcher is conducting the research in an ethical manner and therefore, he will have access to all the data gathered.

WHAT IS THIS RESEARCH STUDY ABOUT?

Society continuously undergoes a process in which it adapts and changes to new technologies that are developed. It is this advancement of technology within the modern 21st century that has prompted the researcher to ascertain whether or not VR-HMDs (a modern special-cognitive technology) could be considered a viable option to the teaching and learning process of pre-service History teachers. The subject emphasis of this study is placed upon History as there is a misconception that History does not require modern ICT's to teach the events of the past.

WHY HAVE YOU BEEN IDENTIFIED AS A SUITABLE PARTICIPANT?

You have been identified to participate in this study because as a second year pre-service History teacher registered for an educational course in one of your focus areas, History, you are ideally suited to provide relevant information about your perceptions regarding your ICT and SDL training with regards to History.

- The second year pre-service History teachers were selected to complete the questionnaires, VR lesson and its accompanying activity, and the focus group interviews due to them already completing a year in the B.Ed Programme and thus being at a developmental stage within their teacher training. They have already gained practical experience, theoretical knowledge and should now start developing their teaching repertoires by expanding their knowledge with regards to the available methodologies and pedagogical tools.
- The identified participants ought to be able to provide an informed and unique opinion that should be able to assist the researcher in determining whether or not VR and more specifically VR-HMDs are a viable option to the teaching and training of pre-service History teachers.

WHAT WILL YOUR RESPONSIBILITIES BE?

Participants will be required to complete multiple questionnaires, attend an individual VR History lesson, and partake in a semi-structured focus group interview. Additionally, there will be two days set out for the data collection process and participants will be allowed to choose between these two days and various allocated time slots that would suit them. Moreover, with your permission, the researcher requests to audio record the semi-structured focus group interviews in order to accurately capture of your responses.

WILL YOU BENEFIT FROM TAKING PART IN THE RESEARCH?

Participation in the study will not provide any direct benefits to you. There is, however, an indirect benefit to you participating in the research as you will be contributing to an academic field that you also have interest in. Furthermore, you are assisting in laying the groundwork for other possible research studies to be done regarding the VR within History education and thus

you are assisting in the development of educational programmes at tertiary institutions. By participating in this study you are also afforded the opportunity to experience VR as a pedagogical tool and by having this experience you could possibly start constructing your own methodological and pedagogical repertoire and include VR as an ICT within said repertoire.

ARE THERE ANY RISKS INVOLVED?

According to the NWU-EMELTEN-REC committee the research study has a medium risk level due to it being a cognitive spatial technology that makes use of a VLE and more specifically VLEs that relate back to the Holocaust. It is due to this perceived risk that the researcher has vetted the VLE that will be used extensively to ensure the well-being of all participants. Besides this perceived risk from the NWU-EMELTEN-REC committee there is no other risk involved with your participation in this study. Furthermore, it has to be noted that no negative consequences will reflect on you should you choose not to participate or to withdraw as is your right. Choosing to participate or not in this research study will not have any effect whatsoever on your amount of credits or marks. If you do, however, choose to participate, the researcher will respect your right to privacy, safety and confidentiality as far as possible. Nevertheless, it is important that you are aware that the researcher is unable to guarantee total confidentiality and anonymity due to the data collection process making use of a semi-structured focus group interview. Participants from the semi-structured focus group will, however, be required to sign a confidentiality agreement in which all participants pledge neither to share the names of fellow focus group members, nor share information from the focus group with any other person, thus participants pledge to not share any information regarding participants and the study.

WHO WILL HAVE ACCESS TO THE DATA?

Anonymity and confidentiality will be ensured by providing each participant with a pseudonym. This pseudonym will be used throughout the study and will be constructed through making use of the time slot and day that you, the participant, will participate with the data collection process. The researcher will not make any reference to your identity in any way and the answers you have provided throughout the data collection process will not be linked to your identity. When referring to the data obtained from your semi-structured focus group interview only the pseudonym allocated to you will be used. The researcher will also ensure that all transcripts of the semi-structured focus group interviews are used anonymously, with pseudonyms being given to all participants. Confidentiality will be maintained in the recorded interviews and any detail that might identify you as a participant or your institution will be omitted in any published and written data. The researcher, the supervisors Prof P Warnich and Prof C vd Westhuizen and an independent lecturer will be the only ones who have access to your personal information, answers and findings of the research. The data will be kept safe and secure by locking hard copies in a cupboard and electronic copies will be password protected.

WHAT WILL HAPPEN TO THE DATA?

The semi-structure focus group interview data will be audiotaped and transcribed verbatim then analysed and be added to the other data gathered from you and will then be conveyed in the research study. Furthermore, data gathered may possibly be included in academic articles or presented at conferences if the opportunity presents itself, but you can rest assured that irrespective of how the data will be used now and within the future your personal details will not be used in any way. After 5 years the data gathered will be destroyed.

WILL YOU BE COMPENSATED TO TAKE PART IN THIS STUDY AND ARE THERE ANY COSTS INVOLVED?

There will be no compensation for your participation towards this study nor will there be any costs involved for you the participant.

IS THERE ANYTHING ELSE THAT YOU SHOULD KNOW OR DO?

You can contact the researcher: Mr J Homan by cell phone at 078 485 9375 or by email at 25033794@nwu.ac.za if you have any further queries regarding the study. Alternatively, the supervisor, Prof P Warnich may also be contacted at 018 299-4728/0836509566 or by email at pieter.warnich@nwu.ac.za.

CONFIRMATION BY PARTICIPANT:

By choosing YES below, I agree to take part in the research study entitled: *The viability of Virtual Reality Head-Mounted Displays in the teaching and learning of pre-service History teachers*.

1. I indicate my willingness to participate in the research project by being interviewed for this study in a semi-structured focus group interview at a time and place convenient to me:

Check only one

☐
☐

Yes
No

2. I, hereby, give my permission to be audiotaped.

Check only one

☐
☐

Yes
No

3. I am aware that this study will make use of audiotapes.

Choose only one

☐
☐

Yes
No

4. I fully understand that my participation within the study: The viability of Virtual Reality Head-Mounted Displays in the teaching and learning of pre-service History teachers is voluntary and that there are no negative consequences in any way or form for choosing not to participate in this research:

Check only one

☐
☐

Yes
No

5. I am confident that the researcher, supervisors and the independent lecturer attached to this research study will ensure the confidentiality that I was promised – my personal information will not be revealed.

Check only one

☐ Yes
☐ No

6. I have been informed that I do not have to answer every question posed to me in the semi-structured focus group interview, questionnaire or activity and can withdraw from the study at any time without experiencing any negative consequences.

Check only one

☐ Yes
☐ No

7. I know that all textual and digital data collected during this research study will be kept in a secure place will be destroyed within 3-5 years in a manner that will still ensure my anonymity.

Check only one

☐ Yes
☐ No

8. I know that the results of the research will only be used for academic purposes.

Check only one

☐ Yes
☐ No

PARTICIPANT CONFIDENTIALITY AGREEMENT – SEMI-STRUCTURE FOCUS GROUP

INTERVIEWS

Respecting and maintaining the confidentiality regarding the identity and contribution of each participant of this research study is of the utmost importance to the researcher. As I, as researcher, and my supervisors and independent lecturer have undertaken not to reveal anything that could identify you in any report on the findings of this research, we would ask that you sign the following confidentiality agreement in which you undertake not to share the names of fellow focus group members, or share information from the focus group with any other person that could possibly lead to the identification of any participant.

Please complete the form below before the commencement of the semi-structured focus group interviews. I hereby declare and agree that:

Only check those applicable to you.

☐ I will not share the names of the other participants in the focus groups with any other person.

☐ I will not share any information given in the semi-structured focus group interview by other participants with any other person.

DECLARATION BY THE RESEARCHER

I the researcher, Juan-Carlo Homan student number 25033794, declare that:

- I explained the information provided in this document to the participant.
- I encouraged him/her to ask questions and took the time to answer the questions adequately.
- I am satisfied that he/she adequately comprehend all the aspects of the research as mentioned in the document.
- I will do everything in my power to ensure the anonymity and confidentiality of all participants.
- I aim to ensure that the data collection process takes place in such a manner that participants feel comfortable and safe.
- I will afford the participants all equal opportunities to provide data within the bounds of the data collection process.

Signed at (place) Potchefstroom on (date) 28 June 2022

Signature of the researcher

J Homan

Signature of the participant

ANNEXURE D – BIOGRAPHICAL INFORMATION



Biographical information, prior experiences and perceptions of second year pre-service History teachers regarding ICT and VR in History teaching and learning

Biographical information regarding the participants

• Age:	•
• Gender:	•
• Race:	•

This questionnaire is aimed at discerning the opinions and attitudes of the 15 second-year pre-service History teachers towards ICT and VR as pedagogical tools within the teaching and learning of History.

1)	During your time as a pre-service History teacher to what extent have you been exposed to ICT's?
----	--

2)	What ICT have you been exposed to the most?
----	---

3)	Describe your experience with the ICT that you have been exposed to the most.
----	---

4)	Have you ever thought of using the ICT that you have most been exposed to in your own lessons one day?
----	--

☐

Yes

☐

No

Elaborate:

5)	Have you ever thought of using any ICT's in your own lessons one day?
----	---

☐

Yes

☐

No

Elaborate:

6)	Before today have you ever heard of VR before?
----	--

☐

Yes

☐

No

If yes please state what you have heard of VR, if no please state why you think you never heard of VR before.

ANNEXURE E – PRE-TEST VLE AND POST-TEST VLE QUESTIONNAIRES



PRE-TEST VLE QUESTIONNAIRE

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I understand what is meant by SDL skills.	☐	☐	☐	☐	☐
I understand what is meant by ICT.	☐	☐	☐	☐	☐
I understand what is meant by VR, VR-HMD and VLE.	☐	☐	☐	☐	☐
I am in favour of using ICT's within the teaching and learning of pre-service History teachers.	☐	☐	☐	☐	☐
I have the ability to question, inquire, and problem solve.	☐	☐	☐	☐	☐
I have the ability to keep an open mind to other points of view.	☐	☐	☐	☐	☐
I have the ability to scan data and the identification of relevant information.	☐	☐	☐	☐	☐

POST-TEST VLE QUESTIONNAIRE

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
According to you does the use of ICT's develop SDL skills?	☐	☐	☐	☐	☐
Could VR-HMDs be considered to be a viable option for teaching and learning of pre-service History teachers?	☐	☐	☐	☐	☐
Could the use of VR-HMDs form part of SDL?	☐	☐	☐	☐	☐
Does VR-HMDs and VLEs effectively convey content knowledge?	☐	☐	☐	☐	☐
Do you believe that VR HMDs had any influence on your SDL skills?	☐	☐	☐	☐	☐
In your opinion do you think that VR-HMDs and VLEs could be used at educational institutions besides tertiary institutions?	☐	☐	☐	☐	☐

ANNEXURE F – PAPER-BASED WORKSHEET



HISTORY-BASED VIRTUAL REALITY HEAD MOUNTED DISPLAY RESEARCH ACTIVITY

Battle re-enactment VLEs, the virtual Holocaust Museum and Pearl Harbour – gaining a deeper understanding

- | | |
|----|--|
| 1) | To what extent has the experience of the virtual Holocaust Museum, the 360° 1941 battle re-enactment video and the 360° Pearl Harbour add to your existing knowledge regarding all three topics? |
|----|--|

- | | |
|----|--|
| 2) | Within the virtual Holocaust Museum there is a lot of emphasis placed on the lives of Jews within the ghettos, this is done to evoke emotions of empathy. In your opinion did the virtual Holocaust Museum succeed in this goal? Motivate your opinion by providing a detailed response. |
|----|--|

[illegible]

3)	In what way did the 360° 1941 battle re-enactment change your perceptions of war?
----	---

[illegible]

4)	Describe the manner in which the 360° Pearl Harbour VLE has added to your understanding of the event.
----	---

5)	Refer to a fact or visual regarding something that stood out for you within these VLEs and explain why this certain fact or visual stood out for you.
----	---

ANNEXURE G – SEMI-STRUCTURED FOCUS GROUP INTERVIEW QUESTIONS

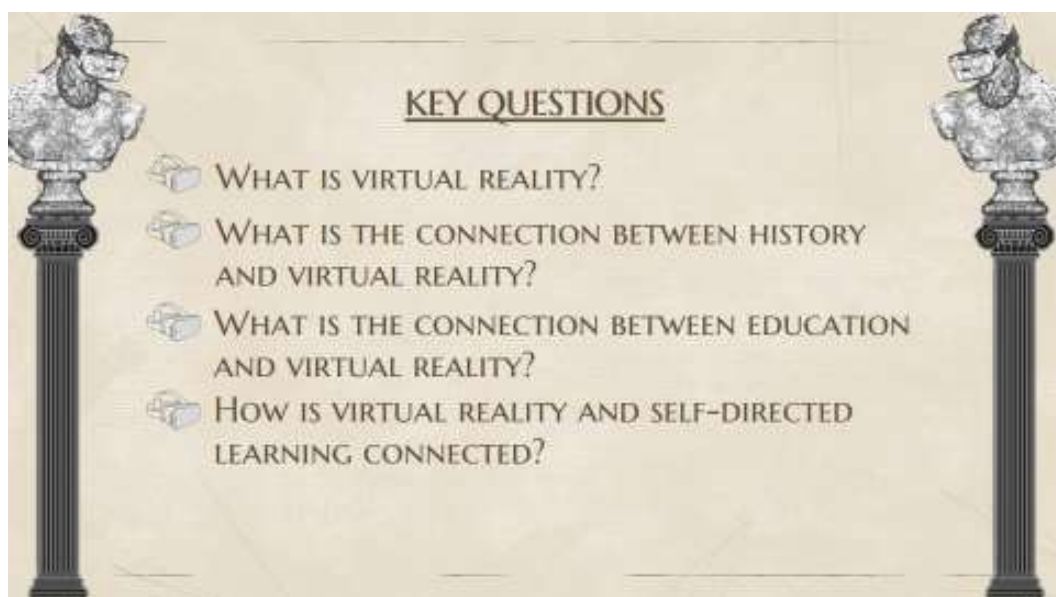


The following questions were presented to the participants in a semi-structured focus group interview after they experienced the VLE through the use of a VR-HMD. These questions were aimed at assisting the researcher in determining the perceptions and attitudes of second-year pre-service History teachers towards VR-HMDs within the teaching and learning of pre-service History teachers. Thus, these questions further assisted in determining whether or not VR could be considered a viable pedagogical tool used within teacher training.

1. What was your experience in using VR and VR-HMDs as a pedagogical tool?
2. Are you of the opinion that VR-HMD based activities can aid in determining an empathetic understanding by the participants when reliving history?
3. Could VR-HMDs aid you in drawing connections between content knowledge, learning motivation and personal experiences?
4. What do believe are some of the benefits of using VR and VR-HMDs within teaching?
5. What do you think could be considered an obstacle to the incorporation of VR-HMDs into the teaching and learning of History?
6. With special reference to South Africa, do you believe that the advantages of VR-HMDs outweigh the shortcomings of VR within an educational institution?
7. Do you think VR should only be used at a tertiary institution or do you think VR could be able to assist at school as well?
8. Should VR and VR-HMDs be included into teacher training?
9. Do you consider VR-HMDs to be a viable ICT that could effectively be integrated into Self-Directed Learning (SDL)?
10. Are you of the opinion that VR-HMDs can influence the participants' ability to rationalise, debate and analyse historical evidence from the various sources.
11. In your opinion to what extent did the use of VR-HMDs make use of SDL skills within the activity?
12. What SDL skill is, in your opinion, used the most when utilising VR and VR-HMDs as teaching and learning tools?
13. Do you believe that pre-service History teachers would be more motivated to engage with their teaching and learning process if they are regularly afforded the opportunity to experience VR?
14. Would you use VR in a lesson if ever given the opportunity?

15. Are you of the opinion that the knowledge you gained regarding VR-HMDs during this research study will have any benefit or lack thereof with regards to your professional development?

ANNEXURE H – INTRODUCTION TO THE STUDY POWERPOINT PRESENTATION ON VIRTUAL REALITY AND SELF-DIRECTED LEARNING



WHAT IS VIRTUAL REALITY?



VR (Virtual Reality) is a simulated computer environment – cyberspace/augmented reality – with which the user of this technology interacts. There are virtual sights and sounds that imitates real life through providing immersive experiences. These simulated environments can be accessed through the use of HMDs (Head Mounted Displays).



Virtual reality Head Mounted Displays are cognitive spatial technologies that afford its user the opportunity to experience the information that it attempts to relay in a manner that simulates real-life experiences.



5

WHAT ARE SDL SKILLS?

IN SELF-DIRECTED LEARNING, EACH STUDENT TAKES RESPONSIBILITY FOR HIS/ HER OWN LEARNING ACTIVITIES.

- KEEP AN OPEN MIND TO OTHER POINTS OF VIEW
- QUESTION, INQUIRE, AND PROBLEM SOLVE
- SCAN INFORMATION AND QUICKLY CHOOSE RELEVANT RESOURCES
- COLLECT INFORMATION ON PERFORMANCE THROUGH SELF OBSERVATION AND FEEDBACK FROM OTHERS
- ASSESS YOUR OWN LEARNING



ANNEXURE I – RDGC PERMISSION GRANTED



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Research Data Gatekeeper Committee

NWU RDGC PERMISSION GRANTED / DENIED LETTER

Based on the documentation provided by the researcher specified below, on 12/09/2022 the North-West University (NWU) Research Data Gatekeeper Committee (NWU-RDGC) hereby grants permission for the specific project (as indicated below) to be conducted at the NWU:

<u>Project title:</u> The Viability of Virtual Reality Head-Mounted Displays in the teaching and learning of pre-service History teachers. <u>Project leader:</u> Dr P. Warnloh <u>Researcher/Project Team:</u> J Homan <u>Ethics reference no:</u> NWU-02068-20-A2 <u>NWU RDGC reference no:</u> NWU-GK-22-084 <u>Specific Conditions:</u> . <u>Approval date:</u> 12/09/2022 <u>Expiry date:</u> 12/09/2023
--

General Conditions of Approval:

- The NWU-RDGC will not take the responsibility to recruit research participants or to gather data on behalf of the researcher. This committee can therefore not guarantee the participation of our relevant stakeholders.
- Any changes to the research protocol within the permission period (for a maximum of 1 year) must be communicated to the NWU-RDGC. Failure to do so will lead to withdrawal of the permission.
- The NWU-RDGC should be provided with a report or document in which the results of said project are disseminated.
- Due to the COVID-19 pandemics the Committee would like to advise the researcher to practice the necessary caution and adhere to the National Covid-19 Guidelines when conducting research with participants.

Please note that under no circumstances will any personal information of possible research subjects be provided to the researcher by the NWU RDGC. The NWU complies with the Promotion of Access to Information Act 2 of 2000 (PAIA) as well as the Protection of Personal Information Act 4 of 2013 (POPI). For an application to access such information please contact Ms Annamarië De Kock (018 285 2771) for the relevant enquiry form or more information on how the NWU complies with PAIA and POPI.

The NWU RDGC would like to remain at your service as scientist and researcher, and wishes you well with your project. Please do not hesitate to contact the NWU RDGC for any further enquiries or requests for assistance.

Yours sincerely



Prof Jeffrey Mphahlele
Chairperson NWU Research Data Gatekeeper Committee

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13 November 2018

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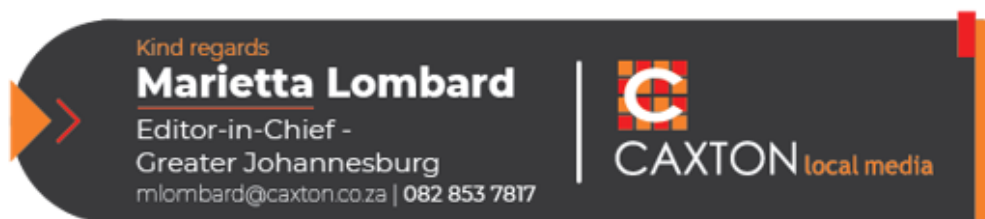
ANNEXURE J – PROOF OF LANGUAGE EDITING

February 22, 2024

This letter confirms that the dissertation titled "The viability of Virtual Reality Head-Mounted Displays in the teaching and learning of pre-service History teachers" has been language-edited by M. Lombard.

Here follows a list of credentials attributed to M. Lombard.

- This is to confirm I am permanently employed as Editor-in-Chief of 34 community newspapers and the publications' associated websites.
- I oversee a sub-hub consisting of 12 sub-editors and 74 journalists.
- I am executive director of the Forum of Community Journalists (FCJ).
- I represent the FCJ on the Press Council of South Africa and I hold private membership with the South African National Editors' Forum.
- I have 25 years' experience in the print media industry.
- I hold a National Diploma in Journalism (1998) from Technikon Pretoria, now Tshwane University of Technology.
- I currently represent the FCJ as Consortium member on the Media and Digital Platforms Market Inquiry to make submissions to the Competition Commission.



ANNEXURE K – TURNITIN REPORT

13060341:j._Homan_-_25033794_-_Jandre_van_der_Walt.docx

ORIGINALITY REPORT

12%

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