

Implementing Augmented Reality Technology in Teaching Human
Anatomy: An Educator's Autoethnography

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February 2024

This thesis is submitted in partial fulfilment of the requirements for the degree of
Doctor of Philosophy

Department of Educational Research

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UK

Abstract

Implementing Augmented Reality Technology in Teaching Human Anatomy: An Educator's Autoethnography- Cassandra Sturgeon Delia

This study delves into the implementation of augmented reality (AR) technology for teaching human anatomy through the lens of transformative learning. The research adopts an autoethnographic approach in response to the dynamic educational landscape and the limited comprehensive support available in the literature for educators adopting new technologies. It details an educator's first-time venture into integrating AR within a vocational context. Addressing a gap in the literature, the study tackles the following research questions:

RQ1- What were my experiences with educational technology before embarking on the AR journey?

RQ2: What was my initial experience as an educator when using AR for the first time?

RQ3: To what extent, if any, have my feelings and perspectives undergone a transformation?

RQ4: How does my experience compare to that of other individuals who have undergone a similar process?

This research aims to enrich the existing literature by infusing a personal, situated, and subjective perspective that explores the intricate processes of cognitive restructuring and perspective shifts achieved through the application of Mezirow's Transformative Learning Theory (TLT). Through the lens of TLT, the study provides insights into the dynamics of learning, the transformation of ingrained habits of mind, and the evolution of points of view. Evocative vignettes are employed to illustrate the successful transformative journey providing relatable insights for educators seeking to integrate technology into their classrooms.

Using autoethnography, the researcher is positioned as a subject, and the study critically examines assumptions through reflexivity, gaining insight into past influences that have shaped longstanding pedagogical beliefs. Field notes, self-observation, and a self-interview capture a detailed journey, showcasing successful transformation through thoughts, emotions, and behaviour. Six member-checking interviews with educators new to implementing AR are incorporated to explore the multifaceted dimensions of the

educator's journey. Extensive preparation and overcoming challenges led to significant confidence and professional growth. The journey's intricacies resulted in a unique shift in perspective for the researcher.

This investigation contributes to the fields of transformative learning, autoethnography, and technology enhanced learning (TEL), offering valuable insights for educators, administrators, and researchers seeking emotional support to navigate the integration of AR in educational settings.

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Acknowledgements

I express my deepest gratitude to Dr Kyungmee Lee, whose guidance and introduction to autoethnography marked the inception of my doctoral journey. Dr Lee, you have not only been an exceptional supervisor but also a confidante, autoethnographic guru and hero throughout this endeavour. Your support and enthusiasm have made this academic journey truly captivating, and I am forever in awe of your brilliance.

To my fellow peers, academics and administrative staff at the Centre for Technology Enhanced Learning at Lancaster University, thank you for embracing me early on and providing encouragement during moments of self-doubt. Your camaraderie has enriched my experience and contributed to my sense of belonging in this scholarly pursuit, despite the distance.

Heartfelt appreciation goes to my Mother, Husband, Son and fur babies, whose understanding and support sustained me through times when I claimed to be too busy. Your patience and encouragement have been my pillars of strength. I want to extend a heartfelt acknowledgement to my beloved Aunt Jane Pointon. Though she is no longer with us, her kindness and encouragement have left an indelible mark on my life. This thesis is a tribute to her influence and the impact she had on me.

I extend gratitude to myself for embarking on this significant journey and persisting until the end even when faced with daunting challenges. Acknowledging my own commitment to personal growth and academic achievement is a testament to the resilience within.

Collectively, each of you has played an integral role in shaping this transformative chapter of my life, and I am profoundly thankful for the contributions of every individual mentioned above.

I would also like to thank the Ministry for Education, Sport, Youth, Research and Innovation for their financial support through the Tertiary Education Scholarships Scheme (Malta). The research work disclosed in this publication is fully funded by the Tertiary Education Scholarships Scheme.

Author's declaration

I declare that this thesis is entirely my own work and has not been submitted in substantially the same form for the award of a higher degree elsewhere.

Word count: 48,538

I declare that the thesis does not exceed the permitted maximum word length.

Signature: Cassandra Sturgeon Delia

Publications derived from work on Doctoral programmes

The thesis has been submitted and accepted by peer review for presentation at the Networked Learning Conference 2024, which shall be held in Malta in May 2024.

Chapter 1: Introduction

1.1 Opening remark: Autobiographic narratives

Despite predominantly optimistic assumptions about new technology being a primary driving force for educational innovation and enhancement, the adoption of new technology has been slow across the broader educational contexts, including vocational education training (VET) (Bacca et al., 2015; Chiang et al., 2022; Dovbenko et al., 2020; Trust et al., 2021; Tzima et al., 2019). Educators' (and teachers') unwillingness to learn and use new technology has repeatedly been blamed for such slow movements (Dovbenko et al., 2020; Dunleavy et al., 2009; Han et al., 2017; Roberts, 2008). Dovbenko et al. (2020) discovered the issue of resistance to the introduction of distance-learning models in the vocational training of educators is fueled by human factors and objective reasons. Both students and representatives surveyed articulated a lack of personal confidence and technological background to be able to design high-standard online courses, which might indirectly influence lecturers' and institutions' public image. Although there has been much research effort to understand better the challenges and difficulties that educators face when implementing technology in their classrooms, in literature, there is a lack of holistic accounts of how educators learn and use new technology for teaching, through which how their long-held pedagogical perspectives are challenged and changed. In this study, technology includes a broad spectrum of technological means, including but not limited to electronic devices, and other tools or systems driven by scientific knowledge and innovation. On the other hand, educational technology (EdTech), is referring to technology specifically used for learning and teaching purposes. However, both terms refer to the practical application of knowledge, methods, and processes to achieve specific tasks, functions, or objectives.

1.1.1 Researcher

I currently hold the position of senior lecturer within Malta's College of Arts, Science and Technology (MCAST), a vocational higher educational college. Coming from a background in health sciences, I specialise in delivering various health science subjects, and my role also includes conducting research.

Prior to assuming my current position, I acquired extensive experience as a critical care nurse in the public and private sectors, thus establishing a solid foundation in healthcare

practice. Subsequently, later my role transitioned into a research role at the University of Malta, further expanding my expertise in the field. Pursuing academic advancement, I embarked on a Doctor of Philosophy (PhD) journey in E-Research and Technology Enhanced Learning at Lancaster University. Under the esteemed Department of Educational Research, my doctoral studies commenced in 2020. Through this program, I aimed to deepen my understanding of how technology can augment learning processes and enhance educational research methodologies.

1.1.2 Research background

I have worked at Malta's leading VET College for the past six years, currently teaching subjects including anatomy, physiology, microbiology, and science as a key skill subject. Turning forty this year, I grew up in a time when technology was not as ubiquitous as it is now. Frankly speaking, I was not taught by teachers who used technology. My teachers relied on blackboards to illustrate concepts, field works to gain experiential learning, and printed textbooks that the students would recite and memorise in class to learn important concepts.

Consequently, my childhood did not involve much technology. I am sure you will not be surprised to read that I feel that educators do not necessarily need technology to accomplish their teaching in the classroom. As an educator, I come to class well-prepared with a PowerPoint presentation (PPP). Still, I easily veer off-script as I appreciate the opportunity for students to ask questions and engage in open discussions, connecting the topic to the VET field. Admittedly, I am an extrovert who enjoys being around others, subsequently, I feel technology might distance me from people and diminish the energising feel I get from a bustling classroom. To be clear, I do not dismiss that technology is important, but technology had not played a significant role until most recently during the COVID-19 pandemic.

Before the pandemic, I had little to no experience using (more precisely, relying on) technology for teaching. I was very traditional in my style of teaching. Two years down the line, I have spent almost a year and a half teaching online due to the pandemic, where I had to improvise and rely on virtual spaces to teach. It was not easy for me to accept the reality of the pandemic and switch to a virtual classroom. I had no previous training, and all my attempts were on trial and error. However, this situation motivated me to take risks; I gradually gained personal and professional growth. Although we are back on campus,

and teaching has taken a traditional form again, I feel the pandemic experience (and simultaneously the initiation of my doctorate) was the beginning of my learning journey towards a new insight into technology and thus made me braver to take on new experiences. This new state of mind results from my experience navigating the uncharted territory of online teaching, where my feelings underwent a profound transformation. Initially, I was filled with uncertainty and apprehension, overwhelmed by the abrupt shift in my teaching approach. The virtual classroom felt foreign and detached, lacking the familiar connection and engagement I was accustomed to. But as I persevered through the challenges, embracing the virtual tools and platforms, my perspective gradually shifted. With each passing day, I gained confidence in my ability to adapt and harness technology for educational purposes. The trial-and-error process became a valuable learning experience, and I discovered hidden potential within myself. I started exploring various online teaching methods, experimenting with different strategies to enhance student participation and foster a sense of community in the virtual space. I discovered innovative digital resources and interactive platforms that allowed me to create engaging and immersive learning experiences. Despite the initial hurdles, I began to witness the positive impact of these technological advancements on my students' learning outcomes. As time went on, I found myself embracing digital collaboration, encouraging students to collaborate virtually, and utilising multimedia to create dynamic and interactive lessons (Sturgeon Delia, 2023).

Now, even though we have returned to the traditional classroom setting, I carry with me the valuable lessons and newfound bravery from the pandemic experience. I am more open to incorporating technology into my teaching practice, and willing to explore and adopt innovative approaches that enhance student engagement and learning but still hold some reservations when it comes to the classroom.

While the pandemic pushed me to adapt and I learnt to utilise technology for teaching when it was not possible to do so within the educational setting, I must admit that a part of me remains cautious. As I embrace the use of technology, I do so with a discerning eye, carefully selecting the digital tools and platforms that align with my teaching objectives and prioritise student wellbeing. I seek to strike a balance between incorporating technology and preserving the fundamental aspects of traditional teaching that foster deeper connections and meaningful interactions with my students. While technology has undoubtedly opened new avenues for teaching and learning, I strive to

maintain a human touch in my pedagogical approach. I prioritise creating an inclusive and supportive classroom environment where students feel seen, heard, and valued, regardless of the medium through which we connect.

My mindset derives from the concerns of how technology has infiltrated our personal and professional lives. To avoid any confusion, I rarely leave home without my phone, and I still require my laptop to carry out administrative tasks at work, such as attendance and inputting marks. Still, however, I always choose the feel of a physical book over downloading an electronic book, and when dining out, I always ask for the physical menu rather than scanning the QR code. Despite the fast-paced nature of today's culture, I believe I could lead a fulfilling personal life with minimal reliance on technology. I would not describe myself as a technology enthusiast, and if I had to characterise my overall sentiment towards technology, I would say that I have mixed feelings about it, especially after my overall positive experience using technology during the pandemic.

Reflecting on my upbringing and comparing this with today's youth culture, I feel that technology has globalised, resulting in less physical contact, and placing focus on screens rather than towards each other (Giddens, 2002). Even today, back on campus, I could be in the staffroom with colleagues yet feel isolated as we all gradually drift apart and become nothing more than names on a computer screen, attending online meetings. For most, technology is integrated into our day-to-day living to the point that technology is taken for granted. I often wonder how we overlook technology's significant impact on our lives. From the way, we use our smartphones and social media to communicate and share information, use the internet to seek knowledge and operate businesses, use electricity to power our homes and devices, and use transportation to travel.

As Giddens (2002) notes in his book 'Runaway World,' "Globalisation is not only about what is 'out there', remote and far away from the individual. It is an 'in here' phenomenon too, influencing intimate and personal aspects of our lives." This insight underscores the pervasive nature of globalisation, highlighting its impact on both external and internal dimensions of our existence. Indeed, globalisation, as Giddens elaborates, is not a singular process but a complex set of processes, further emphasising its multifaceted nature.

Despite the prevalent integration of technology into our daily lives, there exists a debate regarding the extent of our dependence on it. Drawing on my background in healthcare, I am critically conscious of the potential adverse effects associated with excessive

technology use, such as technostress, techno-exhaustion, and diminished wellbeing, as elucidated by Singh et al. in their 2022 study. However, it is important to acknowledge that Singh et al.'s key findings also highlight a contrasting perspective, indicating that individuals with previous experience of online work are at reduced risk of harm. This dichotomy underscores the complexity of the relationship between technology use and wellbeing. Nevertheless, recognising the potential risks, I remain proactive in moderating my own my technology usage to avoid individual and societal harm.

Although I have apprehension towards technology in the classroom, I need to be more innovative and embrace technology by overcoming my doubts, to remain relevant and avoid becoming a monotonous or outdated educator.

1.1.3 Research context

Since 2019, MCAST have been working with an international educational technology company to consult and develop various software, apps and digital tools, including an AR mobile application (app), a virtual reality (VR) game and other digital games. These resources are intended to enhance the learning journey of various lower-level, European Qualification Framework (The European Qualifications Framework (EQF) Europass, 2023) levels one to three, education programmes across all key skill subjects, which include English, information technology (IT), Maltese, Maths and Science. The first EdTech to be implemented was AR for different subjects, including anatomy. AR is a cutting-edge technology that blends the digital and physical worlds, enhancing our perception of reality by overlaying virtual elements onto the real world (Tan & Tay, 2021; Uribe et al., 2023), supplementing our surroundings with computer-generated imagery, audio, or other sensory inputs (Alzahrani, 2020). In this study, AR is described for educational purposes by merging virtual anatomy content with the classroom environment. After consulting with several lecturing staff employed to provide guidance and insights on the curriculum alignment and later assess and evaluate the AR mobile application prototype, the app was completed in 2022. The anatomy section of the app was designed with three dimensional (3D) digital representations of the human anatomy with AR overlays. The digital information is intended to be used in the classroom by students, giving a digital visual representation of all the body systems, allowing them to visualise such organs while listening to the lecture. Educators teaching anatomy to levels one to three across all institutes may implement this specific AR mobile app from the academic year 2022/2023.

Although I am willing to continue this learning journey with EdTech and try this unfamiliar technology, I have three primary concerns. Firstly, I worry about how technology may replace the students' primary focus. Traditionally when teaching lower levels, I employ videos within presentations, use two dimensional (2D) anatomical models from the laboratory, and explain the body's anatomy using examples relevant to their vocational area, to make this topic contextual for students. However, even though I am the one employing these tools, students still manage to lose focus, which takes me to my second concern. From my experience, students at lower levels tend to find multitasking challenging, as they are still developing foundational skills. Moreover, reflecting on my time teaching online during the COVID-19 pandemic, students in the lower levels struggled to multitask using technologies and listen to the lecture, igniting my dilemma of whether implementing a new tool would be successful.

Thirdly, as I am passionate about teaching and want my students to learn effectively, I doubt my ability to be able to deliver the best education possible using EdTech. Overall, I am hesitant about the unknown outcomes, especially given my lack of teaching experience using EdTEch and professional training related to EdTech, which makes me feel overwhelmed and intimidated. Over the years, I have developed my teaching style and become comfortable with my ways, and this may be where my fear stems from.

Although MCAST has been actively pursuing the integration of new technologies to enhance the learning experience, I find myself harbouring these genuine concerns. It is not that I doubt the success of these technologies in capturing students' interest and the potential positive outcomes that other educators have stated in the literature (Cooper et al., 2019; Dovrat, 2022; Ersoy & Bozkurt, 2015). However, my reservations stem from the uncertainty of whether these technologies can effectively work within the unique context of my own classroom.

While I acknowledge that these technologies have demonstrated success in other VET settings (Chiang et al., 2022; Karagozlu, 2018; Radosavljevic et al., 2020), each learning environment possesses its own dynamics and challenges. The specific characteristics of my classroom, the unique needs of my students, and the intricacies of the subject matter I teach necessitate a careful consideration of the potential effectiveness and compatibility of these technologies. I am aware that what may work seamlessly in one educational context may not necessarily yield the same results in another.

Furthermore, as an educator, I have developed a teaching style and methodology that has proven sufficient for my students over time. The introduction of new technologies represents a departure from the familiar and raises questions about the compatibility of these tools with my established pedagogical approach.

While I maintain an open mind towards exploring innovative teaching methods, my priority is to ensure that any integration of educational technology aligns seamlessly with the unique needs and objectives of my students, all while maintaining the high quality of education they deserve. However, it is important to note that my ability to evaluate the compatibility and effectiveness of these technologies within my classroom is currently limited. The absence of comprehensive studies and holistic research comparing the implementation experience of such technologies in similar educational contexts creates a gap in understanding. In this study, holistic accounts refer to comprehensive and integrated perspectives that consider all relevant factors, dimensions, and contexts pertaining to the phenomenon under investigation. The aim is to capture a broader understanding of practices, potentially providing alternative perspectives on the issue under investigation (Luitel & Dahal, 2021). Without this crucial information, it becomes challenging to make well-informed decisions and determine the optimal approach to enhance learning outcomes for my students. Such holistic accounts would provide a complete understanding by synthesising various perspectives, elements, and interconnections, thereby capturing the complexity and richness of the subject matter in its entirety.

1.2 Problem statement: A literature gap

The study's rationale lies in the lack of comprehensive support in the available literature to prepare educators for their journey towards implementing technology in the classroom. A separate literature review chapter will follow to provide more comprehensive discussions on educators' holistic accounts of professional development through learning and implementing technology in the classroom. Here, I will focus on briefly articulating the research problem intended to address in the present study by summarising a body of relevant knowledge and identifying a gap in the current literature.

1.2.1 Augmented reality technology in the educational setting

AR is a technology that uses a digital overlay to create an enhanced reality in the real world through various devices, including mobile applications (Chiang et al., 2022; Dreimane & Daniela, 2021). This technology is helpful in many disciplines, including education, to reach student learning outcomes through realistic and perceptive sensory experiences (Karagozlu, 2018) as AR combines virtual objects interactively in real-time (Azuma et al., 2001) and has the potential to enhance their motivation to engage in learning (Sirakaya & Alsancak Sirakaya, 2022).

Innovative technologies that enable an extended reality, including AR, have infiltrated the educational setting promising professional learning opportunities (Trust et al., 2021). Such technologies can be enabled on smartphones, elevating the contribution of mobile technology in education (Tzima et al., 2019). As part of the fast-developing TEL field, AR is rapidly infiltrating the education sector (Drljevic et al., 2017), even more as this technology can be utilised in the classroom from mobile devices (Bacca et al., 2015).

AR has proved helpful in education to increase student enthusiasm (Di Serio et al., 2013) by projecting virtual apparitions in the real world (Chiang et al., 2022), making conceptual subjects more straightforward to comprehend (Dreimane & Daniela, 2021). Furthermore, the immersive experience offered by AR has been notably valuable in retaining academically opposed students (Drljevic et al., 2017).

Numerous scholars have investigated AR within VET education, seeking the effectiveness of AR in gaining and enhancing students' skills. Such scholars support AR as the tool show's potential to revolutionise VET education by providing new innovative ways to support students' skill development (Radosavljevic et al., 2020) and enhance VET training practice (Loch et al., 2016). However, careful planning, effective pedagogy, ongoing support, and training for educators are critical for AR effectiveness and for avoiding implementation barriers (Bacca et al., 2015; Chiang et al., 2022). Moreover, other scholars argue for teachers and even students to co-collaborate with software developers when creating educational software to overcome implementation barriers (Bacca et al., 2015).

In this study, TEL is defined as the deliberate integration of digital tools, platforms, and resources into educational settings to enhance pedagogical practices and improve learning outcomes. Moreover, TEL, specifically focuses on the application of technology to

facilitate teaching and learning practices. Lastly for this study, when discussing the TEL field, this constitutes a distinct academic field exploring theories, methodologies, and practices for effectively integrating technology into pedagogy and educational settings

1.2.2 Teacher technology integration

Although AR's popularity has grown over the years and is expected to continue to immerse itself within educational organisations (Tzima et al., 2019), this technology's uptake has been slow due to financial costs, student usability issues (Ibáñez & Delgado-Kloos, 2018) and educator barriers (Alzahrani, 2020; Jang et al., 2021; Sırakaya & Alsancak Sırakaya, 2022).

Considering the new technology's didactic value, there are still limitations, as is true with all technologies. It has long been acknowledged that despite the potential advantages technologies proclaim, educators remain adamant about their use (Demetriadis et al., 2003; Finley & Hartman, 2004; Griffiths & Goddard, 2015; Howard, 2013; Purcell, 2005). Indeed, adopting technology in pedagogy is more complex than simply installing technology to teach. For technology to be an effective tool, it requires thoughtful integration into the pedagogy to form a relationship between the technology and the teaching practice (Koehler & Mishra, 2009). Educators must be trained to use technology effectively in their pedagogy and continuously supported through professional development (Jang et al., 2021; Trust et al., 2021). With certain technologies such as AR, constant technological changes have proved to be a barrier to its uptake in the classroom, where educators need continuous training (Tzima et al., 2019).

Studies exposing educators' challenges in integrating technology are well documented in the recent literature (Dovbenko et al., 2020; Khatoony & Nezhadmehr, 2020; Pazilah et al., 2019; Rasheed et al., 2020). Comparatively, so are studies revealing educators' struggles with AR (Akçayır & Akçayır, 2017; Alalwan et al., 2020; Drljevic et al., 2017; Trust et al., 2021; Tzima et al., 2019). Moreover, certain studies are specifically dedicated to providing technological solutions and recommendations aimed at helping educators overcome classroom barriers (Gupta, 2021; Johnson et al., 2016; Lo & Hew, 2017). However, despite the considerable research on teacher technology integration, there remains a gap in the literature regarding how teachers learn to use technology in the classroom. The literature on this topic is limited and does not exhaustively illustrate

holistic experiences relatable to other teachers seeking a personal and social transformation.

1.3 Research overview

Using autoethnography as a methodological approach, this study aims to enhance the literature by adding a researcher's personal, situated and subjective perspective on her own transformative learning (TL) process and implementing AR in the classroom. Hence evocative vignettes, illustrated in autobiographical writing, could further contribute to helping other educators achieve new philosophical understandings, subsequently improve students' learning. Autoethnography can reach multiple audiences through engaging accounts (Adams et al., 2015) that could support educators experiencing teaching dilemmas; hence, this personal journey has important implications for educators with mixed feelings about whether to uptake new technology in the classroom.

In this autoethnographic inquiry, therefore, I explore my personal experience as an educator who used AR to teach human anatomy to vocational students, aiming to offer a detailed account of my journey as a novice in this role, documenting my thoughts, emotions, and behaviour as I build competencies during class periods. Rather than offering prescriptive strategies for using technology, the study aims to provide insight into the journey of educators through my own experiences, offering support and understanding as they navigate similar transformations in their own practice.

This autoethnographic study involves the researcher (myself) as both the research subject (i.e., the educator) and the researcher. Autoethnography was chosen as the methodology to provide insight into my perspectives, which are heavily influenced by my past experiences and shape my initial perception of technology. This approach allows me to critically examine my assumptions and identify a transformative process by reflexively analysing my past experiences. In this study, a transformative shift denotes a fundamental and substantial change that redefines personal perspectives, leading to a profound reconfiguration of understanding through TL opportunities. This shift signifies a significant departure from initial perception, resulting in lasting impacts on my pedagogy and creating new opportunities for innovation, advancement, and growth within the classroom environment. Autoethnography is a valuable tool for investigating TL, as it provides methodological principles and strategies for understanding the self (Chang, 2016), and for effectively exploring personal experiences and perspectives (Lee, 2019).

To effectively examine my experiences, understand the challenges I faced, and hopefully develop competencies during the exploration phase of implementing AR, I employed a transformative learning theory (TLT). This theory provides a comprehensive perspective that covers cognitive, affective, and social processes (Mezirow & Taylor, 2009). Using this theory-informed analysis, I can gain insight into the internal conflicts that have shaped my longstanding pedagogical beliefs and assess the extent to which a TL experience has occurred by examining how my perspectives have been reintegrated through the learning process.

1.3.1 Objectives

The objectives of this study are threefold. Firstly, I aimed to critically examine my position on educational technology by unpacking my perspectives and tracing the experiences chronologically that led to my mixed feelings. I collected personal memory data through reflexivity and honestly revealed experiences that contributed to my disorienting dilemma with technology. Secondly, reflecting on my own lived experiences and using TLT, I self-examined shifts in my experiences and new role as it developed to determine whether a transformative process had occurred and, if so, to what degree. Such in-depth explorations of the transformation process and relationships are necessary to better support and guide other educators in effectively and comfortably using technology to improve their teaching and students' learning. Lastly, I sought to challenge the uncritical and overly optimistic assumptions about technology in the academic field of TEL by developing a more balanced perspective and nuanced discourse about educational technology from educators implementing unfamiliar technology through member-checking interviews.

Through the methodology of autoethnography and the presentation of truthful narratives, my aim was to achieve realism capable of evoking genuine emotions from the reader. Thus, the goal of this study was to establish verisimilitude (Ellis et al., 2011), hoping to evoke believable and lifelike feelings, thereby underscoring my credibility as a researcher. To bolster the validity of this approach, I collected voices from other educators to enhance the credibility of the narrative truth and to broaden the representation, thereby enriching the knowledge derived from my experience and fostering a more holistic and balanced view.

1.3.2 Research Questions

This autoethnographic study seeks to delve into the transformative nature of my pedagogical beliefs as I embark on an uncharted journey of incorporating AR into my classroom. By sharing a detailed first-hand account of my experiences, this research aims to offer valuable support and insights to fellow educators who may share similar mixed feelings of lacking experience, competence, and training in utilising unfamiliar technologies in their teaching practices especially as traditional studies are too impersonal. Through this comparative journey, I anticipate a profound evolution in my pedagogical approach and a reshaping of my long-held beliefs. By immersing myself in the exploration and mastery of AR, I aim to gain confidence and competence in applying technology as a pedagogical tool, ultimately enhancing my overall teaching competencies. By highlighting the challenges, breakthroughs, and transformative moments encountered during this journey, this study aims to contribute to the existing body of autoethnographic writings in the field of TL. By sharing my personal growth and development, I hope to shed light on the potential for growth and professional transformation that can arise from embracing innovative technologies in the classroom.

Through the reflective examination of my own journey, this study seeks to uncover the intricacies and nuances of utilising AR in education, offering practical insights to empower educators who may be navigating similar uncharted territories. By promoting the sharing of experiences and providing support to fellow educators, this research aims to foster a collaborative learning environment and promote the effective use of technology for enhanced teaching and learning outcomes.

To achieve this, the study employs an engaging form of research to address the following four research question (RQ):

RQ1: What were my experiences with educational technology before embarking on the AR journey?

RQ2: What was my initial experience as an educator when using AR for the first time?

RQ3: To what extent, if any, have my feelings and perspectives undergone a transformation?

RQ4: How does my experience compare to that of other individuals who have undergone a similar process?

1.4 Research approach

1.4.1 Theoretical approach

The TLT focuses on how individuals change their beliefs, attitudes and behaviour by critically reflecting on their experiences (Mezirow, 2009b). As this theory depends on critical reflection to address a profound change in perspective, this theory offers a holistic theoretical approach to personal growth. Although within educational research, several studies have explored TL to present its application to the classroom (Dirkx, 1998; King, 2004; Lewis, 2018; Meijer et al., 2017; Ukpokodu, 2009), this study at hand has the implication of contributing to the TEL field by broadening the understanding of how TL works in practice. By exploring an educator's first-hand account of implementing AR for the first time in the classroom, this research will offer valuable insights into the individual's challenges and opportunities, highlighting where and how the learning took place. Moreover, as the study uses autobiographical writing, the reader can also know the educators' initial perception through unpacking personal experiences exposing the underlying cultural, social, and historical factors that shaped the individual initial perceptions towards technology. As a critical reflection on the self/others is the foundation of the transformative paradigm (Qutoshi, 2015), the outcomes of this research will be helpful in the TEL field for educators to gain a better understanding of what implementing technology in the classroom will look like from a first-hand account. Furthermore, this study has the potential to provide individuals who have ambivalent attitudes towards technology with a sense of hope by showcasing the transformational experiences of others who share similar feelings, which has yet to be thoroughly explored in the existing literature.

1.4.2 Methodological approach

Autoethnography is a genre of creative exploration where the researcher is the main object of study, focusing on a case at hand rather than a generalised study (Ellis, 2004), thus offering a unique perspective based on one's own experience. The personal narrative combined with the theoretical analysis allows for unique and engaging research. This autobiographical writing has a charm that entices the audiences to reflect on their practice as they envision their future (Belbase et al., 2008). As previously noted, educators' holistic accounts exposing their personal transformative journey are currently lacking in the literature. To date, only one study explicitly uses autoethnography as a methodological

tool to critically self-examine educators' deeply personal and emotional journey to recognise a transformed perception; still, this study is expressly directed to a virtual teaching experience (Lewis, 2018).

Thus, the literature still lacks educators' first-hand experiences using AR as an educational technology in the classroom to have a detailed holistic account to portray a deeper insight into this specific phenomenon through personal nuances leading to the final perception transformation towards technology. Through the research process of reflexivity, the author can deliver engaging vignettes that allow the reader to connect with the story in a relatable way that currently is lacking in the TEL field.

1.5 Potential contribution

1.5.1 Contribution to knowledge in technology enhanced learning and teacher education

This study can potentially contribute significantly to TEL and teacher education. Firstly, the study offers a unique and personal perspective on integrating AR technology in the classroom by employing an autoethnographic approach. This qualitative research method allows for an in-depth exploration of the researcher's experiences, emotions, and TL journey, providing valuable insights into the complexities and challenges of implementing unfamiliar technology in educational settings. The study's focus on transforming long-held pedagogical beliefs in response to AR technology adds to the existing body of knowledge in TEL and teacher education. By examining the impact of AR on the researcher's pedagogical approach, the study contributes to a deeper understanding of how technology can shape and reshape educators' (and teachers') beliefs and ultimately practices. This insight is essential in guiding teacher education programs and professional development initiatives that effectively prepare educators to integrate technology in their classrooms by offering insight in to what a transformative learning process looks like.

Additionally, the study's emphasis on supporting educators who may feel inadequate or lacking in experience, competence, and training in using unfamiliar technology offers practical insights and support for transformative teacher education. The first-hand account of the researcher's journey, including the challenges faced, breakthroughs achieved, and the resulting growth and confidence, provides valuable guidance for educators seeking to navigate similar transformative journeys. This knowledge can offer emotional support for educators and teacher education programs by fostering a

collaborative learning environment. By promoting the sharing of experiences among educators, the study contributes to a supportive community where educators can learn from each other and feel empowered to embrace technology in their classrooms. The emotional support plays a crucial role in professional development, and this study can provide that for educators navigating the complexities of technology integration and venturing into TEL.

This study's contribution lies in its unique perspective, qualitative insights, and practical implications for TEL and teacher education. It adds to the growing body of knowledge in these fields by exploring the transformative potential of AR technology and offering support for educators embracing innovative technologies in their teaching practices.

1.5.2 Contribution to the theory of transformative learning theory

This study has the potential to make a valuable contribution to the theory of TL. By employing an autoethnographic approach and focusing on integrating AR technology in the classroom, the study provides insights into the TL process experienced by the researcher. Through the exploration of the researcher's journey, including the challenges, breakthroughs, and transformative moments encountered during the implementation of AR, the study offers a rich and detailed account of the TL experiences that can arise when educators engage with unfamiliar technologies. This personal narrative serves as an empirical example of TL in action, showcasing how the integration of AR technology can challenge and reshape long-held pedagogical beliefs.

The study adds to TLT by expanding our understanding of the factors influencing transformative experiences in educational contexts. It highlights the role of technology, specifically AR, as a catalyst for TL, prompting educators to reassess and reconstruct their beliefs and practices. Examining the researcher's journey provides valuable insights into the cognitive, emotional, and social processes involved in TL. It offers a nuanced understanding of how educators navigate and make meaning of their experiences with innovative technologies.

Conjointly, the study's emphasis on supporting educators who may feel uncertain, overwhelmed or lacking in experience and training contributes to the theory of TL by addressing the importance of a supportive environment and resources for facilitating transformative experiences. By sharing the researcher's struggles and growth, the study

underscores the significance of scaffolding and professional development opportunities in nurturing TL in educators.

Therefore, this study's contribution to the theory of TL lies in its empirical examination of the transformative experiences arising from integrating AR technology in the classroom. It adds to our understanding of the cognitive, emotional, and social dimensions of TL and highlights the role of technology and support systems in facilitating transformative experiences for educators.

1.5.3 Contribution to methodology of autoethnography

This study has the potential to contribute to the methodology of autoethnography significantly. By utilising an autoethnographic approach to explore the integration of AR technology in the classroom, the study offers insights into the application of autoethnography as a research method within the field of education.

One potential contribution is the demonstration of the effectiveness of autoethnography in capturing the researcher's personal experiences, emotions, and TL journey. The in-depth first-hand account of the researcher's experiences with AR technology provides a rich and nuanced understanding of the complexities and challenges involved in implementing unfamiliar technologies in educational settings. This is an example of how autoethnography can facilitate a deep exploration of personal experiences and reflections, offering valuable insights that may not be captured through other research methods.

By sharing the researcher's journey, including the challenges faced, breakthroughs achieved, and lessons learned, the study offers valuable guidance and support to fellow educators navigating similar technological transitions. Thereupon, the study contributes to the methodology of autoethnography by showcasing its potential for generating a sense of camaraderie and supporting educators. This highlights the potential of autoethnography as a method for producing academically rigorous, relevant research, and applicable to real-world contexts.

Furthermore, the study's exploration of the researcher's TL process through autoethnography contributes to the theoretical development of autoethnography as a research methodology. It showcases how autoethnography can examine personal growth, beliefs change, and pedagogical practice shifts over time. This adds to the understanding

of the potential of autoethnography as a method for studying transformative experiences and personal development within educational contexts.

Overall, this study's contribution to the methodology of autoethnography lies in its application of the method to explore the integration of AR technology in the classroom. It demonstrates the effectiveness of autoethnography in capturing personal experiences, generating practical knowledge, and supporting educators. Additionally, it contributes to the theoretical development of autoethnography by showcasing its potential for examining TL experiences.

1.6 Dissertation layout

This dissertation is arranged in the following structure. The proceeding chapter delves into the existing literature about how educators learn to use new educational technology, critically assessing how teacher goes through the implementation process and how shallow the technology implementation process is carried out. Moreover, the review seeks literature showing educators' holistic, TL journey towards implementing educational technology and their transformation of perspectives after the implementation process. The chapter identifies a lack of first-hand accounts of how educators learn throughout this implementation process, signifying how the research of this kind has been largely overlooked. Hence, the existing literature points towards how holistic research regarding how educators learn to use new technology for teaching is still unavailable.

The theoretical framework is presented in Chapter Three, giving a theoretical introduction to Mezirow's TLT and a reasonably comprehensive overview of how this theory is essential to contextualise and explore the experience critically to examine whether a learning transformation occurred within this holistic account. This section attempts to understand how this theory can be the foundation for comprehending an individualistic change in point of view regarding educational technology in practice. Bearing in mind that, to date, there is a lack of scholarly research exposing educators' first-hand experiences and emotions of using new technology to teach, this dissertation tactically aims to elicit further discussions by using this basic theoretical framework to gain a better understanding of educators' journey towards change in perceptions through the experience of implementing educational technology. The latter chapter describes the methodological approach of this study.

The remaining chapters shall deliver the specific contribution and application of the study. Through a profound initial reflection, Chapter Five allowed me to make sense of the various challenges I experienced. The findings are divided into two sections, allowing me to answer the RQ separately as the data was collected. Furthermore, the first part of the results answers RQ 1, whereas part two answers RQ 2 through narrative writing. Chapter Six presents the discussion of the analyse of the overall experience through self-examination to critically recognise personal transformation through the application of TLT in practice allowing me to answer RQ 3 while validating the data through other educators that experienced a similar experience to mine, giving a balanced discourse, simultaneously answering RQ 4. This chapter discusses my confirmed TL experience and demonstrates the significance of the findings by providing arguments supporting broader contexts as well as implications to the concepts and theory of TL in education from an educator's perspective.

Although this study mainly portrays one educator's experience that cannot be generalised to all educators' experiences and changes in perception, the general picture emerging from the analysis allows me to argue that this deep reflection compels readers through the authors' evocative voice and mode of storytelling, that other educators can relate to. Furthermore, the study collects other educators' voices through member-checking interviews, enhancing the study's validity and balancing the nuanced discourse. The final chapter summarises the findings and highlights this study's additional knowledge of the literature. Here in this chapter, limitations are addressed, and it also encourages researchers to explore areas that this study lacks to investigate.

Chapter 2: Literature review

2.1 Introduction

In the previous chapter, I divulged my initial reservations regarding technology and its potential impact on my teaching methods. Despite these concerns, I was driven by the desire for innovative and pedagogical relevance, motivating me to explore the integration of technology in the classroom. Consequently, I took upon myself the challenge of embarking on a journey to implement AR within my classroom, to teach anatomy to lower-level students within vocational education.

This chapter is dedicated to an in-depth exploration of existing scholarly works in three key domains: technology enhanced learning, technology integration in anatomy education (specifically AR) and technology enhanced teacher transformation. The review project employed a methodical approach in its literature search and article selection for critical review, as described in Arksey and O'Malley's work from 2005. The evidence was gathered by searching for peer-reviewed journal articles in Scopus, which is recognised as the largest abstract and citation database for peer-reviewed literature (www.scopus.com). The search involved utilising compound search terms, focusing on the titles, abstracts, and keywords of papers. Within Scopus, the use of curly brackets serves to pinpoint exact phrases, while quotation marks indicate a loose phrase. The asterisk served as a versatile wildcard character to broaden the search through variations in the terms, enhancing flexibility and search precision. Boolean phrases 'AND' and 'OR' were utilised to filter and narrow down the search results. The choice to use the Scopus platform was driven by the desire to comprehensively encompass existing research, ensuring the veracity and authenticity of the literature incorporated within this review.

As mentioned in section 1.2, my focus centres on the distinct research area of teacher professional development centered around transformative learning experiences of teachers for EdTech integration. This emphasis is significantly influenced by Jack Mezirow's TLT, which will be further expounded upon in the following chapter and serve as the guiding framework for the subsequent analysis of research findings.

Within the context of professional development for EdTech integration, I conducted three separate systematic reviews, spanning over the four weeks of August 2023, of current literature

to explore AR to teach anatomy and the role of technology in promoting transformative teacher learning. This involved examining studies, including those in-press, focussing on AR and its integration in education, how teaching anatomy could benefit from AR, and finally how educators (and teachers’) integrate innovative technology, to understand their overall experience, the potential transformation they underwent, as to understand what makes transformation successful. Additionally, I sought to identify any research gaps in the field, particularly by emphasising the personal and subjective aspects of transformative teacher learning experiences. This unique perspective allows educators to introspectively examine their professional growth, beliefs, and experiences within professional development.

In the upcoming sections, I initially outline the methodology employed for assembling the literature dataset, utilising a meticulous preliminary review. A detailed exposition of the review process is furnished, encompassing pertinent search terms, data parameters and inclusion and exclusion criteria, all of which serve to promote transparency (Arksey & O’Malley, 2005) to future researchers embarking on their own academic pursuits. This systematic procedure is replicated for each of the previously delineated principal domains, thereby facilitating the acquisition of the most credible and authoritative data available.

Upon the conclusion of the review process, the selected studies will substantially enrich the practical knowledge base of the aforementioned key domains. The ensuing critical analysis of the literature will underscore existing disparities, thereby highlighting a discernible gap in the research landscape that this study aspires to address and rectify.

2.2 Technology enhanced learning with a focus on augmented reality

This section explains the methodology for selecting studies on TEL to create a well-curated compilation that aligns with the theme. Here I delve into the scholarly landscape of TEL’s significance in modern education, focusing on its transformative potential and the historical evolution leading up to the introduction of AR in education, leading to the next part of this literature review.

2.2.1 Data compilation and analysis overview of technology enhanced learning

As previously mentioned, the online platform Scopus was used to gather ample and reliable papers, employing the following search terms:

- “technology enhanced learning” OR “educational technology” AND
- {augmented reality} OR {AR} AND

- “classroom”

The eligibility criteria were established to facilitate a subsequent filtering procedure, resulting in a robust and justifiable (Meline, 2006) selection of studies for the review. That is, to be included in the review, the abstract of the paper must demonstrate: i) a focus on technology enhanced learning; ii) a focus on AR within the domain of education; and iii) a focus on AR use in the classroom. The term ‘classroom’ included a broad spectrum of educational settings, including primary, secondary, vocational, and university level. The scope of the literature review was designed to provide a comprehensive understanding of AR in the classroom setting. A specific timeframe was not included, although this would have reduced the numbers to a more manageable timeframe, I did not want to lose articles that could be relevant to the study, seeing that TEL and AR go back more than twenty years.

The initial search on Scopus, conducted in August 2023, yielded 105 items. Papers that were not available in the English language were removed. Then, I reviewed the titles and abstracts of these papers, using the eligibility criteria (Table 2.1) to exclude certain articles, and following the question: Does the article discuss AR within the concept of this educational technology to enhance classroom education? This exclusion was based on the criteria such as if the articles focused on different areas (e.g., VR, or E-learning or workplace learning, or learning theories). Subsequently, I scrutinised the sources of peer-reviewed academic papers on Web of Science provided by Clarivate, to ensure their reliability and adherence to rigorous editorial standards. As a result of this process, I retained thirty articles, as shown in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta Analyses) flow diagram, Figure 2.1, for systematic reviews (Page et al., 2021). The items that fit the inclusion criteria were saved using the reference management software, Mandaley as a PDF management.

| Criteria | Inclusion | Exclusion |
|------------------|--|---|
| Language | English | Any other language |
| Research type | Primary research | Secondary research |
| Publication type | Academic journal | Editorial notes, conference abstracts, books/chapters, reviews |
| Subject of study | Technology enhanced learning | Articles within the realm of education however that do not relate to technology enhanced learning |
| Topic of study | Augmented reality for classroom learning | Augmented reality for work training, site visits or other types of informal training |

Table 2.1: Exclusion and inclusion criteria for article search 1

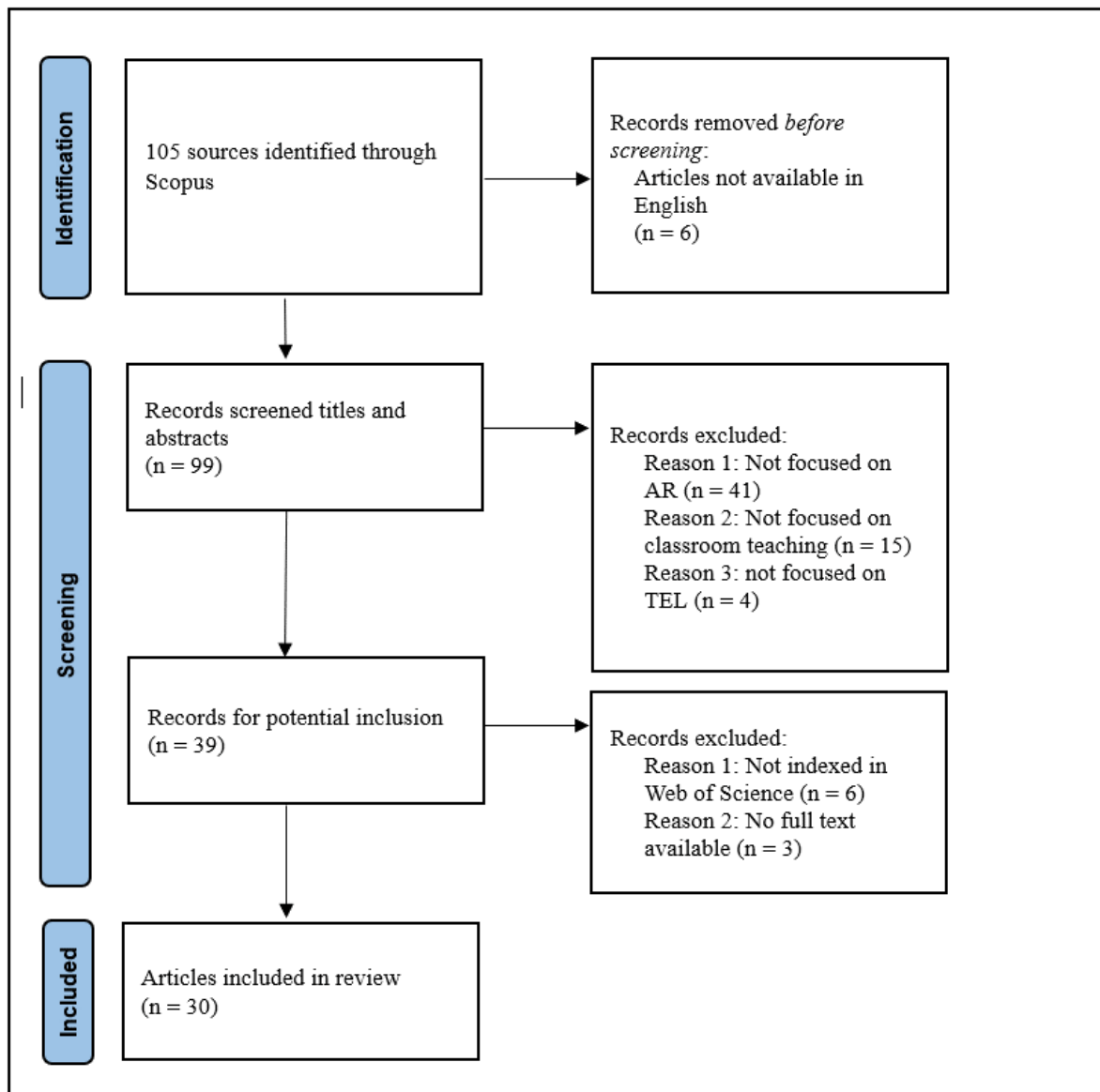


Figure 2.1: PRISMA flow diagram for article retrieval 1

Subsequent to this stage, I initiated a thorough examination of each article in its entirety. As I explored the application of AR to enrich classroom learning, I documented a variety of terminologies related to the interactive use of AR in education, observing how these terms were employed in conjunction with the primary assertions and the supporting evidence. Later, I synthesised the key themes evident in academic articles concerning the incorporation of AR into educational settings. Finally, to enhance this process, I incorporated additional studies frequently referenced within the dataset.

The synthesis encapsulates an assimilation of research that navigates the frontiers of technological integration, shedding light on how AR has been harnessed to augment and revolutionise the educational paradigm. The discourse embarks on a comprehensive journey, examining the dimensions of AR's capabilities and its potential in education. This exploration includes a discussion of the pedagogical implications of utilising AR, encompassing aspects such as engagement, motivation, and visualisation of complex concepts.

By intertwining empirical insights and theoretical deliberations, this section stands poised not only to chronicle the evolution of technological influences within education but also to underpin the transformational trajectory catalysed by the advent of AR. It is envisaged that this discourse will resonate as a guiding compass for educators, researchers, and stakeholders alike, who endeavour to harness technology's prowess in ushering forth a new era of enriched and immersive pedagogy.

2.2.2 Significance of technology enhanced learning in modern education

Over the past few decades, rapid technological advancements have dramatically improved people's lives and revolutionised both the concepts and methods of teaching and learning, exceeding our wildest expectations (Lee, 2022). Considering the advancements in technology and the transformation of information, it is fitting to characterise the 21st century as the era of electronics. In recent decades, the proliferation of computers has surged, the internet has attained eminence, and the union of digital data, lifestyles, and educational methodologies has harmoniously melded into everyday life (Tsai, 2018).

The ongoing process of change in education known as digital transformation, particularly in the aftermath of the pandemic, reflects the societal changes taking place (Serrano-Ausejo & Mårell-Olsson, 2023). The transformative change in technology has led to advancements in tools and apparatuses used in education, prompting educational establishments to allocate resources almost indispensable to technological progress (Önal & Önal, 2021). These

advancements, as described by Jdaitawi et al. (2023) have expanded the horizons of teaching and learning, fostering the evolution of instructional delivery methods such as computer-assisted teaching, e-learning, multisensory-based instruction, video recording, and virtual lectures. Moreover, more recently, heightened endeavours to utilise technology for the betterment of learning have given rise to educational settings undergoing a metamorphosis (Schmidthaler et al., 2023). This transformation is characterised by the integration of computers, multimedia resources, interactive whiteboards, the internet, web 2.0 authoring tools, simulations, games, and mobile phones (Jdaitawi et al., 2023) to improve the educational achievements of students (Moro et al., 2017). Additionally, emerging technologies like mixed realities, artificial intelligence, and virtual assistants have surfaced (Newman et al., 2022) with broad expectations for educational adoption (Lu et al., 2021). The 2022 HORIZON report (<http://www.educause.edu/eli>) has recognised these latter technologies as emerging forces with the potential to significantly influence the landscape of teaching and learning.

As digital technology becomes increasingly integrated into our daily lives, there is anticipation among students, particularly those of Generation Z, for more captivating and interactive learning experiences. This generation, having grown up with technology at their fingertips, often finds conventional educational materials uninspiring (Önal & Önal, 2021). However, it is important to note that while some students may gravitate towards innovative tools and approaches, others may still appreciate the simplicity and effectiveness of traditional methods. Therefore, the challenge lies in striking a balance between incorporating new technologies and honouring the fundamentals of education (Birt & Cowling, 2017). While technology can undoubtedly enhance engagement and provide opportunities for active involvement, educators must also consider individual differences, the adaptability of materials, and the broader context of effective teaching and learning. By taking a holistic approach and considering diverse perspectives, educators can create a more dynamic and inclusive learning environment for all students (Tsai, 2018).

2.2.3 Evolution of technology enhanced learning and its impact on teaching and learning

Educational technology is revolutionising the way individuals interact with educational content (Demircioglu et al., 2023). Its objective is to establish an enriching environment in which students can harness their inherent capabilities to comprehend intricate ideas and acquire sufficient knowledge by means of observation, emulation, and active participation (Moro et al.,

2017). In today's rapidly evolving landscape, where technology continues to advance, the integration of technology into educational settings has evolved into a benchmark for the excellence of education (Önal & Önal, 2021). The significance placed on incorporating technology into education is progressively growing over time (Assem et al., 2022). Notably, the use of digital technologies in education has been crucial in supporting and preparing students with 21st-century skills. These skills encompass interpersonal abilities such as communication, critical thinking, problem-solving, teamwork and digital tool management – all of which are essential in today's digitised society (Serrano-Ausejo & Mårell-Olsson, 2023).

Given that learners in this era are accustomed to accessing varied information through networks and digital multimedia channels (Tsai, 2018), it is not surprising that contemporary students are identified as being more inclined towards visual media compared to preceding generations, favouring a visual, hands-on approach to learning over traditional listening or reading methods (Birt & Cowling, 2017). In this new digitalised society, changing learning approaches to provide students with greater independence in their learning and the opportunity to develop 21st century skills through a student-centred approach may enhance the learning process and promote meaningful learning (Serrano-Ausejo & Mårell-Olsson, 2023).

2.2.4 Technology enhanced learning and its role in transforming educational practice

The emergence of new computer technologies has introduced a wealth of diverse teaching materials and media, promising to enrich students' learning experiences (Tsai, 2018). While these resources offer enhanced opportunities for interaction and engagement (Schmidthaler et al., 2023; Serrano-Ausejo & Mårell-Olsson, 2023), it is important to consider the broader implications. While multimedia technology, digital content, and software undoubtedly make learning more accessible for many students (Moro et al., 2017), we must also acknowledge the existence of a digital divide, where socioeconomic disparities can limit access to these resources. Moreover, the effectiveness of these tools in promoting deep learning and critical thinking skills is not guaranteed and may even increase cognitive load for some learners (Chen et al., 2022; Küçük et al., 2016). Thus, while technology holds potential benefits for efficiency and accessibility (Moro et al., 2017), educators must carefully consider its integration, ensuring that it complements rather than replaces traditional teaching methods and prioritises sound pedagogical principles. Ultimately, effective teaching hinges not solely on technological

innovation but on the thoughtful balance between technology, pedagogy, and the diverse needs of learners.

Through the utilisation of digital technology, teaching can be enhanced by enabling visualisation (Dandıl et al., 2022), which in turn improves learning and elevates students' abilities in conceptualising, manipulating, applying, and retaining their knowledge and skills (Birt & Cowling, 2017). The effectiveness of TEL is maximised when it seamlessly integrates into the curriculum, alleviates the passive nature of lectures in large classrooms, and serves as a platform through which students can actively engage in meaningful experiences while acquiring knowledge (Moro et al., 2017). In simpler terms, technology is not an added accessory, it is an essential part of the learning process (Kim, 2022). With this acknowledgement, the adoption of digital learning has surged in popularity as a creative pedagogical method aimed at boosting student engagement. This approach is readily accessible in the classroom through personal mobile devices, thereby enhancing its accessibility (Lee, 2022).

In the 21st century, mobile devices, especially smartphones, have undeniably become ubiquitous in global society. This widespread integration of mobile technology has undoubtedly shaped various aspects of daily life, including education. While there is no denying the convenience and accessibility afforded by mobile devices, it is essential to critically evaluate their impact on learning and society as a whole. Research related to mobile learning has evolved significantly since initial large-scale projects were undertaken in the early 2000s (Aguayo et al., 2017). The popularity of mobile learning has risen due to its inherent mobility and portability, enabling the construction and consumption of knowledge to take place anywhere (Lu et al., 2021). While initial research on mobile learning showcased its potential benefits, including enhanced mobility and flexibility in knowledge construction and consumption (Poçan et al., 2023; Radosavljevic et al., 2020), it is important to recognise that widespread adoption does not necessarily equate to universal access or equitable outcomes. Socioeconomic disparities, infrastructural limitations, and digital literacy gaps can hinder the full realisation of the benefits of mobile learning for all learners. Additionally, concerns about screen time, digital distraction, and reduced face-to-face interaction warrant careful consideration (Bacca et al., 2015; Wijayanto et al., 2023). Therefore, while acknowledging the transformative potential of mobile devices in education, educators and policymakers must address these challenges proactively, ensuring that mobile learning initiatives are inclusive, equitable, and conducive to meaningful learning experiences for all learners.

Viewed within the framework of constructivist theory, which posits that learning is an engaged and dynamic process (Lu et al., 2021), students have the potential to boost their confidence and motivation when they encounter tasks through an inventive and captivating learning environment (Aydoğdu, 2022). Active engagement significantly impacts students' grasp of participating in discussions and activities, especially those demanding advanced cognitive abilities. In this context, technology has emerged as an invaluable approach implemented within educational institutions (Jdaitawi et al., 2023).

2.2.5 Augmented reality and its integration into educational environments

In 1990, while employed as a researcher at Boeing, Thomas Caudell originated the term 'augmented reality' (Chien et al., 2010). Prominent corporations were exploring the application of AR for purposes such as visualising pilot training and other uses (Schmidthaler et al., 2023). This tool enriches reality rather than substitutes it (Lu et al., 2021) by enabling users to perceive their real surroundings while superimposing virtual elements onto or blending them with the environment, creating the illusion that the objects are part of the actual scene (Assem et al., 2022; Pérez-López & Contero, 2013; Wen et al., 2023). In essence, it enhances the existing reality by incorporating 3D virtual components into reality in real-time, presenting the spatial relations (Demircioglu et al., 2023). Typically, this technology is not restricted to a specific device, and finds support on smartphones or tablets, as this device encompasses the necessary components such as the processor, display, sensors, and input mechanisms (Newman et al., 2022), making AR flexible for users (Wen et al., 2023).

In recent years, there has been a growing fascination with multiple reality technologies like AR within many sectors (Schmidthaler et al., 2023). AR has found applications across various domains, ranging from the military to marketing. However, its most intriguing applications have emerged in educational contexts (Chanlin, 2018), where it serves to bridge the divide between the real and virtual realms, enabling learners to actively participate in this fusion (Jwaifell, 2019). AR offers learners experiences that go beyond what the physical world can provide, offering a sense of presence, immediacy, authenticity, and immersion (Lee, 2022). The capability of AR tools to provide scaffolding is effective in helping students gain accurate knowledge during periods of exploration and inquiry (Wen et al., 2023). The advantages of AR encompass its accessibility and affordability, thanks to the widespread adoption of mobile devices like smartphones and tablets (Lee, 2022). Exploring the possibilities of AR, offers notable advantages in the educational realm, such as crafting environments unattainable within

traditional classrooms, thus facilitating the safe and more accessible instruction of abstract concepts (Önal & Önal, 2021).

Taking a closer look at AR, it provides students with interaction that, in turn, fosters the development of comprehension, understanding, imagination, and retention through visualisation. These aspects are essential for enhancing learning and cognitive skills in learners (Demircioglu et al., 2023). Visual representation enhances learners' comprehension of structures and enhances student awareness by conveying detailed and meaningful visual information, facilitating connections between concepts, and fostering deeper understanding (Habig, 2020). Combining AR and mobile technologies has the potential to create a powerful impact on education, particularly when AR is integrated with gaming (Lee, 2022). An excellent illustration of this concept is Pokémon GO, a game supported by mobile AR, renowned for its visually immersive and interactive experience, which, drawing on the work of Wu (2021), has been recently harnessed for educational purposes. Such first-hand game-based learning interaction fosters motivational learning environments (Lu et al., 2021) that stimulate cognitive engagement (Lee, 2022). Pérez-López and Contero (2013) endorses the utilisation of AR in education, highlighting its capacity to provide immersive experiences that engage multiple senses, encompassing sound, visual, tactile, and emotional aspects. They argue that this multisensory stimulation fosters active participation in the learning process, a contrast to conventional teaching methods where these senses are typically engaged individually.

Recent studies have unveiled that AR does, in fact, hold the promise of substantially enhancing both teaching and learning processes. This is particularly evident in its ability to enhance students' reading experiences (Chanlin, 2018; J. Lee, 2022; Şimşek & Direkçi, 2023), boost motivation (Aydoğdu, 2022; Jdaitawi et al., 2023; Koç et al., 2022), and positively influence knowledge acquisition and retention (Assem et al., 2022; Birt & Cowling, 2017; Demircioglu et al., 2023; Demitriadou et al., 2020; Lu et al., 2021; Pérez-López & Contero, 2013; Tsai, 2018; Wen et al., 2023). Furthermore, AR has been demonstrated to enhance comprehension of intricate processes commonly encountered in science, technology, engineering, arts, and mathematics (STEAM) subject (Habig, 2020; Newman et al., 2022; Önal & Önal, 2021; Schmidthaler et al., 2023; Serrano-Ausejo & Mårell-Olsson, 2023). With that being said, AR holds a significant role in science educational field, encompassing numerous abstract concepts, including but not limited to anatomy (Chien et al., 2010; Moro et al., 2017; Newman et al., 2022; Nuanmeesri et al., 2019), astronomy (Önal & Önal, 2021), biology (Abdullah et al.,

2022; Chen et al., 2022; Demircioglu et al., 2023; Schmidthaler et al., 2023; Wen et al., 2023), and chemistry (Habig, 2020; Lu et al., 2021; Zhang et al., 2022).

In conclusion, AR technology shows significant potential for enhancing teaching and learning, particularly in anatomy education. It improves student experiences, motivates learners, and aids in knowledge acquisition and retention. This technology plays a pivotal role in the realm of anatomy education, offering exciting possibilities for further exploration and implementation to enhance the learning experience in this subject area.

2.3 Augmented reality integration in anatomy education

In this section, I offer a concise overview of the methodology used to select studies for the integration of technology into anatomy education. With the selected articles, the discussion delves into a thorough exploration of the scholarly landscape concerning the utilisation of technology, specifically AR, for teaching anatomy. The rationale behind this focused approach is to provide a specific and in-depth examination of AR for anatomy teaching, allowing for a comprehensive review of the literature in this specialised niche, ultimately delivering a more detailed and meaningful analysis. Furthermore, this targeted focus contributes to the relevancy of the literature review, addressing a niche area of research. It is tailored to educators within this domain and emphasises real-world applications, making it particularly valuable for professionals and institutions involved in anatomy education.

The primary focus is on the challenge of teaching anatomy, a complex subject, which students often find difficult to grasp, highlighting the significance of visualisation in such contexts. With a strong emphasis on visualisation, the conversation turns to how the trends in teaching anatomy have evolved and how the application of AR is finding its way in to educational settings to enhance the teaching of such a subject. It then transitions to showcase studies that have already utilised AR in the classroom, and their findings with regards to classroom teaching of anatomy.

2.3.1 Data compilation and analysis overview of technology integration in science education

Once again utilising the online platform Scopus, articles were gathered using the same screening and data collection protocol as previously described. The search included the below terms combined with the Boolean phrase ‘AND’ and ‘OR’ as conjunctions to combine the keywords to form strings:

- {anatomy} AND
- {augmented reality} OR {AR} AND
- “education” AND
- “learning” OR “teaching”

Once again, the establishment of eligibility criteria served to simplify the subsequent filtering process. In other words, to be considered for inclusion in the review, the paper’s abstract needed to exhibit the following characteristics: i) a focus on the subject of anatomy; ii) a focus on the use of AR within the realm of education; and iii) a focus on teaching or learning. Once more, a specific timeframe was deliberately omitted to prevent the exclusion of potentially relevant articles for the study. This search yielded a total of 261 items. I meticulously assessed the titles and abstracts of these papers, employing the eligibility criteria (as outlined in Table 2.2) to identify and exclude specific articles, guided by the question: ‘Does the article address the utilisation of AR in the field of education for the purposes of teaching or learning anatomy?’ This exclusion was influenced by various criteria, such as language (excluding non-English papers) and the articles’ emphasis on different areas (e.g., AR combined with other strategies such as VR or gamification, or the focus not being education, or AR being used to teach/learn animal anatomy). Subsequently, I conducted a comprehensive examination of the sources of peer-reviewed academic papers through the Web of Science. As a result of this process, I retained forty-one articles, as depicted in the PRISMA flow diagram (Figure 2.2). The articles that met the inclusion criteria were added to the Mendeley tool.

| Criteria | Inclusion | Exclusion |
|-------------------------|---|--|
| Language | English | Any other language |
| Research type | Primary research | Secondary research |
| Publication type | Academic journal | Editorial notes, books/chapters, reviews |
| Subject of study | Use of augmented reality to teach human anatomy | Use of augmented reality to teach other subjects / training or veterinary anatomy Use of other tools to teach anatomy |
| Topic of study | Education | Other disciplinary fields |

Table 2.2: Exclusion and inclusion criteria for article search 2

Following this stage, I embarked on a comprehensive examination of each article in its entirety. As I delved into the application of AR for teaching anatomy, I distilled the key themes found

in academic articles discussing the integration of AR as an educational tool for anatomical instruction. To further enrich this process, I included additional studies commonly referenced within the dataset.

This synthesis represents an amalgamation of research that pushes the boundaries of innovative education, illuminating the ways AR has been employed to teach anatomy by visualising organs. It also embarks on a thorough exploration of how educators leverage AR to instruct in this subject, examining its various dimensions. In the ensuing discussion, I will examine a collection of case studies in which authors have employed AR tools in the classroom, to gauge their efficacy in advancing the learning of anatomy. These investigations offer invaluable perspectives on how this state-of-the-art technology has the potential to transform the teaching and comprehension of human anatomy.

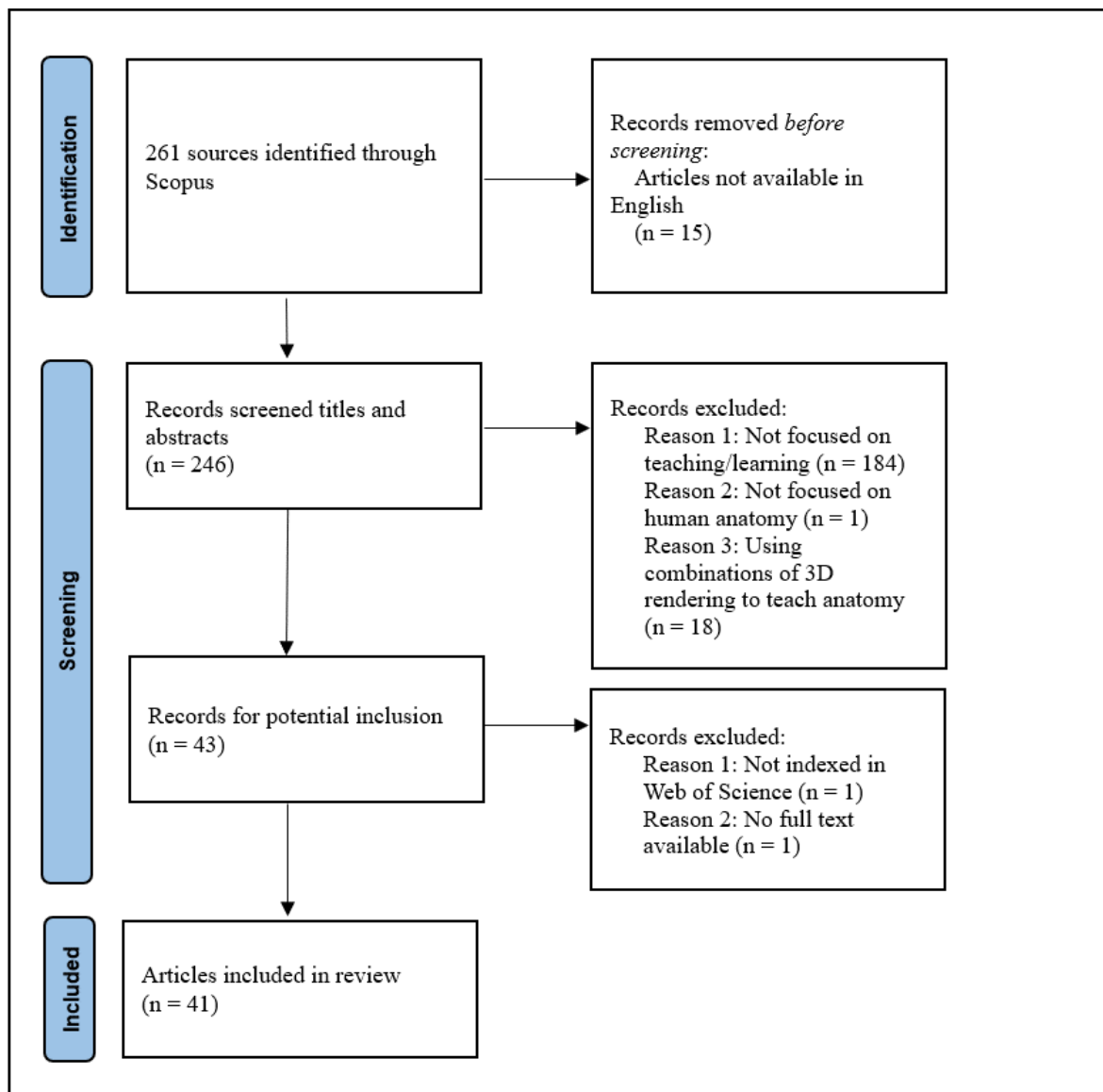


Figure 2.2 PRISMA flow diagram for article retrieval 2

2.3.2 Enhancing anatomy education: The evolution from traditional methods to immersive learning

Anatom's origins reach back to around 3000 BC, with Egyptians naming major organs and Greeks (circa 500-600 BC) pioneering medical dissections (Chien et al., 2010). Traditionally, non-medical anatomy has been typically taught through classroom lectures featuring slideshow presentations and verbal explanations of concepts (Bork et al., 2021; Moro et al., 2017). However, relying solely on passive teaching methods in anatomy education may hinder students' capacity to effectively grasp and retain new anatomical information (Zammit et al., 2022). Medical anatomy has customarily been taught through cadaver dissections, but this approach has waned in popularity over the past few decades (Duarte et al., 2020). As a result,

anatomy teaching now employs videos, diagrams, and plastic models as instructional aids, and self-directed study of anatomy often involves the use of 2D images and multimedia resources (Moro et al., 2021), however, they tend to offer limited interactivity and lack a sense of realism (Geerlings-Batt et al., 2022).

Humans unconsciously and instinctively encode the spatial positions of objects to aid in retrieving and recalling their locations (Chien et al., 2010). Establishing mental models of anatomical structures and comprehending their spatial relationships is a fundamental aspect of studying the anatomy of our body (Dandil et al., 2022). Students need visual presentations to help them better understand the body's scalability of the organs, shape, and function, 2D images cannot suffice as an appropriate form of instructional media (Nuanmeesri et al., 2019). Visual learning, when contrasted with conventional approaches, enhances memory retention significantly, as students achieve better comprehension of information through the utilisation of visual content as opposed to textual data (Duarte et al., 2020).

The optimal way to learn anatomy is in an environment where one can thoroughly examine desired structures from various perspectives (Moro et al., 2017). Anatomy is widely recognised as a challenging and intricate subject that requires effective resources to display visual information regarding the location and representation of organs and their function (Moro & Phelps, 2022). While the use of cadavers in medical courses and organ dissections in non-medical courses is a common method for teaching anatomy, it presents challenges due to ethical and financial limitations, as well as disparities in the student-to-supervisor ratio (Dandil et al., 2022; Moro et al., 2017; Zammit et al., 2022). As this approach becomes less practical, students are left without a realistic representation of human anatomy, that cannot be captured in a textbook (Chien et al., 2010). Consequently, the adoption of immersive technology is growing in popularity (Bölek et al., 2021) to offer students an authentic, multisensory learning experience that enriches their understanding through visual-spatial representations (Zammit et al., 2022). Leveraging 3D displays offers superior support for a particular spatial memory task, specifically learning an object's location through 'virtual anatomy' (Moro et al., 2017). Consequently, implementing AR facilitates the presentation of a lifelike 3D environment that establishes a direct link between the physical and virtual realms, thereby augmenting spatial performance and memory retention (Chien et al., 2010).

2.3.3 Augmented reality for conceptual understanding of anatomy exploration

AR systems fall into three primary categories based on how they present combined content: handheld such as through a mobile device or tablet that has a back camera, spatial displays such as a desktop or laptop (Jamali et al., 2015), and head-mounted displays (HMD) (Bork et al., 2021). Handheld AR overlays virtual elements onto a mobile device's live camera feed, like smartphones or tablets. In contrast, spatial displays, especially screen-based AR, show users a video camera view with added content on a standard monitor. Additionally, optical see-through head-mounted displays employ optical combiners and microdisplays to project virtual images directly in front of the user's eyes such as HoloLens® (Bogomolova et al., 2020).

In recent times, educators and scholars have been actively seeking inventive methods to enrich the educational journey, particularly within intricate disciplines like anatomy (Bölek et al., 2021; Duarte et al., 2020; Henssen et al., 2020). An exciting avenue being explored is the incorporation of AR technology within educational settings. AR has demonstrated considerable promise in captivating students (Eranda et al., 2023; Nuanmeesri et al., 2019) and enhancing their grasp of intricate anatomical concepts (Ferrer-Torregrosa et al., 2016; Sinou et al., 2023). In the context of anatomy education, a notable transformation is underway marked by the growing adoption of innovative learning tools that empower students to actively engage with 3D anatomical models (Duarte et al., 2020; Duncan-Vaidya & Stevenson, 2021; Jamali et al., 2015; Uribe et al., 2023). Among these emerging technologies, AR is gaining prominence as a valuable resource in anatomy education (Bork et al., 2021; Chytas et al., 2020; Moro et al., 2021; Moro & Phelps, 2022). AR is regarded as a highly promising technology in the field of life science education, particularly for elucidating abstract and unfamiliar concepts to students, like instructing on biological subjects such as human anatomy (Moro et al., 2017; Newman et al., 2022). Zammit et al. (2022) conducted a study to investigate the effectiveness of AR in retaining anatomical details, enhancing perception, and grasping spatial relationships during the learning of anatomy. Their findings emphasised the significance of AR as an educational tool, as it led to substantial improvements in students' comprehension of spatial relationships, facilitated the quicker absorption of intricate details, and deepened their understanding of fundamental concepts. The authors stressed that AR should not replace traditional teaching methods in anatomy but rather complement them. Similarly, Sinou et al. (2023) also emphasised the value of AR as enhancing the gold standard in medical anatomy, suggesting that it could be integrated with traditional approaches. In line with this, Henssen et al. (2020) recommended incorporating AR as a supplementary teaching tool for anatomy education, based

on their assessment of its effectiveness. Their findings indicated that students who utilised AR experienced reduced cognitive load compared to those who did not, highlighting the educational benefits of AR. Kck et al. (2016) supported these findings by establishing a connection between the use of AR and lower cognitive load. They also accentuated how AR facilitated independent learning outside the classroom.

AR represents an innovative instrument that holds the potential to be employed in education to energise, bolster, and foster learning encounters using graphical visualisation (Jamali et al., 2015). When contemplating, AR holds the capability to exhibit intricate 3D anatomical structures, replicate dissections, and even immerse students in dissection procedures, it becomes evident that this technology represents a profoundly immersive experience that significantly amplifies learning by fostering spatial understanding (Moro et al., 2021). Prior to the advent of educational technologies, the subject of anatomy without 3D visuals was often perceived as difficult to grasp because of limited spatial comprehension skills. However, with the emergence of technologies like AR, learners can now access exceedingly lifelike educational experiences that facilitate intricate learning processes (Newman et al., 2022). To put it differently, AR breathes life into two-dimensional images, elevating comprehension, and piquing students' interest in the subject matter (Nuanmeesri et al., 2019). In a study conducted by Bork et al. (2021), the effectiveness of head-mounted AR was examined for anatomy instruction. This research involved sixteen students and followed a pre-test and post-test design. The results of the study demonstrated that the utilisation of AR significantly enhanced students' anatomical knowledge, increased their engagement, and positively influenced their motivation through the visualisation of the structures. Similarly, Nuanmeesri et al. (2019) highlighted how AR facilitated easy and quick learning. Building on the work of Ferrer-Torregrosa et al. (2016), this research noted overall higher grades, improved focus, and better attention retention when using AR. However, in contrast, a study conducted by Duncan-Vaidya & Stevenson in 2021 explored the use of AR for teaching anatomy. This study, which included thirty-two college students, found that AR did not increase the effectiveness of teaching when conveying anatomical knowledge. Nevertheless, their findings did indicate that AR was engaging in nature, and students provided positive feedback regarding the use of this technology.

On the other hand, while many of the aforementioned studies back the positive impact of AR on visualisation, some research has indicated that this technology might not be equally available to all users. Nevertheless, the findings on this matter are inconclusive. Bogomolova

et al. (2019) conducted a study to assess the educational impact of stereoscopic AR visualisation and its influence on visual-spatial abilities during the learning process. Their research revealed a noteworthy contrast in the effectiveness of learning between 2D and 3D educational materials, particularly among participants with varying levels of visual-spatial abilities. Specifically, the study demonstrated that 3D visualisation enhanced comprehension for students with higher visual-spatial abilities, as they exhibited distinct eye movement patterns that enabled them to excel in mental rotation tasks compared to their peers with lower capabilities who tended to utilise the tools less effectively. Additionally, the study underscored the advantages of AR for collaborative and embodied learning which was congruent with the work of Uribe et al. (2023). Conversely, referencing the research conducted by Bork et al. (2019), their results indicate that AR had the potential to enhance spatial comprehension, especially among individuals with low spatial abilities, resulting in the establishment of an immersive, interactive, and self-guided learning environment. A similar result was seen in a study that compares AR, VR, and tablet-based technologies for delivering an anatomy lesson. In the work of Moro et al. (2017), fifty-nine students were introduced to the three aforementioned technologies to determine their relative effectiveness in learning. The findings revealed that students reported higher levels of enjoyment for the lessons, but did not exhibit any significant improvement in their test scores. The authors suggest that this discrepancy might be attributed to the novelty effect, which could have diverted students' attention away from the actual content of the lesson. Additionally, the study observed that VR induced cybersickness more frequently compared to the experiences with AR, however, this was not reported in other studies in this literature review.

AR promotes a shift away from passive, teacher-centred, and delivery-oriented learning methods, towards an interactive, student-centred, and exploratory approach that highlights the hands-on nature of learning anatomy, in accordance with Pérez-López and Contero (2013), as they assert that authentic learning necessitates firsthand experience. It facilitates the participation of multiple students in collaborative, team-based learning environments (Bork et al., 2021). Altogether, AR appears to provide solutions to the challenges associated with limited laboratory resources, costly equipment, and the challenges of obtaining and preserving specimens. It offers a convenient and cost-effective means of granting virtual access, which enhances students' comprehension and knowledge (Schmidthaler et al., 2023).

Moreover, augmented reality was discovered to be effective in teaching specialised areas within anatomy, as well as gross anatomy. Those who maintain that AR is effective in specialised

areas of anatomy include Bölek et al. (2021), who discovered that AR proved particularly valuable and engaging, especially when exploring inner brain structures that are not visible from the exterior. This finding is congruent with the work of Mendez-Lopez et al. (2022), which also confirmed AR as a highly valued and effective tool for teaching neuroanatomy. Also, Kugelmann et al. (2016) also support the use of AR in medical anatomy, as their large-scale study (n=880) shows positive results where AR enhanced motivation, increased active participation, and increased acquisition of knowledge. However, a study conducted by Geerlings-Batt et al. (2022), that studied the effectiveness of AR in anatomy in comparison to the use of radiographic image processing, a commonly employed tool in medical education, confirmed that, while the virtual models presented anatomical structures accurately, they still required students to consult textbooks for distinguishing structures. The authors proposed that incorporating algorithms and plugins into these programs could enhance automated segmentation of the body systems, addressing this limitation.

In conclusion, this literature review has provided valuable insights into the utilisation of AR for anatomy education. The potential of AR to enhance the learning experience and engage students in a more immersive and interactive manner is evident. As we transition into the next part of this review, I shall delve deeper into transformative educational experiences, and how such experiences can empower educators to evolve their teaching methodologies and provide students with an enriched learning environment.

2.4 The technology enhanced teacher transformation

The previous literature has emphasised the essential role of technology in the field of education, noting it as an indispensable tool in shaping teaching and learning experiences. Among the variety of technological advancements in mixed reality, AR stands out as a transformative force in the field of anatomy education (Bork et al., 2021; Chien et al., 2010). AR offers educators novel opportunities to engage students in immersive (Mendez-Lopez et al., 2022), interactive (Bölek et al., 2021), and spatially oriented learning experiences (Bogomolova et al., 2020). However, the effective integration of AR into the pedagogical framework hinges not only on technological capabilities but also on the willingness and adaptability of educators themselves.

In this section, we delve into the realm of teachers' reception and adjustment to innovative technologies, with a particular emphasis on teachers' experiences navigating change leading to TL experiences. Our exploration primarily centres on qualitative research, offering an intimate and personalised glimpse into how educators engage with technology within their classrooms.

Additionally, in cases where case studies were scarce, we also scrutinised larger-scale qualitative studies examining teachers' encounters and growth towards professional development. This comprehensive approach enables us to gain insight into the multifaceted aspects, including pre-conceptions, challenges and opportunities that made up the experiences of the potential transformation.

By synthesising these varied viewpoints, the objective of this section was to illuminate the intricate interplay among educators, technology, and their evolving professional development. Recognising teachers' experiences and perspectives is not only pivotal for shaping effective professional development but is also instrumental in harnessing the full capacity of integrating technology into teacher's classroom practices.

2.4.1 Data compilation and analysis overview of the technology enhanced teacher transformation

Using Scopus once more, I collected articles using the identical screening and data collection protocol as previously outlined. The search incorporated the following terms, combined with the Boolean operator 'AND' and the asterisk acting as a versatile wildcard character:

- "teacher" AND
- "integrating technology" OR "integrating educational technology" AND
- "experience*"

Initially, two other strings were attempted before settling on the above terms. The terms included for the first string including "integrating AR" OR "integrating augmented reality" instead of "integrating technology" OR "integrating educational technology" in addition to "teacher" AND "experience*". However, this search only resulted in twelve results, so the latter was used to replace them. The second string incorporated the terms "transformative learning" in addition to "teacher" AND "experience*", however, this search only resulted in one item, so this term was eliminated, resulting in the final string mentioned above.

The criteria specified in Table 2.3 were designed to identify studies relevant to the topic of teacher experiences implementing technology in pedagogy, within the field of education. Therefore, I set the data parameters to search for articles as detailed in the inclusion and exclusion criteria. Once again, a specific time frame to narrow down the search results was not applied to avoid overlooking potentially relevant articles for the study.

| Criteria | Inclusion | Exclusion |
|------------------|---|--|
| Language | English | Any other language |
| Research type | Primary research | Secondary research |
| Publication type | Academic journal | Editorial notes, books/chapters, reviews |
| Subject of study | Teacher experiences using specific educational technology | Studies that do not specifically address experiences of integration of technology in educational settings Teachers' preconceptions/beliefs about educational technology Student experiences using educational technology |
| Topic of study | Integrating educational technology to teach | Pre-service teachers' experiences using educational technology Technology to teach virtually |

Table 2.3: Exclusion and inclusion criteria for article search 3

Once again, the establishment of eligibility criteria served to simplify the subsequent filtering process. In other words, to be considered for inclusion in the review, the paper's abstract needed to exhibit the following characteristics: i) a focus on integrating educational technology; ii) a focus on educational setting; and iii) a focus on teacher experiences. This search yielded a total of 171 items. I meticulously assessed the titles and abstracts of these papers, employing the eligibility criteria (as outlined in Table 2.3) to identify and exclude specific articles, guided by the question: 'Does the article delve into the experiences of teachers implementing technology to teach?' This exclusion was influenced by various criteria, such as language (excluding non-English papers) and the articles' emphasis on different areas. A large amount of the studies focused on educators exploring online learning, and remote teaching, during the switch to online learning during the COVID-19 pandemic. As these studies used technology (such as laptops/PCs) the study focus was more focused on virtual learning rather than the teachers experience integrating the technology per se. Hence, they did not fit the criteria, thus they were eliminated. Other reasons included not being teacher-centred (e.g., the focus being on others including parents, students, and pre-service teachers), the focus being on teachers' preconceived beliefs of educational technology without the integration, or the focus not being teachers' experiences. Subsequently, I conducted a comprehensive examination of the sources of peer-reviewed academic papers through Web of Science. As a result of this process, I

retained thirty-eight articles, as depicted in the PRISMA flow diagram (Figure 2.3). The articles that met the inclusion criteria were added to the Mendeley tool.

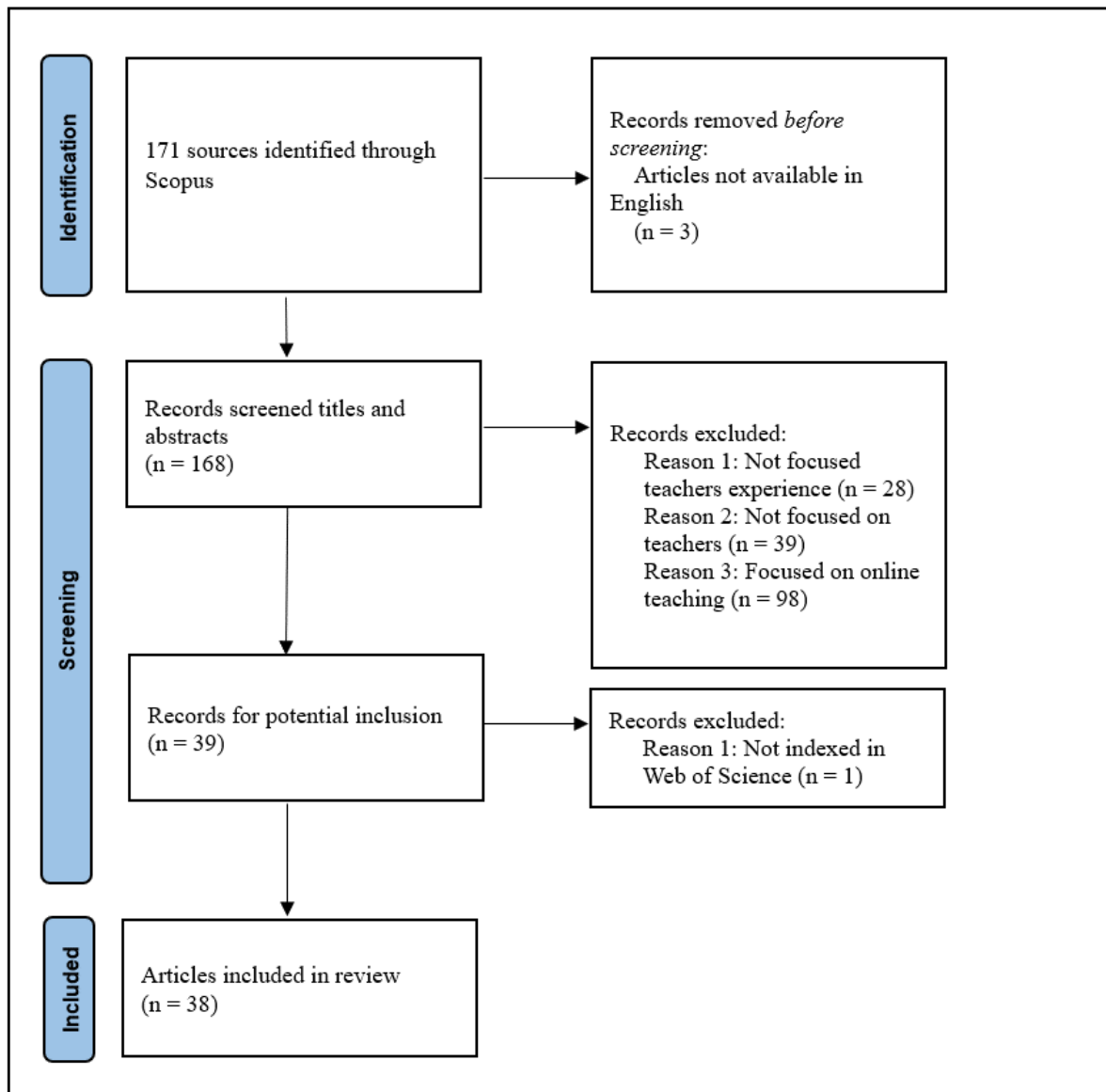


Figure 2.3: PRISMA flow diagram for article retrieval 3

2.4.2 Technology integration and the teacher

The incorporation of technology into educational environments is regarded as a pivotal reform. In this context, numerous developed countries' governments and institutions have embarked on substantial budgeted technology integration initiatives to overhaul their educational systems, aiming to provide equal opportunities to all students (Pamuk et al., 2013). Illustrative instances of these initiatives encompass the New Opportunity Fund (NOF) training program in

the United Kingdom, which operated from 1998 to 2002, and the Digital Strategy for Teachers and School Leaders in Australia, aiming to furnish teachers with substantial IT proficiency (Lai, 2010).

One of the foremost concerns in the realm of education revolves around the methods and agents responsible for accomplishing the integration of technology. In this context, educators bear the dual responsibility of not only proficiently employing technology but also imparting skills to students on how to harness information through technological means (Ersoy & Bozkurt, 2015). The essence of technology integration in education hinges on the effectiveness of its implementation. The quality of this implementation in the teaching and learning process primarily rests on the shoulders of educators (Agustin et al., 2018). Educators are anticipated to embrace new educational technologies and navigate evolving teaching landscapes, which necessitates a multifaceted learning journey capable of reshaping their perspectives (Lee & Brett, 2015).

Despite the potential of technology, its integration into instruction introduces fresh challenges for educators and necessitates a shift in teaching methodologies; the introduction of new technology cannot merely replace previous practices (Bell & Gresalfi, 2017). Mishra and Koehler (2006), (cited in Bell and Gresalfi, 2017) state that the integration of technology becomes exhilarating when it aligns with teachers' conceptions of technology and their expertise in the specific subject matter being taught.

In the 1990s, initial investigations in teacher technology implementation highlighted several obstacles to the implementation of technology in educational settings. These challenges included a dearth of experience in utilising technology, insufficient on-site IT guidance and assistance, limited access to necessary facilities, financial constraints, and a shortage of time dedicated to incorporating technology into the curriculum (Hedayati & Marandi, 2014). Today's existing literature indicates that these challenges have remained consistent over time, undermining teachers' confidence in incorporating technology into their classrooms (Allsop & Jessel, 2015; Kovalik et al., 2014; Patterson & Han, 2019). Such obstacles have instilled hesitancy among educators when it comes to incorporating technologies in the classroom (Hedayati & Marandi, 2014; Park & Son, 2009). Indeed, within the field of TEL, significant areas of research encompass teacher attitudes on change (Avidov-Ungar & Eshet-Alkabay, 2011; Howard & Mozejko, 2015; Kovacs, 2018; Marpa, 2021; Serin & Bozdağ, 2020), resistance among educators (Dovbenko et al., 2020; Finley & Hartman, 2004; Griffiths &

Goddard, 2015; Hannafin & Savenye, 1993; Howard, 2013; Purcell, 2005; Westberry et al., 2015), and teachers' proficiency in pedagogical content knowledge, often referred to as Technological Pedagogical Content Knowledge (TPACK) (Agustin et al., 2018; Avidov-Ungar & Eshet-Alkakay, 2011; Koehler & Mishra, 2009) as introduced by Koehler and Mishra in 2008. However, conducting research that leverages teachers' critical reflection to explore strategic ideation for challenging existing beliefs and addressing resistance can provide valuable insights into how to foster a transformative mindset, particularly in the context of integrating new technologies. Currently, there is a notable gap in understanding this transformative process.

2.4.3 Overcoming challenges and resistance

Change is a challenging process within the realm of education. Education systems worldwide often struggle to facilitate change and innovation due to the inherent complexity, rigidity, and deeply rooted traditions that characterise these systems (Kovacs, 2018). Concerning the adoption of technology by teachers, they recognise that their role has evolved. Nevertheless, owing to inadequate training, teachers find themselves uncertain about the specific steps to effectively embrace these changes (Allsop & Jessel, 2015).

The educational field is rapidly evolving, and the integration of technology in the classroom has become a main area of discussion and research (Park & Son, 2009). With more resources available to educators than ever before (Bell & Gresalfi, 2017), the role of teachers has shifted from traditional knowledge distributors to facilitators of immersive and interactive learning experiences (Nikian et al., 2013). This paradigm shift has given rise to a need for teachers to adapt and evolve, embracing innovative technologies to enhance student engagement and outcomes. With the following studies, I delve into the literature that investigates teachers who have embarked on this journey of change, exploring their challenges, triumphs, and broader implications for modern education.

Allsop et al. (2015) conducted a qualitative investigation involving ten teachers representing two diverse nations who integrated computer games into their classrooms. In-depth interviews revealed that while teachers recognised the educational effectiveness of digital games, they faced various obstacles hindering their adoption. These barriers shed light on educators' hesitancy to incorporate technology into their classrooms, with the most prominent challenges including difficulties in finding games that align with the subject curriculum, a lack of knowledge regarding new pedagogical approaches, and insufficient teacher training in utilising

new technologies. This study underscores the commonality of challenges faced by teachers implementing technology in the classroom, regardless of their geographical location, suggesting that there are consistent, universal barriers to technology integration in education that transcend international boundaries.

Similarly, in their 2014 study, Hedayati and Marandi conducted interviews with twelve EFL teachers to explore the constraints of integrating computer-assisted language learning into their teaching methods. The participants were mixed between those who had experienced using this technology, and others without experience using this technology but were on the verge of integrating this teaching method. The findings of this investigation revealed three primary areas of concern. Firstly, insufficient preparation, training, and digital literacy, are also emphasised by Lai (2010). It was observed that these teachers had not received professional development training in technology, nor had this subject been covered in their pre-service education. Secondly, obstructive attitudes where the study identified that educators lacked an understanding of the advantages of incorporating technology into their classrooms. This lack of awareness led to apprehensive attitudes, which acted as barriers, deterring them from embracing technology and its application. The authors' perceived lack of skill was directly related to their resistance, driving fear of the unfamiliar. Lastly, lack of support from stakeholders. The third area of concern revolved around the absence of support from various stakeholders, including supervisors and students. This lack of support contributed to teachers' apprehension about modifying their pedagogical approaches. Additionally, inadequate access to facilities and tools further compounded their perception of inadequate support from supervisors. Teachers also expressed concerns about students' attitudes, as they felt either unmotivated by students or feared that not all students would have equal access to technology.

In conclusion, while the integration of technology into educational settings often encounters its fair share of challenges and resistance, it is imperative to remember that these obstacles are not undefeatable. By addressing concerns, providing adequate training and support (Pamuk et al., 2013), and fostering a culture of adaptability (Allsop & Jessel, 2015), educators and institutions can pave the way for meaningful pedagogical shifts and transformation.

2.4.4 Pedagogical shifts and transformation

Educators need a transformative shift in mindset to change their perceptions and embrace technology in their classrooms and adapt their teaching methods (Lee & Brett, 2015). Utilising a TL framework can elucidate the educational technology adoption journeys of teachers, where

instances of critical self-reflection and the subsequent transformation and growth of their perspectives are observed (Mezirow, 2009b). Such a study that uses TL to address an educator's journey can be seen in the study by Ersoy and Bozkurt (2015).

This case investigation delved into an individual teacher's classroom experience of implementation and utilisation of technology. Employing narrative inquiry as their methodological approach, these authors sought to comprehend one educator's practices throughout his teaching career. By adopting TLT as their conceptual framework, they contextualised how the teacher incorporated technology into his teaching methods, fostering innovation and transformation. The results of this study reveal that the teacher's decision to integrate technology into the classroom stemmed from a desire to adapt to the technological changes observed in his students. This implies that teachers can be motivated to embrace technology when they perceive its relevance in the educational context. In this context, it became evident that triumphing preconceived biases against technology and embracing innovation played a pivotal role in motivating this teacher to embrace cutting-edge technological tools. This suggests that teachers may need to change their mindset and be open to adopting cutting-edge technological tools. Furthermore, this research highlights the importance of teachers receiving mentorship and support from peers who are adept at using innovative technologies in the classroom. This fosters encouragement and guidance, which is also discussed by Kim (2022) underscores the idea that teachers learn to use technology by building off each other's experiences. Additionally, the study underscored the significance of certain prerequisites for educators to effectively adopt innovative technologies, including adequate time for adaptation, meticulous preparation, access to appropriate resources, and the acquisition of necessary knowledge on the technology and how to implement it in the classroom. Furthermore, teachers must equip themselves with the skills necessary to troubleshoot potential technical issues that may arise during the instructional process. These findings were consistent with those of Hedayati and Marandi, (2014).

An additional investigation of a teacher's professional growth who integrated VR technology in the classroom at an elementary school is by Patterson and Han (2019). Their primary objective was to chart the transformation of the teacher's knowledge, beliefs, and instructional practices throughout the technology's implementation process. To achieve this, the authors relied on a comprehensive methodology involving their observations, video recordings, the teacher's written reflections and fieldnotes, as well as pre-and post-interviews with the teacher. Significantly, the VR employed in this study was tailor-made to correspond with the

instructional unit's specific curriculum, a factor that this study identified as contributing to increased teacher usage of the tool, particularly when they have been actively involved in the technology's development, leading to a sense of ownership. The study's outcomes revealed that the teacher encountered a range of opportunities and challenges during the four-week period of implementation. These experiences collectively contributed to a meaningful learning journey, enhancing the teacher's proficiency in utilising emerging technologies. The teacher's regular utilisation of critical reflection for self-assessment aligns with Kim's (2022) assertion that this practice can facilitate a more meaningful integration of technology. Additionally, the teacher was motivated to take risks, engage in reflective lesson planning, and incorporate unfamiliar tools into their teaching practices. This article offers valuable insights into how teachers' professional growth can occur through technology integration, which can be related to this current study at hand. However, a notable limitation of this study is the absence of a theoretical framework, which could have substantially enhanced the theoretical underpinnings related to TL. Yet this qualitative inquiry illustrated a teacher's professional development despite the absence of a theoretical foundation.

Lastly, a more recent study by Han and Patterson's (2020) significantly advances the discourse on the impact of TPACK on educators' professional growth. Their research delves into the intricate process of a teacher's learning journey and the development of TPACK within iterative design processes. By focusing on an experienced teacher's utilisation of VR and investigating the influence of various barriers and facilitators on design decisions, their work illuminates how knowledge, beliefs, and instructional practices evolve. Through a systemic analysis, the study delineates the pathways of this teacher's learning within curriculum design practices. Importantly, it provides practitioners and researchers with invaluable insights into how educators cultivate integrative knowledge regarding innovative technology usage and underscores the critical role of professional development in supporting teachers' continual learning and adaptation.

Consequently, apart from the latter, this literature search found studies that show educators implementing technology in the classroom, however, either due to not using TL as an underpinning or since the studies were not in-depth enough, the studies could not represent a multifaceted learning experience that has the potential to reshape teachers' attitudes, viewpoints, and ultimately, their practices. The following studies identified were pertinent to this review because they did explore the incorporation of technology into the classroom, albeit

not in a transformative manner. Nevertheless, these studies merit a clear acknowledgment as they contribute valuable insights to the existing body of literature.

Agustin et al. (2018) studied twenty-five science teachers to describe their experiences integrating digital technology in classrooms using TPACK as a framework to assess technological knowledge and proficiency. The findings revealed a significant gap between teachers' technological and content knowledge, negatively impacting technology integration. However, the study lacks depth, suggesting the need for a more comprehensive exploration. Building on Avidov-Ungar and Eshet-Alkalai (2011), the study aligns with Koehler and Mishra (2009) notion that educators with higher TPACK levels show more openness to technology-based teaching methods and view their institutions as hubs of learning.

In their 2017 case study, Bell and Gresalfi examined a teacher using a video game as a math teaching tool. The study aimed to evaluate the impact of this technology on instructional methods. While it highlighted technology integration and its potential influence on teaching it overlooked the chance to delve into the teacher's personal experience and its direct impact. Including the teacher's input could have added depth, providing a more immersive perspective beyond the analytical breakdown.

Pamuk et al. (2013) investigated a pilot project introducing interactive boards to eleven schools, focusing on teachers' perspectives. Through questionnaires distributed to 181 teachers, the study found an overall positive response, despite technical challenges and pedagogical issues. Problems included a lack of interaction between the board and students' devices, resulting in classroom management difficulties and reduced student engagement. Teachers expressed anxiety over technical knowledge gaps and ineffective use of the technology, along with concerns about increased workloads and a shortage of suitable electronic materials. The study did not explore specific classroom opportunities and did not assess educators' pre-existing perceptions of technology, leaving uncertainties about attitude transformations. However, a positive outcome was the noticeable increase in teachers' interest and motivation towards technology.

Nikian et al.'s (2013) examined the perspectives of seven teachers integrating technology into their classrooms. While it touched on their collective experiences and challenges, it lacked an in-depth exploration of whether there was a pedagogical transformation at the core of their encounters. This omission raises questions about the study's thoroughness, particularly regarding evaluations of instructional method changes, the impact on student achievements,

and the long-term consequences of technology incorporation. Examining these dimensions would enhance understanding of technology's potential for classroom transformation.

In an article by Kovalik et al. (2014), four teachers share experiences with free Web 2.0 tools in their classrooms. The article covers tool introduction into the classroom, utilisation, student reactions, and teacher perspectives but falls short of providing a deep understanding of the teachers' lived experiences. This limitation raises about the study's scope, including whether it explored changes in teaching approaches, effects on student achievements, and unique obstacles and achievements. There's untapped potential to investigate teachers' learning experiences for valuable insights for educators. Addressing these dimensions would result in a more exhaustive exploration of teachers' Web 2.0 tools use, offering valuable insights for the wider educational community.

2.5 Research gap

The first two sections of the literature review present compelling evidence supporting the efficacy of AR as a valuable tool for education and then more specifically in enhancing anatomy instruction. However, the widespread adoption of AR technology for educational purposes in schools remains relatively scarce. This limited adoption can primarily be attributed to the persistent requirement for educators to possess digital competence and confidence in adopting these methods, as highlighted by Serrano-Ausejo and Mårell-Olsson (2023). Additionally, teacher beliefs have been identified as a key factor influencing the acceptance and implementation of technology in education (Jang et al., 2021).

In the final section of this review, I endeavoured to identify studies that shed light on successful transformative journeys undertaken by teachers when implementing technology. Unfortunately, the literature to date lacks studies that specifically highlight such transformative journeys using AR technology. To contextualise this gap in the study at hand, it is essential to consider it within the broader context of technology integration and the challenges that educators encounter when embracing innovative educational approaches. While the existing studies included provide valuable insights into the general integration of technology, they fall short of addressing the unique characteristics of AR technology and its implications for teacher-centred TL. Furthermore, the examined studies lacked a firsthand account that educators aspiring to transform could connect with. This notable gap in research underscores the necessity for a more in-depth investigation into the transformative possibilities of AR within the educational realm.

2.6 Conclusion

As we delve into the existing literature, it becomes evident that AR stands as a powerful tool within the realm of education, with relevance in the field of anatomy. The body of research highlights the efficacy of AR in enhancing learning experiences. Nevertheless, a noteworthy observation is that most studies primarily focus on establishing AR's effectiveness as a teaching tool in a broader educational context. When AR is applied specifically within the domain of anatomy education, the prevailing narrative shifts towards comparing AR with traditional pedagogical methods. These studies illuminate the positive impact of AR on the visualisation of complex anatomical structures, offering promising insights.

Yet, an overarching trend emerges. Rather than addressing the practical concerns and challenges faced by educators looking to adopt AR technology, the research predominantly emphasises the need to establish AR's place within educational settings. Internal barriers, such as varying attitudes among educators, and external barriers, such as resource constraints, are acknowledged but not thoroughly explored on a personal level that would allow teachers to be aware of how to overcome such barriers. Even within the broader landscape of innovative classroom technologies, studies often lack a comprehensive understanding of what educators actively immersed in technology integration truly experience.

This literature review underscores the expanding body of research within TEL and the wealth of resources available to educators. However, it also highlights the need for more studies that go beyond proving the potential of AR and delve into the practicalities, challenges, and solutions that educators require when implementing this promising technology to reach the status of transformation.

While we know that teachers are incorporating technology, there are a few studies that showcase a personal in-depth teacher transformation experience. Hence, what successful technology integration in the classroom looks like remains unclear, especially when using AR. Thus, this paper aims to enhance our evolving comprehension of how teaching methods with this cutting-edge technology can look, with a specific example of using a tailor-made AR mobile application, crafted to reach the pedagogical outcomes within the classroom context. When educators (including teachers) share their successful experiences of integrating technology into their classrooms, they provide valuable real-world insights that provide emotional support to others. These narratives can, in turn, support other educators to acquire proficiency in using specific technologies, recognise their potential to assist students in

reaching educational objectives, formulate suitable learning strategies and activities, and give courage for them to take chances with their own students.

In the next chapter, we shall delve into the methods used to carry out this study, including the philosophical background, methodology and methods. In the upcoming chapter, we will embark on a comprehensive exploration of the methods employed to conduct this study. This journey will encompass a brief explanation of the philosophical underpinnings that shaped the research approach, a detailed overview of the methodology employed, and an in-depth discussion of the specific methods and techniques used to gather and analyse the data of this autoethnography. By delving into these key components, I aim to provide readers with a clear understanding of the robust framework underpinning the study, ensuring transparency and rigor.

Chapter 3: Theoretical framework

3.1 Introduction

3.1.1 Overview of the chapter

This chapter initiates an exploration of the theoretical framework (TF) underpinning this study. It begins by elucidating the purpose of the TF and introduces the focal theory, TLT, along with its pertinence to the study. A rationale for selecting TLT over alternative theories is presented, elucidating the theory's linkage to methodological implications and research design, thereby articulating how TLT will serve as a paradigm for this investigation. Subsequently, a comprehensive examination of TLT unfolds, delving into its historical backdrop, elucidating the theory principles, and spotlighting prominent theorists and their contributions.

Furthermore, the chapter dissects the fundamental components of TL, identifying, and explicating their interrelationships through examples that illustrate TL in practical scenarios. Following this, the chapter delves within the philosophical underpinnings of TLT, scrutinising the theoretical foundations supporting the framework and delving into any critiques or debates within the literature concerning these assumptions.

The narrative then proceeds to underscore the significance of key components of TLT, and establish connections between disorienting dilemma, discourse and the centrality of experience, critical reflection, and the ten phases of TLT.

Ultimately, the chapter culminates by summarising the pivotal impact of the TF on the study. It underscores the importance of TLT in shaping the research questions and study objectives. A concise conclusion recaps the key points of the chapter, seamlessly transitioning to the next chapter.

3.1.2 The importance and role of the theoretical framework in the current study

TF play a crucial role in elucidate and forecasting relationships, drawing from insights gained through various tests and research endeavours (Cohen et al., 2018). These frameworks establish foundational underpinning conceptual relationships. In research's exploratory phases, TFs enhance theoretical concepts (Connelly, 2014).

Employing a TF is vital for organising and directing research, furnishing a theoretical foundation, and enhancing overall rigor and validity (Grix, 2010). This framework establishes

a conceptual groundwork, facilitating comprehension of key concepts, variables, and relationships. Additionally, it guides the researcher (hereafter I) in making informed decisions about methodology, hypothesis development, integration with existing literature, relationships to explore, and subsequent data analysis and interpretation.

Guided by the theoretical underpinning of TLT, particularly influenced by Mezirow (1978), my data collection and analysis were shaped. While various theories were considered, Mezirow's theory stood out. My exploration of a theoretical standpoint commenced early in my doctoral studies, sparked by a growing interest in autoethnographic research. Throughout my doctoral modules, I explored autoethnography as a research method and engaged with diverse theories in educational research, specifically those aligning well with the TEL field, including the Technology Acceptance Model and Activity Theory. However, as I prepared for this thesis, my focus shifted towards personal growth and perspective transformation, rather than solely understanding the technology adoption or exploring the social and collaborative aspects offered by other theories. Consequently, I chose to utilise TLT as a guide to critically reflect on my assumptions, using Mezirow's (1997) frame of reference. TLT allowed me to address transformative changes in perspective, beliefs, and ways of thinking in alignment with my objectives. The chosen theory, combined with autoethnographic writing as a methodological tool, enabled me to showcase how my perspective is shaped throughout the process of unpacking, especially as I grappled with my dilemma of incorporating EdTech throughout the years. Initially, I sought a doctorate in TEL to address this challenge, but then unexpectedly found myself navigating the complexities of the COVID-19 pandemic and global technological changes. TLT allowed me to address transformative changes in perspectives, beliefs, and ways of thinking in alignment with my set objectives.

Autoethnography serves as an empirical research methodology aimed at studying both the self and presenting alternative perspectives (Hughes & Pennington, 2018) where the foundation for gathering data involves recollecting personal memories and experiences (Chang, 2016). The skill of accessing memory, coupled with critical reflection, can be translated into textual data. The process, facilitated by member-checking (Carlson, 2010), establishes a discourse with both oneself and others. TL and autoethnography collaborate effectively, mutually fostering critical reflection, discourse, and an exploration of the centrality of experience. Furthermore, they bridge the personal and the cultural, situating the self within a social context (Holt, 2003). In this study, the framework of TLT was employed to conceptualise my educational journey, emphasising the critical examination of my past. Complementing this approach,

autoethnography serves as both the research method and the tool, enabling a critical examination of the past. Through reflective analysis of my experiences, I identified a pivotal moment, akin to an epiphany (Adams et al., 2015; Ellis, 2004), marking the initiation of my TL journey, specifically encountering a disorienting dilemma (Mezirow, 1978).

Additionally, the narrative inquiry inherent in autoethnography, including storytelling, proved instrumental in making sense of my journey. This method facilitates a reconsideration of preconceptions and serves as a motivating force for personal improvement (Christie et al., 2015). The diverse data collection methods within autoethnography offer extensive avenues for reflection. These methods encompass chronicling my personal history through introspection, cross-verifying recollections with external sources (member-checking) and capturing field notes to analyse my experiences within the classroom setting (self-analysis and self-evaluation). Autoethnography provides an immersive engagement with the data, while TLT intentionally guides and shapes the research process with purpose. The narrative format reflects personal and professional growth, aiming to resonate with a wider audience.

3.2 Philosophical underpinnings of transformative learning theory

3.2.1 Historical background of the theory

TL is a concept entrenched in the field of adult and vocational education (Wang et al., 2021), and holds relevance in adult learning environments. This theory underscores the idea that as adults engage in diverse learning experiences, they can cultivate ingrained habits of thought and behaviour. These habits, once established, may persist, or resurface during periods of change (Reinsfield, 2018). According to Mezirow (2012), TL involves a process wherein learners reshape their mental habits by redefining problems, scrutinising assumptions, and evaluating the content or methods employed in problem-solving. This process fundamentally relies on critical reflection (Wang et al., 2021).

Mezirow (2000) posits that the transformative journey commences with a ‘disorienting dilemma’. This pivotal moment prompts learners to reflect on their emotions and assess the assumptions that led to the disorienting dilemma. Recognising and navigating this dilemma is essential for the transformational process to unfold. Subsequently, individuals undergo a series of events, including acknowledging shared feelings with others and exploring preventive measures against future disorienting dilemmas. Through planning, experimentation, and the development of novel ideas, learners gain new experiences that catalyse a shift in perspective.

This transformative journey results in learners adopting fresh viewpoints, thereby broadening and informing their frame of reference (Kitchenham, 2008). The culmination of this process allows individuals to integrate their newfound perspectives into their daily lives.

Mezirow (1978) coined the term ‘transformation’ in his examination of U.S. women re-entering postsecondary education or the workforce after an extended hiatus. With a focus on addressing the needs of women returning to education or employment following a prolonged absence, Mezirow conducted a qualitative study in 1975. This study aimed to identify factors that either hindered or facilitated women’s progress in re-entry programs. Examining twelve diverse college re-entry programs with eighty-three women participants across the United States, Mezirow conducted in-depth investigations.

As a subsequent step, he extended his research through a nationwide telephone survey across eleven states and sent mail to 1,172 colleges, receiving responses from 846 institutions, of which 314 sponsored re-entry programs for women. The findings from these studies led Mezirow and his research team to assert that these women had experienced a ‘personal transformation’, giving rise to the identification of ten phases that continue to be employed today to recognise TL (Kitchenham, 2008).

3.2.2 Theoretical background

Over the last four decades, Jack Mezirow’s TLT has fundamentally altered our comprehension of adult learning and consequently influenced the approach to pedagogy for adults. His contributions have led the TL movement, acknowledged by virtually every academic reference citing his work (Calleja, 2014). Mezirow’s TLT drew inspiration from various sources, such as Thomas Kuhn’s (1962) paradigm, Paulo Freire’s (1970) conscientisation, and Jürgen Habermas’s (1971, 1984) concepts of learning domains (Kitchenham, 2008).

Mezirow drew upon Kuhn’s (1962) concept of paradigms, theorised as a shared set of problems, solutions, a differentiated focus of interest, and a common worldview. This served as the foundation for Mezirow’s development of TLT. Kuhn’s influence is evident in Mezirow’s TLT, particularly in the concept of frame of reference (Calleja, 2014). Mezirow views ‘A frame’ as a social situation, detailing how to understand and navigate it, diverging from Kuhn’s paradigm in that Mezirow’s frames are implicit and establish boundary structures for perception and comprehension. This gave rise to meaning perspective and habits of mind making up the frame of reference leading to a perspective transformation (Mezirow, 1991).

Mezirow's concept of TL bears the imprint of Paolo Freire's theories, notably his exploration of conscientisation (1970). Conscientisation involves acquiring the ability to perceive social, political, and economic contradictions, fostering critical self-awareness to empower individuals to confront oppressive realities actively. Freire outlines a progression through three stages of consciousness growth, with critical transitivity representing the pinnacle influence on Mezirow's work. This stage is attained by identifying problems critically and taking decisive action to instigate transformative change. Mezirow's ideas, such as disorienting dilemmas, critical reflection, self-reflection on assumptions, and critical discourse, clearly reflect the influence of Freire's work (Calleja, 2014; Kitchenham, 2008).

Ultimately, Mezirow's development of TLT was significantly influenced by Habermas's (1971, 1984, 1987) examination of discourse, instrumental, communicative and emancipatory knowledge. The pivotal concepts of argument and rationality played a crucial role in shaping TLT (Wang et al., 2021). Mezirow drew on Habermasian concepts, particularly the ideas of discourse, as a TL mechanism (Kitchenham, 2008). Additionally, Mezirow incorporated Habermas's perspective on participatory democracy, emphasising critical reflection as a fundamental assumption in TL (Eschenbacher & Fleming, 2020).

Mezirow, in his examination of these domains, articulated a perspective transformation that highlighted the importance of dialogue, communication, and critical reflection (Kitchenham, 2008). This perspective transformation, in turn, incorporated the ten phases of adult learning (Mezirow, 1978).

3.2.3 Key concepts and principles of transformative learning

TL within adult, higher, and continuing education has maintained its presence for more than four decades, persisting as a prominent theory that remains a focal point of discussion and research in the realm of education (Taylor, 2007). To grasp TL, it is essential to comprehend the domains of adult learning. These domains underscore the varied aspects of TL, emphasising that personal and intellectual development entails a multifaceted journey encompassing various facets of an individual's life.

3.2.3.1 The domains of learning and its application to the study

According to Habermas, as outlined by Mezirow (1991), the three fundamental 'knowledge-constitutive' domains in adult learning are the technical, the practical, and the emancipatory. These domains represent the origins of knowledge and the methods for acquiring it. In the

aforementioned technical domain, cognitive processes are directed toward instrumental action (strategic action), involving the acquisition of knowledge governed by technical rules. This aims to acquire skills and information essential for the functioning of the system. Instrumental action inherently involves predicting observable events and subjecting them to scrutiny through system monitoring feedback for validation or refutation.

The second cognitive sphere, termed practical, engages in communicative action. In this domain, systematic inquiry is directed toward understanding meaning rather than establishing causality, as articulated by Mezirow (1981). This form of learning enables us to connect with the world, interact with others, and delve into our own intentions, feelings, and desires (Mezirow, 1991). Mezirow elaborates that while instrumental learning allows us to assess skills acquired through technical success, communicative learning evaluates success by comprehending the underlying issue. Consequently, TL may involve a shift in the frame of reference in both domains (Mezirow, 2000).

The third domain involves an emancipatory interest that confronts distorted perspectives on meaning through a process of self-reflection. This domain stands apart from the initial two sources of knowledge due to its roots in critical self-reflection, constituting appraisive knowledge rather than prescriptive or designative knowledge (Mezirow, 1991). Mezirow (2000) clarifies that TLT considers this third domain as relevant to both instrumental and communicative learning spheres, renaming it reflective discourse.

In this study, I employed a TL framework to analyse my educational journey, wherein I deliberately questioned and challenged my conventional teaching norms. This approach facilitated a nuanced integration of both practical and emancipatory learning elements. TL, characterised by its capacity to instigate shifts in perspective, critical reflection, and a profound examination of assumptions and beliefs, played a pivotal role in shaping my educational experience.

The study specifically entailed the application of technology in the classroom, coupled with meticulous critical reflection through fieldnotes. This methodology not only underscored the practical application of acquired knowledge but also encompassed emancipatory dimensions. Through a deliberate inquiry into my traditional approaches and disorienting dilemma, I engaged in the unpacking of experiences, thereby seeking transformative insights.

The synthesis of practical and emancipatory learning components within the TL framework underscores the depth and complexity of my educational journey, providing a comprehensive understanding of the multifaceted nature of my pedagogical development.

3.2.3.2 Shifting meaning structures through schemes and perspectives

Mezirow's (2000) conceptualisation of TL involves meaning perspectives, which function as frames of reference or structures of assumptions and biases shaping the filtration of sense impressions. These frames of reference derive from interpretations of experiences, influenced by cultural or personal beliefs constituting meaning schemes (beliefs and feelings). A frame of reference is comprised of a habit of mind, with such habits being influenced by our assumptions, thus reflecting our meaning perspectives defined by social, ethical, philosophical, psychological, and aesthetic values (Mezirow, 2000). Meaning schemes, in turn, represent how we express these assumptions or enact habits of mind in alignment with these values. These meaning schemes form viewpoints regarding our emotional responses to the real world (Taylor, 2007). Often, we remain unaware of our meaning schemes, impacting our interpretation of the world and shaping our frame of reference, which is communicated to others and contributes to our identity. Perspective transformation involves the critical awareness of how and why our presuppositions limit our perception, understanding, and emotional responses to the world (Wang et al., 2021). Critical reflection is a fundamental aspect of TL.

3.2.3.3 Transformative reflection

Critical reflection relies on examining content, process, and premise, as emphasised by Wang et al. (2021). According to Mezirow (2000), content reflection involves scrutinising a problem, while process reflection entails being aware of the problem-solving strategies employed. Ultimately, premise reflection prompts individuals to question the underlying assumptions of their beliefs. To underscore the interconnectedness of reflective practices, Kitchenham (2008) elucidates the direct impact of content and process reflection, prompting individuals to scrutinise their past actions and the experiences associated with them. In contrast, premise reflection delves deeper, encouraging individuals to contemplate the broader context and evaluate their underlying value system, thereby initiating a more profound transformation.

Building upon this notion, Mezirow (1991, 2000), emphasises the pivotal role of critical reflection in catalysing one's frame of reference. This transformation encompasses ingrained habits of mind and their corresponding perspective, leading to four distinct types of TL: the

expansion of existing frames of reference, acquiring of new frames of reference, a transformation of habits of the mind, and ultimately, the evolution of points of view. Mezirow (2000) further highlights the intricate process involved in altering ingrained habits of mind or beliefs, shedding light on the multifaceted nature of TL.

3.2.4 Critical examination of transformative learning

Mezirow's concepts have found application among diverse adult learner cohorts, including individuals facing health challenges, homemakers facing displacement, and male domestic abusers (Brookfield, 1995). As per Mezirow (1991), this theory elucidates the process by which adult learners derive meaning from their experiences, the influence of social and other structures on their interpretation of those experiences, and how the dynamics of modifying meanings shift when learners perceive them as dysfunctional. Mezirow's theory primarily centres on individual transformation, highlighting the importance of rational and non-coercive dialogue to effect positive changes (Christie et al., 2015). Nevertheless, criticism of his work has arisen (Clark & Wilson, 1991; Collard & Law, 1989; Ekpenyong, 1990), contending that TL tends to place excessive emphasis on individual transformation. However, Mezirow consistently welcomed critiques and actively sought alternative perspectives on how transformation may occur (Hoggan & Hoggan-Kloubert, 2022).

Debatably, TLT has revolutionised the approach to adult education (Kitchenham, 2008). Despite its inception in the 1970s as a conceptual framework aimed at comprehending adult learning, personal development, self-challenge, and transformation, this theory holds even greater relevance in the present day (Yamamoto & Enkhtur, 2017). Similar to other theories, TLT has undergone critique, examination, revision, and repeated testing over decades to establish a definitive framework for elucidating optimal adult learning processes (Kitchenham, 2008). The primary criticisms of the theory encompass inadequate attention to emotions (Brookfield, 1995; Jarvis, 1987), insufficient focus on social interaction (Clark & Wilson, 1991; Collard & Law, 1989) and a perceived lack of solid theoretical foundations (Taylor, 2007). Despite facing criticisms, Mezirow's TLT has greatly advanced through valuable contributions and productive discussions within the academic publishing arenas of our field. It remains an evolving theory that broadens our understanding of transformation and enhances our analytical frameworks for describing it (Hoggan & Hoggan-Kloubert, 2022). This is evident in the establishment of institutes, international conferences such as the International Conference of Transformative Learning, and a dedicated journal known as the Journal of

Transformative Education (Yamamoto & Enkhtur, 2017). Furthermore, several leading universities now assert their integration of TL into their curricula or the provision of programs focused on TL (Kasworm & Bowles, 2012).

3.3 Applications and contributions: Shifting perspectives and adult education

TL involves the process of converting problematic reference frameworks into a more intrinsic, open, reflective, and adaptable form, characterised by meta-cognitive questioning (Mezirow, 2003). According to Mezirow (1997), individuals shape their feelings, concepts, and values through experiences, establishing habits of mind and perspectives. The transformative nature of learning is evident as perspectives can shift when individuals alter their assumptions in response to new experiences and problem-solving (Mezirow, 1997).

Success in perspective transformation hinges on readiness and motivation. The transformation process can be intense, with the disorienting dilemma alone inducing stress that may hinder learning (Wang et al., 2021). In contrast to the educational experiences of children, TL in adults relies solely on new information. Therefore, meaningful, and well-incorporated learning is essential for adults to develop a symbolic frame of reference, constituting an active process that engages thought, feelings, and disposition (Mezirow, 1997).

Using TLT as a theoretical framework for a study can assist researchers in elucidating the intricate processes involved in individuals' cognitive restructuring and perspective shifts. This framework provides a comprehensive lens through which researchers can analyse the transformative journey (Calleja, 2014), offering valuable insights into the dynamics of learning through the expansion or acquisition of frames of reference, the transformation of ingrained habits of mind, and the evolution of points of view (Mezirow, 2000). Additionally, it facilitates the exploration of the nuanced interplay between personal experiences, reflection, and the development of a deeper understanding of one's beliefs and values (Mezirow, 1998). Previously, researchers have endeavoured to incorporate TL successfully as a theoretical perspective in the TEL field (Ben-Atar & Ben-Asher, 2023; Ceko, 2021; Esterhuizen et al., 2013; Pavlou, 2020). Consequently, the goal of TL, as outlined by Christie et al. (2015) is to assist individuals in challenging their current assumptions and, if they desire change, fostering the creation of a better world through this transformative process. Rooted in these traditions, Mezirow's theory advocates for a transformative process wherein learners transition from a state of disorientation to a moment of reflective self-examination, ultimately culminating in a

transformation of perspective. These phases may not be distinctly clear-cut, as their identification within an individual's life journey can be complex. Nonetheless, the subsequent section outlines the ten phases integral to Mezirow's TLT and provides a detailed explanation of how I seamlessly applied to pursue TL within the narratives presented in the study.

3.3.1 Ten phases of transformative learning

American adult educator Jack Mezirow (1991) delineates ten phases, illustrated in Figure 3.1, within the process of perspective transformation. It commences with phase one, encountering a *disorienting dilemma*, an initial discovery by Mezirow (1978). This phase refers to experiences that bring to light and challenge previously unnoticed and unquestioned assumptions shaping our understanding of ourselves and the world. Mezirow suggests that this disorienting dilemma is often triggered by a life crisis or significant transition, paving way for a transformative shift in perspective. Additional authors, such as Boyd and Myers (1988), as referenced in Calleja (2014), contend that this crucial phase involves a sense of mourning stemming from the realisation that previous patterns or perspectives are no longer applicable. In the narratives, I deliberately sought instances where I encountered cognitive dissonance, such as unexpected changes in my cultural environment, transitions or crisis in my career or role, personal crisis, and global events. I remained mindful that a disorienting dilemma is more than just a predicament, as Mezirow (1978) asserts that resolving such a dilemma goes beyond acquiring more information, improving problem-solving skills, or enhancing competencies. Instead, it necessitates a learning process in which the individual transitions from an unexamined mode of thinking to a more scrutinised and critically reflective approach. This recognition facilitated my acknowledgement of this crucial first phase.

The disorienting dilemma serves as the precursor to the second phase of TL, a *self-examination*. This phase involves a deep dive into emotions such as guilt or shame triggered by the crisis or dilemma, in this case, the disorienting dilemma. Consequently, I intentionally sought occurrences where I exhibited signs of reflecting on my assumptions, beliefs or perspectives that included scenarios where I questioned my choices, actively sought feedback or created dialogues with others, engaged in self-evaluation or immersed myself in the process of introspection.

The third phase, a *critical assessment*, calls for learners to evaluate the underlying assumptions shaping their current understanding actively and critically. In this context, I sought illustrations where I rigorously assessed the validity of my beliefs. This involved seeking instances

questioning the origin of beliefs or values, comparing my existing perspectives with alternative viewpoints, analysing my emotional reactions to situations using technology, and identifying the impact of social, environmental and contextual factors on my belief.

Subsequently, phase four, *recognition*, dawns that one's personal predicament extends beyond the private sphere to become a shared and sometimes public issue. Learners acknowledge that others have faced similar changes and challenges, thus I sought examples of self-awareness, acknowledgement, and increased openness to alternative viewpoints. Moving forward, in the fifth phase, *exploration*, learners investigate alternative ways of existing, encompassing relationships, roles, and actions. Hence, I pursued patterns displaying options for experimentation, such as seeking new available experiences and opportunities, being open to learning or even participating in learning communities.

This phase aligns with the following phase six, *planning a course of action*, where learners' strategies new courses of action. Here I sought instances of goal setting, making alliances, applying for roles, or any other actions that ensure implementing a plan.

In phase seven, *acquisition of knowledge*, learners acquire the necessary information to implement these actions. In this context, I endeavoured to seek behaviour showing engagement with formal or informal educational opportunities, self-learning, shared insights, and opportunities to put knowledge into practice. Following this comes the experimental eight-phase, *provisional trying new roles*, where I sought actual role experimentation of implementing the AR in the classroom. This involves seeking out new opportunities, facing challenges, and new roles that come with these dynamic changes.

In the ninth phase, *building of competence and self-confidence*, learners experience empowerment, resulting in improved performance and a heightened self-perception. Here, I sought evidence of skill development, building proficiency, and the positive emotions derived from these accomplishments leading to an enhanced self-perception.

Finally, in the tenth phase of *reintegration*, individuals seamlessly incorporate a new and transformed perspective into their lives, showcasing personal growth and self-discovery. Throughout this phase, I looked for signs of a shift in perception stemming from the understanding to make choices, assuming leadership roles, or engaging in advocacy for change within this specific context or adopting sustainable practices in the classroom.

For the study at hand, the findings chapter highlights the presence of all ten phases, paving way for an in-depth exploration and discussion in the following sections.

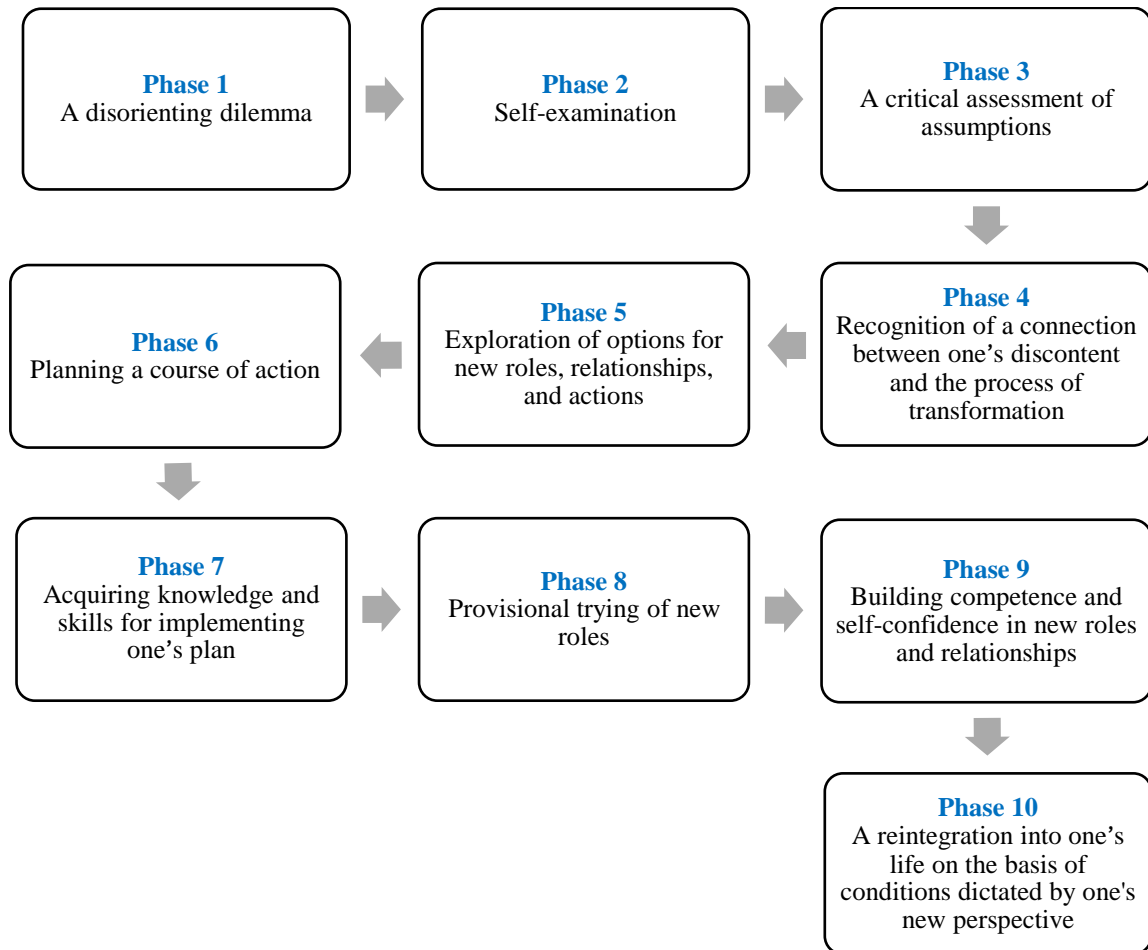


Figure 3.1: Ten phases of transformative learning adapted from textual descriptions in Mezirow (2009, p. 19)

3.3.2 Discourse and the centrality of experience

In this context, discourse pertains to the communication methods (Habermas, 1984) through which individuals navigate and give meaning to their transformative experiences. This can encompass internal dialogue facilitated by critical reflection or external conversations with others, contributing to the social construction of understanding and the development of a community of practice (Mezirow, 1998).

To critically and reflexively examine TLT, particularly concerning its compatibility with subjective approaches like autoethnography, we must scrutinise the role of discourse in shaping individual experiences and understanding. Mezirow (1998) highlights the significance of

discourse in navigating disorienting dilemmas, emphasising its function in critical reflection and meaning-making. However, while discourse facilitates both internal reflection and external dialogue, it is essential to interrogate whose voices and perspectives are privileged within these communicative processes, especially considering power dynamics and marginalised voices.

Furthermore, the concept of discourse extends beyond mere communication methods; it encompasses a dialogue aimed at evaluating competing interpretations and perspectives (Mezirow, 1997). This critical examination of evidence and arguments suggests the need to challenge dominant narratives and epistemologies inherent within TLT. Autoethnography, with its emphasis on personal narrative and subjective experience, offers a lens through which to deconstruct and reconceptualise existing power structures within education.

Moreover, the notion of critical reflection on assumptions underscores the transformative potential of subjective reframing (Mezirow, 1997). By interrogating our own beliefs and perspectives, we engage in a process of self-awareness and potential transformation. However, we must remain vigilant of the limitations of individual reflexivity, recognising that it can be influenced by broader socio-cultural contexts and power dynamics.

In considering the centrality of experience within TLT, particularly disorienting dilemmas, we must acknowledge the complex interplay between personal encounters and broader socio-political contexts (Mezirow, 1997). Autoethnography offers a means to situate these experiences within larger societal frameworks, thereby enriching our understanding of transformative learning as both a personal and collective process. Autoethnography, with its emphasis on personal narrative and situated knowledge, challenges traditional notions of objectivity and expertise, offering a more inclusive approach to knowledge production and dissemination. Additionally, educators must create spaces for dialogue and reflection that allow for the interrogation of dominant narratives and the co-construction of knowledge within diverse learning communities.

Discourse involves a dialogue focused on evaluating the reasons presented to support competing interpretations, achieved through a critical examination of evidence, arguments, and alternative perspectives, where the greater the availability of beliefs, the higher the likelihood of discovering a more reliable interpretation (Mezirow, 1997). Our *frames of reference* transform through *critical reflection* on the assumptions that underlie our interpretations, beliefs, and habits of mind or perspectives (Mezirow, 1991). Engaging in communicative learning enables us to become critically reflective of these assumptions. Through self-

reflectivity, where we assess our own ideas and beliefs (subjective reframing), we can critically reflect on assumptions, potentially leading to significant personal transformations (Mezirow, 1997). Moreover, the centrality of experience emphasises that personal encounters, especially those that challenge or disrupt established beliefs (disorienting dilemmas), play a crucial role in the TL process (Mezirow, 1997). The relationship between discourse and the centrality of experience in TL is interconnected through reflection and communication. This interplay contributes to a shared comprehension of central experiences, illustrating how specific encounters mould perspectives and foster TL (Mezirow, 2009a). In sum, the combined result is a deeper, collective understanding of the transformative journey.

In extrapolating from Mezirow's theoretical framework to the VET context addressed in this thesis, it is imperative to consider how discourse, critical reflection, and personal experience intersect within vocational learning environments. While Mezirow's framework provides valuable insights into the transformative learning process, it is essential to acknowledge the potential variations and adaptations required when applying these concepts to specific educational settings, such as VET.

Within the VET setting, discourse takes on a unique significance, as it involves not only dialogue within the classroom but also interactions within workplace contexts. In VET, learners engage in critical reflection not only on academic knowledge but also on practical skills and professional practices relevant to their chosen vocation. This broader conception of discourse and critical reflection encompasses not only theoretical debates but also real-world applications and industry standards.

Moreover, while Mezirow's emphasis on personal experience and disorienting dilemmas remains relevant in the VET context, it is essential to recognise the diversity of experiences and challenges faced by vocational learners. Disorienting dilemmas within VET may arise from discrepancies between classroom learning and workplace realities, conflicts between personal values and professional expectations, or technological advancements impacting industry practices. As such, VET educators must facilitate a learning environment that acknowledges and addresses these varied experiences, fostering critical reflection and transformative learning across diverse vocational pathways.

However, it is crucial to acknowledge the potential limitations of Mezirow's framework when applied to the VET context. As Mezirow himself acknowledges, his model may not capture the full complexity of TL across different settings (Mezirow, 2009, p. 19). In recognising this

shortfall, this chapter explores how Mezirow's ten phases of TL serve as a starting point for understanding transformative processes within VET but also acknowledges the need to adapt and contextualise these phases to the specific realities of classroom learning in vocational education.

3.3.3 Critical reflection

The concept of fostering critical reflection has become a central idea for adult educators in their quest for a learning approach unique to adults. Developmental psychology provides evidence, with constructs such as embedded logic, dialectical thinking, working intelligence, reflective judgment, post-formal reasoning, and epistemic cognition, showcasing how adults engage in contextual and critical thinking (Brookfield, 1995). Mezirow (1991) has made a significant contribution to the field of critical reflection. He delves into the concept of perspective transformation, explaining how adult learners derive meaning from their experiences, navigate influences, and modify their understanding to regain coherence.

In Mezirow's (1998) article on critical reflection, he describes reflection as involving a retrospective consideration of an experience, signifying an awareness of an object, event, or state. This encompasses being conscious of perceptions, thoughts, feelings, dispositions, intentions, actions, or even one's habitual approach to these aspects. Mezirow further states that it is possible to engage in reflection on the act of self-reflection. In parallel, Brookfield (1995) defines three interconnected processes of critical reflection. Firstly, it entails individuals questioning and replacing assumptions that were previously accepted without scrutiny. Secondly, it involves adopting an alternative perspective on ideas that were previously taken for granted. Lastly, critical reflection involves recognising the dominant features of cultural values and understanding how these seemingly self-evident perspectives reinforce the power and self-interest of unrepresentative minorities. Such a process is vital for understanding deep structured shifts such as those that occur in TL (Calleja, 2014). As previously defined, adults acquire a coherent body of experience including associations, concepts, values, feelings, and conditioned responses, making up frames of references that define their life world. Such frames of reference, which include habits of mind and a point of view, are systems of assumptions that shape our understanding of experiences. (Mezirow, 1997).

3.4 Conclusion

In this chapter, the focus has been on clarifying the transformative process, as outlined by Mezirow in his TLT, through an exploration of the philosophical foundations and essential components of TL. Additionally, the chapter presented insights into the significance of the TF of the study, serving as a perspective through which the analysis and comprehension of the study unfolded. It emphasised how the chosen theory indicates a dedication to self-reflection, TL, and a nuanced investigation into the intersection of personal experiences with broader educational contexts.

Highlighting the methodological implications, this chapter has specifically emphasised the influence of aligning the research method, autoethnography, with the chosen educational theory TLT. Moreover, it underscored the essential components of TL, explaining how this theory forms the basis for a thorough examination of my learning journey.

The upcoming chapter will delve into a comprehensive exploration of the methodological approach employed in this study. It will provide a detailed account of the step-by-step process meticulously employed to collect the data, offering transparency and clarity on the research methodology.

Within the upcoming chapter, a detailed exploration of the participant selection, the development of data collection instruments, and the comprehensive strategies employed to capture the nuances of the research context is found. The chapter offers a clear and open account of my decisions at every stage of the data collection process, underlining the precision applied to uphold the study's integrity.

In summary, the forthcoming methodology chapter endeavours to furnish a thorough understanding of the undertaken in conducting this research. It is designed to serve as a guide, elucidating how the chosen methodology was put into practice, and providing insights into the intricacies of data collection, along with my reflective engagement throughout the entire process.

Chapter 4: Research methodology

4.1 Introduction

The primary objective of this research was to enrich existing literature by incorporating the researcher's personal, contextual, and subjective insights of her own transformative journey of learning how to implement AR within the vocational classroom. The researcher sought to examine the evolution of her beliefs and perspectives by critically analysing and reflecting on her past experiences through the unpacking process. By exploring past personal experiences, the social and cultural contexts in which they occurred can be better understood, providing insight into the researcher's current beliefs about technology. After reflecting on the past experiences, the researcher analysed her current journey to understand how classroom experiences using technology may have transformed her beliefs. To achieve this goal, a qualitative research methodology was selected, and the study was guided by the following RQ:

RQ1: What were my experiences with educational technology before embarking on the AR journey?

RQ2: What was my initial experience as an educator when using AR for the first time?

RQ3: To what extent, if any, have my feelings and perspectives undergone a transformation?

RQ4: How does my experience compare to other individuals who have also undergone a similar process?

Previously, there was a demand for broadening the range of techniques employed for carrying out studies in the domain of technology education (Hoepfl, 1997). Drawing on Cronbach's (1975) work, the author argues that a quantitative methodology is insufficient in capturing the interactions occurring within social contexts that could yield significant but statistically insignificant results, which may remain unnoticed. The chosen research method for this study is qualitative, which aims to explore a transformative experience as a autoethnographical inquiry. This approach seeks to provide a comprehensive account that captures the interconnectedness of the experience, enabling the reader to relate to it (Hoepfl, 1997). A qualitative design method can tie in an in-depth insight into people's lives as they unfold, revealing meaning to complex social issues within different fields (Davies & Logan, 2022).

This qualitative research study utilised autoethnography, incorporating various tools and techniques to collect qualitative data, tailored to address the research questions and enhance

the study's validity (Cohen et al., 2017). By employing a qualitative research approach, the study was able to gain a constructivist interpretation of the TL journey by drawing meaning from the experience. This was especially valuable because qualitative research allows for a thorough exploration and understanding of subjective experiences and perspectives, particularly relevant in TL. As the TLT expounds a significant shift in one's beliefs (Mezirow, 1991), using quantitative methods alone would not suffice. But qualitative research, on the other hand, allows a constructivist approach to explore the individual's personal experiences and perspectives, enabling the analysis to produce richer interpretations of their experiences, allowing an understanding of the nature and impact of their TL journey.

4.2 Philosophical background: Constructivism

During my search for a research topic for my PhD dissertation, I aimed to undertake a significant and personally engaging study that would allow me to actively participate in the process. This motivation arose from experiencing feelings of impostor syndrome within the field of TEL, where I felt the need to be directly involved in the study and closely interact with the data to overcome my challenges with self-confidence in using technology. My interest was piqued by the opportunity to integrate technology into teaching practices, which seemed like a suitable choice for a research study, particularly considering that the educational institution where I am employed was in the midst of developing and implementing technological tools for teaching purposes. By selecting autoethnography as my chosen approach, I aimed to explore and comprehend my personal experiences within the larger research context. This method involves immersing myself in the experience and periodically stepping back to maintain a balance between interpretive and descriptive elements (Chang, 2016). This approach enables a constructivist interpretation of the goals I set out to achieve during my PhD journey, providing a satisfying conclusion to the start of my budding career in the TEL field.

Thinking about the correct epistemological assumption, TLT appeared to make an excellent TF to address whether my axiology would shift throughout this sought journey. TL concerns the innate structural shift of the learner's thoughts, feelings and behaviour (Kitchenham, 2008) that takes on a constructivist approach to active learning (Cohen et al., 2017). As the learner needs to experience learning to interpret a meaningful experience, I felt this approach would allow me to search for a constructive interpretation throughout the development of the self through interweaving narratives from the past as they contextualise in the present.

4.3 Autoethnography as a methodology and method

Despite its existence for more than six decades, credited to Richard Firth's initial use in 1956 (Anderson, 2006), autoethnography remains relatively unfamiliar to numerous academic researchers as a genre within empirical qualitative research. This lack of awareness is primarily due to its unconventional methodology. However, over the last few years, this research methodology has become much more prevalent in academia as either a stand-alone or complementary method in qualitative research (Hughes & Pennington, 2017). Following the scrutiny qualitative research underwent, critiquing traditional practices for research saw the wake of a postmodern movement towards objective research (Richardson, 2000). However, this emerging writing and research genre has not gone without criticism (Holt, 2003), as authors deemed this methodology 'too self-indulgent', 'narcissistic' (Coffey, 1999) and 'at the boundaries of academic research' (Sparkes, 2000). Initially, this methodology was derived from the ethnography methodology commonly used by anthropologists to study individuals in their community. However, as the anthropology and liberal arts disciplines intertwined, so did their questioning, bringing forth the 'I' in their observations (Anderson, 2006; Ellis, 2004).

Autoethnography has been deemed a hybrid term to describe the genre of the methodology but also the actual approach to the technique to collect data, i.e. the methods (Hughes & Pennington, 2017). As a research method, autoethnography allows researchers to self-reflect on their experiences to understand a phenomenon, diminishing the 'crisis of representation' that instigated the need for a research methodology where the researcher's interactions were represented (Holt, 2003). Thus, autobiographical writing was adopted to draw upon my experiences as a complete member researcher (Anderson, 2006) to produce a relatable self-narrative of my journey. Using personal memory as a data collection is justified in autoethnography's research methodology and requires reflexivity as a crucial criterion (Hughes & Pennington, 2017). Such a research design enfolds a deeper understanding of emotions experienced (Hammarberg et al., 2016) from a first-hand encounter through storytelling.

As a research methodology, autoethnography can be used to explore in-depth experiences; however, autoethnography can be approached differently according to the discipline and phenomenon of the study at hand (Hughes & Pennington, 2017). This study proposes a personal narrative style to create an analytic autoethnography, where I, the researcher, am a full member and primary data source within the study, where my voice is visible within the text. Moreover, as a researcher, my utmost dedication lies in fully understanding the phenomenon under

investigation. My aim is to enhance the theoretical comprehension of how educators develop the ability to alter their view on technology and effectively utilise it to improve the TEL field. I intend to achieve this by sharing my own experiences through autobiographical writing.

Autoethnographic writing utilises reflexivity as a tool to achieve self-awareness and critical reflection, which is a crucial aspect of analysing the results of a TL experience, as proposed by Mezirow (1997). Another advantage of this approach is that the researchers undergo a transformation during the data interpretation process as they engage in a self-analytical process. This process, as described by Freeman (2015), involves self-discovery through re-examining the past and moving beyond it to gain a deeper understanding of how the self has developed or transformed after undergoing a change process.

This present study can be considered a story focused on the protagonist, an educator disclosing her diverse and complex journey towards implementing technology in the classroom through an autobiographical style of writing, using reflexivity and field notes to collect an autoethnographically account as the journey takes place, intended to provide guidance and inspire other educators seeking a similar path. Thus, this analytic autoethnographic manuscript can produce evocative writing accounts showing the true in-depth author representation and objectivity that qualitative research had been deemed lacking (Charmaz & Mitchell, 1996).

Autoethnography is distinguished by its emphasis on sharing personal narratives that convey emotional experiences through narrative storytelling (Chang, 2016). This approach engages readers in a constructive interpretation of the researcher's individual perspectives, setting it apart from other qualitative methods. While some may argue that autoethnographic writing requires unique individuals who have undergone singular experiences (Christman, 2004), it can serve to bridge gaps in the literature and guide ordinary people in making decisions and taking action in their personal and professional lives (Méndez, 2013)

Recent examples of autoethnographic studies in the TEL field include Ceko's (2022) work, which employs narrative writing to explore his experience implementing technology in a language school from a director's perspective. By recounting his personal narrative, Ceko makes a valuable contribution to the TEL field. He offers first-hand insights into the emotional responses elicited by encountered challenges, including instances of teacher resistance. Such accounts can immensely benefit individuals in management positions, empowering them to make more informed decisions when implementing technology.

Additionally, Al-Ali (2021) provided a contextual understanding of her experience of teaching online in Kuwait during the pandemic, contributing to the TEL field by sharing her unique experience as a female educator teaching female students within a Saudi cultural context. Her work adds to the TEL literature by providing depth, authenticity and the emotional resonance that only this methodology can provide. Scholarly literature indicates other recent autoethnographies that show the ability to connect with readers through articulating personal struggles, challenges, relationships, and cultures. While the potential for exposure and scrutiny associated with autoethnography poses challenges, it can provide meaningful and professionally significant accounts when carefully planned. As such, autoethnography aligns with the research objective of self-discovery within the TL context and has the potential to contribute to professional development.

4.4 Research methods

Autoethnography views the researcher as the primary instrument for data collection (Adams et al., 2015). In this approach, the researcher may use various synchronised data sources to give meaning to their story (Harris, 2019). As stated earlier, a mixed strategy was employed to collect data, enhancing the credibility of results (Cohen et al., 2017) and providing a more comprehensive understanding of the phenomenon under investigation (Greene, 2008). The research design encompassed three distinct phases, each phase employing various data sources. The subsequent sub-sections outline the research context, the data-gathering sources, and the methods employed for data collection in each respective phase.

4.4.1 Research site

The researcher is a member of the staff at Malta's foremost institution for vocational education and training, offering a diverse selection of vocational programs from certificates to doctoral degrees. The vocational institution comprises seven institutes that provide diverse courses tailored to their respective domains. Each institute delivers fundamental subjects (key skills) to students at lower levels, including English, IT, Maltese, Maths, and Science. The researcher's role involves teaching science (key skills) across various institutes (and courses), which may vary from year to year. In the current academic year 2022/23, the researcher taught science in two institutes. The implementation of AR within the classroom was carried out with the researchers eleven classes, encompassing various lower levels and courses. The details of these classes can be observed in Table 4.1 provided below.

| Institute | Course | Level | Number Of Classes | Number Of Students |
|---------------------------------|-----------------------------------|-------|-------------------|--------------------|
| Institute of Community Services | Introductory in Care Services | 1 | 1 | 11 |
| Institute of Community Services | Introductory in Hairdressing | 1 | 1 | 10 |
| Institute of Creative Arts | Introductory in the Creative Arts | 1 | 1 | 12 |
| Institute of Creative Arts | Foundation in the Creative Arts | 2 | 4 | 63 |
| Institute of Creative Arts | Diploma in Performing Arts | 3 | 1 | 9 |
| Institute of Creative Arts | Diploma in Art and Design | 3 | 3 | 50 |
| Total number | | | 11 | 155 |

Table 4.1: Class overview

The researcher introduced AR in all her classes, aiming to personally undergo the implementation journey and evaluate how her initial viewpoints changed as her skills and understanding developed during the learning process. The subsequent section provides a comprehensive account of how the data was gathered throughout this procedure.

4.4.2 Data sources and methodological approach

4.4.2.1 Self-reflective data: Personal memory data

Collecting personal memory data is a valuable primary source to understand the present self by unlocking the ‘richness of the past’ (Chang, 2016). Although reconstructing details of the past may prove challenging, personal memory can provide a prosperity of self-information that can be transferred to textual data (Méndez, 2013). Reflexivity is a central criterion in autoethnography (Hughes & Pennington, 2017). This type of internal data was utilised to become self-conscious about past experiences by re-visiting memories and becoming aware of life-changing experiences deemed ‘epiphanies’ (Adams et al., 2015) that make up the present self. Driven by the appeal to understand myself, reflexivity permitted a self-conscience introspection that made me aware of how the past connects with the present and influences the research context (Anderson, 2006). Thus, utilising self-reflective data allowed me to make sense of what makes up my identity and perceptions, similar to the metaphor described in the collective autoethnography by Lee et al. (2022a), which stated how conducting autoethnography was like ‘weaving a tapestry of who I am’ (p.608). Using reflexivity as rigour involved combining profound introspection to address past personal experiences that sculpted

cultural beliefs, practices and values. To reflect upon such experiences, I had to examine the impact of specific encounters on my beliefs, actions, and principles. Additionally, I had to assess my present stance based on my previous experiences.

The self-reflective data was critical for me to understand my position towards technology that had developed from past personal experiences. Thus, I needed to visualise my past experiences and recognise encounters that had influenced my earlier formed perceptions through reflexivity. To relive these events, I needed to position myself in that earlier mental state, thus, a chronological sequence was established. I chose a timeframe when there was a disposition in my life, moving from the UK to Malta, where I felt that this moment had caused a cultural disconnection and limited my access to technology. This reference point was a starting position for my story and engenders a disorienting experience of loss, change and adaptation.

The data collection occurred in manageable steps, including visualising the self in a timeline and chronicling the past (Chang, 2016, p.72) while writing down fragmented memories. I started writing down the memories as a list with dates and places, including what occurred in the memory and other persons present. Including who was there was vital for validating the memories later (member-checking conversations). Memorabilia such as photos (artefacts) were used as mnemonic tools to stimulate memories. The tasks were broken down starting from the earliest memories of events in attempting to follow a sequential order, using headnotes to create a chronicling timeline using a narrative writing style portraying myself as the main character. Idea-gathering strategies were used to gather glances into the past. One strategy was an inventory activity, where while recalling a memory and writing down all the details and those present, I attempted to look beyond by asking myself, 'What happened next' as to recall a sequence of following events and placing them in the timeline.

These strategies lead to an unravelling of memories transformed into textual data of autobiographical timeline, subsequently the fragmented memories written in prose. These proeses were later expanded through multilayering of the memories, which led to a generation of more memories, filling out the gaps and thus bringing forth more recollections of important events that led to epiphanies. The autobiographical timeline covered a thematic-focused lifespan, from childhood to the current day, that included significant events when technology was withdrawn or re-emerged into my life, primarily educational experiences, creating an education-focused self-narrative. Screening of personal memory data was utilised to avoid irrelevancy. Thus, when using headnotes to recall memorable experiences and recollect

conversations with others, the personal connection was kept in mind, including the experiences and insights gained. However, I also considered the relationship to the larger context, the phenomenon being researched; thus, the RQs were kept as a guide to the study's epistemology. The main component in any research is the questions set to answer (Alvesson & Sandberg, 2013); thus, the RQs were used as a guide, directing me towards the knowledge sought. Moreover, to avoid redundancy, the data collected was managed throughout the data collection phase to ensure a logical structure using labels to manage the personal memory data, conversations with others or artefacts, clearly labelling the data for later analysis.

Poulos (2013) presents a framework for assessing the validity of autoethnographic projects. According to Poulos, seven key aspects should guide the evaluation of autoethnography: the centrality of the autoethnographer, its connection to broader constructs beyond personal experiences, its emphasis on creativity, emotion, and evocation, its departure from traditional research goals by aiming to transform or impact the reader, its integration of both intellectual and emotional dimensions, its grounding in reflexive, phenomenological, praxis-driven knowledge, and its interpretive and critical nature (p. 45-47). These criteria underscore the autoethnographer's dual responsibility: not only to authentically represent personal experiences but also to acknowledge and analyse the influence of social constructs on those experiences, framing them within theoretical contexts.

4.4.2.2 Textual artefacts

The inclusion of artefact collection as a valuable data source in the genre of autoethnography has been recognised, as it helps bridge gaps in the researcher's memory (Chang, 2016, p107). The proverb says, "One picture is worth a thousand words." Hence, visual images and texts were utilised in this study to elicit memories and evoke thoughts and emotions associated with the past. Personal photographs (non-textual artefacts) from earlier years were employed to deepen my understanding of myself within the context of my life after relocating to Malta and throughout my educational journey. Additionally, locating my childhood passport served to validate the precise timeline of the move. By examining the passport stamp, I obtained an exact date from the inked impression, establishing a starting point for the autobiographical timeline.

Textual official and non-official artefacts were also employed in this study to immerse myself in the mindset of my earlier life stages and unveil the evolution of changing values and perspectives throughout my journey. Personal letters that I had written as a child to my late Father, who resided in the UK, were located, and utilised to assess the emotions and expressions

of change in my immediate environment. Official University transcripts from my undergraduate and postgraduate studies were employed to corroborate marks (associated with memories) obtained from online modules. Lastly, emails exchanged and discussions on the Moodle platform among lecturers, peers, and myself were utilised to validate experiences during the earlier phase of my ongoing PhD journey.

Before collecting artefacts, I created a checklist of all the textual (and non-textual) artefacts to be collected, including the location and contact person of where they can be located. A day was allocated to collect all the artefacts, as not all were in my possession. The photograph's needed to be collected from my Mother, and my personal letters sent to my late Father needed to be taken out of storage, as my Aunt had sent them to me years before. Other official documents (transcripts) were easily located within my home. Once all artefacts were in hand, an inventory exercise was conducted, which included describing the artefact and its relevance for introspection (as seen in Table 4.2) to identify how these artefacts could help my memory. The description of each artefact was divided into manageable categories. The pictures were organised into categories according to their timeframe, placing them by year in chronological order. Once all artefacts were collected, these were viewed one by one to help me 'fill in the blanks' or enhance my personal memory data. As I evaluated each artefact, notes on memories were taken that were later cross-referenced with my personal memory data.

| Artefact | Significance to self-introspection |
|--|---|
| Photographs (Total 45) | |
| <ul style="list-style-type: none"> The first year I moved to Malta (n=16) | Visual representation of a new life shows various outdoor experiences within a new social context and the memories triggered. |
| <ul style="list-style-type: none"> From primary school (n=8) | School sports days, plays, and photographs of the researcher outside the school trigger memories of the ambience and feeling of being there over four years. |
| <ul style="list-style-type: none"> From secondary school (n=10) | The school choir, drama club, and photographs of the researcher in the garden with her friends during school break, triggered memories of her time there, evoking memories of schooling over five years. |
| <ul style="list-style-type: none"> From College and University (n=11) | Candid pictures are taken by the researcher and her friends of the lecture halls, laboratories, and canteen. Essential to get into the frame of mind of being back in College and University. |
| Personal letters (n=5) | Personal letters were sent to my Father (late). Essential to understand the impact and immediate perspective of the move from a child's view through self-narrative text showing emotions and truths written in text. |
| Passport (n=1) | Necessary for validation of the timeline. |
| Official University transcript (Degree/MSc) (n=2) | Degree transcript to confirm grade from the first-ever online unit. MSc transcript to guarantee the grade of the webinar unit. Both are important to validate the memory. |
| Lancaster Moodle platform /emails | Evoke memories and feelings including the sense of being an imposter and gradual improvement validated through platform modules. |

Table 4.2: Artefacts inventory

4.4.2.3 Member-checking conversations

I employed member-checking, inspired by Ellis et al. (2011), to validate my recollections and discussions from early childhood to the present. In acknowledging the importance of contingency, I recognised the fallibility of memory and the inherent difficulty in accurately recalling (Chang, 2016), or data mining (Poulos, 2021) lived experiences. Conversations with those close to me, including my Mother, two trusted friends, and my Husband, served as touchstones to explore various aspects of my life. Member-checking conversations involved revisiting significant events such as the relocation from the UK to Malta, my educational journey and the challenges faced as an online educator during the COVID-19 pandemic.

Those close to me were able to establish whether the personal memory data collected was accurate and gave valuable input to rekindle other memories (Koelsch, 2013) making the writing more credible and verisimilar (Ellis et al., 2011). I set up dates to meet up twice with all informants individually. The location was essential to avoid distractions, so we met at their

home or mine. The first encounter was to generate more memories through an informal conversation without any particular structure regarding times, in particular, relevant to the story, i.e. the move to Malta (my Mother), attending primary/secondary schools and using the computer labs (Friend 1), particular credits in the degree and the mode of learning (Friend 2), me working in education, and teaching online during the pandemic, the earlier stages of my PhD (my Husband). Throughout these conversations, I took down short notes that were later cross-referenced with my personal data memory and either confirmed, tweaked, or added as new data. The second meeting was used to validate the write-up, where the informants were asked to read the self-reflective data to check for accuracy. Those involved were told that the write-up could be altered, and a few comments were added throughout the meeting as other memories surfaced.

4.4.2.4 Systematic self-observational data: Field notes

A systematic self-observation was adopted as a data collection strategy for this autoethnography to observe and record my feelings and emotions occurring during the implementation of AR in the classroom. Self-observational data is a method that allows a researcher to collect observable activities while associating the cognitive engagements, thoughts and feelings occurring within specific present circumstances, revealing changes in perspectives when compared to personal memory data (Chang, 2016). This data method serves as a helpful tool for analysing changes in feelings, emotions, and emerging perspectives through self-observations. These observations can be collected either in a narrative format or through pre-structured structures, either in real-time or later (retrospectively).

A blended methodology was employed to gather self-observational data, incorporating elements of both narrative writing and predefined keyword-based guidance. Instead of relying on a pre-structured recording form, a narrative writing format was adopted to capture a more comprehensive and unrestricted observation, enabling me to express emotions and capture the essence of the experience. Nevertheless, keywords were utilised as a helpful guide throughout the process. Moreover, the field notes were written retrospectively on-site, which was vital as data was collected immediately after the intervention (lesson) rather than during. According to Chang (2008, p.93), the collection of immediate recordings allows for the instant capture of behaviours and emotions. However, this author also argues that this approach may interrupt the natural flow of the experience and result in biased data due to heightened self-awareness. On the other hand, relying solely on retrospective data may not fully capture the authentic essence

of the experience due to potential memory lapses. Therefore, I adopted a hybrid approach by collecting data retrospectively on-site, where the memories were still vivid, and the environment retained its energetic impact.

The self-observational data was planned for within the research design and was time specific as the collection needed to be carried out according to the lecture delivery. The anatomy lectures conducted by the researcher, started in the first week of October and ran till mid-December of 2022, thus over a total of ten weeks with eleven cohorts simultaneously. I planned for a fifteen-minute timeframe for self-observational recording in the classroom after each pre-booked session to avoid disturbing. Although I utilised a narrative method of writing, keywords were used as cues that included: behaviour (physical), feelings (cognitive), mood (general), emotions (experienced), and the overall take. Data were collected utilising narrative style writing (uninterrupted), and when completed, I referred to the keywords to see that all areas had been covered. These keywords were helpful initially; however, as time passed, I became much less dependent on the keywords as I got acquainted with the data. However, I still referred them to ensure all bases had been covered. Time and date were recorded to have a timeline; furthermore, the class cohorts were recorded to seek whether the experiences and emotions were reproducible between cohorts.

4.4.2.5 Self-interview

Following the ten-week implementation phase, the collection of self-observational data involved conducting a self-assessment to evaluate my existing perspectives and assess the potential for a change in mindset. While it is possible to pursue a shift in perspective solely through analysis of the self-observational data, the inclusion of a self-interview served as a valuable source to validate the observational data and address any gaps that might have been overlooked.

The self-interview occurred in the first week of January, utilising the same questionnaire employed for the member-checking interviews. However, only answering questions four to twelve were answered, as the preceding questions aimed to gather reflective data from the past, which had already been addressed in the personal memory data collection. The interview was scheduled just like member-checking interviews and occurred in my home office when there would be no disturbances. The platform Microsoft (MS) Teams was utilised to record the self-interview, using captions to auto-transcribe the interview and save the data. I read the questions aloud and responded to the questions vocally using a narrative format, as one would do in a

typical interview. The answers were checked for accuracy due to the auto-transcription, and when I was happy with the data, it was saved on my personal computer. The interview lasted thirty-five minutes.

4.4.2.6 Member-checking interviews

Employing member-checking makes it possible to incorporate diverse perspectives within the study, enabling the triangulation of results (Doyle, 2007). This practical application of member-checking can help mitigate the potential for systematic bias, commonly associated with studies utilising specific data collection methods (Candela, 2019).

Informants were utilised to create an assemblage of data to develop multi-layered accounts that support the autoethnography through feedback by comparing/contrasting interpretations against the primary data collected through triangulation (Koelsch, 2013).

Member-checking interviews validated the findings' accuracy and fostered an alternative analysis (Candela, 2019). As an analytic autoethnography, the primary data source is derived from my experiences as an active participant. Therefore, it is crucial to have an alternative interpretation to ensure a comprehensive understanding of the data. Additionally, Doyle (2007) highlights that the practice of member-checking openly recognises the therapeutic aspect it holds for the primary researcher. Through engaging with the stories of others, member-checking enhances the researcher's comprehension and perspective of the study, leading to a deeper understanding and personal growth.

The study involved lecturers teaching the science key skills unit, from within the same vocational educational institution as the researcher. Thus, the participants were selected based on their subject and their willingness to take part. Out of the thirteen individuals who had the opportunity to utilise AR, only six educators participated. Consequently, six member-checking interviews were conducted. The participants were evenly distributed in terms of gender, with an average age was thirty-nine. Additionally, all participants had over five years of experience teaching anatomy, sharing a common background that all participants had experienced the COVID-19 online transition, and thus had taught virtually. Despite this shared characteristic, no participants incorporated EdTech in the pedagogy.

For the study, the target participants were recruited in the first week of October of 2022, after the AR topic was brought up in the departmental science meeting and discussed for the year's implementation plan. The educators had been informed about AR a few days before. I took the

opportunity to demonstrate the mobile application first-hand, discuss the study at hand study, and express my interest in recruiting educators to participate as member-checking respondents. I disclosed what was expected, including utilising AR in their classroom teaching, and later sharing their perceptions of technology and their experiences of using the tool to teach anatomy during a one-to-one interview. I held a question-and-answer session for fifteen minutes after the meeting, as for most, this was the first time they saw the application in motion, and they needed more information. That same evening, after the meeting, I sent an email to all educators teaching science key skills, along with the participant information letter (Appendix 1), consent form (Appendix 2), the Lancaster University and the educational institution (where the study shall be conducted) ethics approval (Appendix 3 & 4). The email stated the study's intent and what was expected of the participants, including the research design and how they would be member-checking respondents, thus not the main subjects of the study. The email also clearly stated that the interview would be conducted at a later stage when and if the participants implemented the AR to teach human anatomy. Eight participants responded that they would participate and signed the consent forms. The interviews were planned for early January 2023, when the unit was closed. In the third week of December 2022, the eight educators were emailed to arrange the interviews. Although all responded the email, two educators who had not managed to implement the AR were not scheduled for an interview. When asked about their reasons for not implemented AR, both cited a limited timeframe as the primary constraint.

The interviews occurred between the first and third week of January 2023. The participants were subjected to a one-to-one online semi-structured interview. Questions can be found in Appendix 5. The interviews were conducted via MS Teams and had a duration ranging from fifty-five to sixty minutes each. The interviews were audio recorded and transcribed verbatim. These transcripts were returned to the participants to check that the transcription was correct. Finally, as part of the member-checking process, two members from the educators, selected through an email asking for a volunteer to check the report's accuracy, representation and themes, occurred in February 2023 as part of the triangulation process. Fortunately, the two independent volunteers agreed with my concluding interpretation and emerged themes.

4.4.3 Data collection

The data collection for this study was conducted in three distinct phases, as outlined in Table 4.3. These phases involved gathering internal and external data, encompassing self-reflective data derived from personal memory, systemic self-observational data, and interviews

conducted with oneself and others. Data collection spanned a period of eight months, commencing in July 2022 and concluding in February 2023. Collecting self-reflective data, textual artefacts, and member-checking for corroboration occurred from July to October 2022. Field notes were gathered from October to December 2022 within the classroom setting. All member-checking interviews, including the self-interview, took place from January until the end of February 2023.

Firstly, data were collected through self-reflective personal memory that created blocks of narrative writing, attaining the unpacking of the educator's initial perceptions from introspection and self-analysis (Chang, 2016). Exposing distinct moments or life-changing epiphanies, as described by Adams et al. (2014), where the researcher faced disorienting dilemmas with technology throughout her life and later in her career as an educator, were utilised to gain an in-depth understanding of her position towards technology and what experiences led to her to hold mixed feelings towards technology. In this part, the autoethnographic data comes from the past through 'recalling' (Chang, 2016, p71), where the writing was mainly conducted by positioning the author in an in-depth mindset whilst maintaining a self-conscious awareness of how the author is connected to the research context (Hughes & Pennington, 2017), also known as reflexivity. Relevant artefacts were also analysed to help fill in the gaps, while member-checking was also used to corroborate memories.

Autobiographical writing was also employed during the second phase of data collection to uncover the educator's individualistic journey towards implementing technology in the classroom. Through self-observational data highlighting critical moments that show her struggles and opportunities to learn, giving the reader a front-row seat to a personal emotional experience that could lead towards a personal transformation and ultimately a change in perception. The autoethnographic data utilised in this study originates from the present time. The data was collected through self-observational fieldwork conducted within the classroom, capturing the interactions, emotions, and inner thoughts while the process of implementing the technology was still vivid in memory. This descriptive raw data is imperative for the autobiographical writing process to conserve graphic details of the experience (Chang, 2016), not losing the essence of the new thought processes that show the newly represented perspectives.

The third and final data collection phase, shown in Table 4.3, was compiled using member-checking interviews to determine whether other educators in a similar position had undergone

similar experiences or whether this was an isolated encounter. Koelsch (2013) proposes that member-checking is not merely a process to validate one’s findings but also an opportunity for the participants to reflect on their feelings and the outcome of the experience. Moreover, a self-interview was executed to critically self-evaluate the learning experience and reassess my new position on technology, seeking out whether a personal transformation had occurred and to what degree. Although comparing the systemic self-observational data to the personal memory data could articulate meaningful changes and shifts in my feelings and perspectives, the self-interview further validated the analysis of the self-observational data.

| Data collection phase and duration | Processes | Linked RQs | Sources |
|--|------------------------------------|------------|---|
| Phase 1 July to October 2022 | Self-reflective data | 1 | Personal memory, artefacts, corroborative member-checking |
| Phase 2 October to December 2022 | Systematic self-observational data | 2 | Field notes |
| Phase 3 December 2022 to February 2023 | Validating data | 3 & 4 | Member-checking interviews, Self-interview |

Table 4.3: Data collection phases

4.4.4 Data analysis

Following the data collection, all narrative texts and transcripts were imported on the Qualitative Data Analysis Software (QDAS) NVIVO 12 Plus program for managing, analysing, and storing the data. Here a comprehensive procedure of data coding and identification of themes was undertaken, with the the practical steps taken to organise, analyse, and interpret the qualitative data illustrated in Figure 4.1.

When I commenced coding the data, my focus was on indexing the data to derive meaningful concepts for theoretical exploration. The analysis was based on, a hybrid process of inductive and deductive thematic analysis (Fereday & Muir-Cochrane, 2006). Thematic analysis was undertaken by searching for themes that emerged by reading and re-reading the data, seeking patterns in the data where themes develop categories of interest (nodes). Although an inductive data-driven approach was used to seek patterns within the data, a deductive approach was used by utilising Mezirow’s TLT to code data proving to be an integral part of the emergence of themes. By using a hybrid approach towards the analysis of the data, the themes were allowed to emerge directly from the coded texts, as I highlighted verbatim transcripts, narratives and fieldnotes, coding important information that added richness to labelled categories bringing ‘order to the chaos’ (Jackson & Bazeley, 2019, p.98).

Guided by TLT, I operationalised its principles by creating theoretical nodes within NVIVO, aligning with key constructs from the theory as suggested by Jackson and Bazeley (2019). For instance, the node *'The learning journey'* encapsulated moments of cognitive dissonance and critical reflection, mirroring the TLT emphasis on reflection and the examination of underlying assumptions. Nodes titled *'Challenges'* and *'Acquired skills'*, were linked to the transformative process outlined in TLT, where overcoming challenges and acquiring new skills signify transformative outcomes. Moreover, the emergent nodes directly derived from the data, indigenous nodes, such as *'The move and loss,'* were consistently analysed through the lens of TLT to capture nuances of transformative shifts within the narratives.

The intentional alignment between the coding process and TLT not only provided a theoretical foundation for analysis but also facilitated the identification of transformative patterns, contributing to a richer understanding of the experiences described in the narratives. These nodes served as tags for my data about ideas I wanted to track and were listed alphabetically, without having any specific hierarchies at this stage. Memos played a crucial role, in capturing uncertainties, reflections and ideas.

Some narratives needed multiple codes for relevance, as exemplified in the following narrative *'Once again, not all students could download the AR application[frustration], however, I had already anticipated this and divided students into groups, this way, at least they had one phone per group that had a working app'*. This code was coded both for *'Challenges'* and *'Overcoming challenges met'*. This approach for multiple coding was used to later form patterns from the combination of codes such as *'Challenges'* AND *'New opportunities'* AND *'Self-motivation'* that later merged into the themes. The coding structure, organised hierarchically, enhanced conceptual clarity, and revealed patterns between nodes, despite challenges posed by lengthy narratives. Decisions on narrative relevance were informed by a strategy of comparing and contrasting textual data (coding comparison) to avoid an overload of highlighted information. When faced with challenges in determining narrative relevance, I employed Lyn Richards (2009), as cited by Jackson and Bazeley (2019, p75), asking myself why a passage was interesting and why I found a concept intriguing. Those narratives that did not meet the criteria were preserved as memos, ensuring a comprehensive record of the coding journey.

By continually assessing and rethinking the labelled codes (constant comparative method), TLT was applied to deductively capture the richness of the phenomenon and interpret a pattern that

fit the research question and the theoretical framework. The tools incorporated in the NVIVO software further assisted analysis by managing ideas, including theoretical knowledge stored within the project files that were needed to generate the themes, and finally visualising the categories and themes through creating conceptual maps that was found important to visual the nodes and themes.

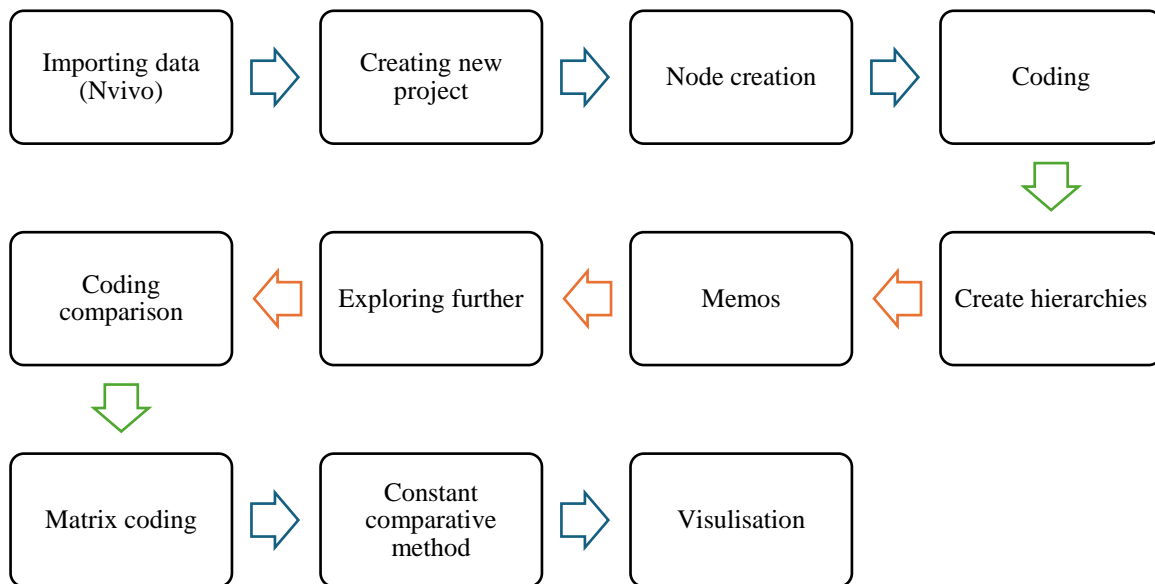


Figure 4.1: Steps for coding in NVIVO

4.5 Ethical considerations

Although autoethnography’s primary focus is on the self, other human subjects were involved through the narratives, more so when the study involves others through interviews (Chang, 2016) for member-checking purposes as applied in this study. The research design included all considerations to protect the privacy and ensure the confidentiality of others in this autoethnographic story.

Firstly, as my identity is already known, the identities of others connected to me, thus my Mother and my Husband, are transparent to my audience. Although I have not disclosed their real names, referring to family members as ‘Mother’ and ‘Husband’ could be easily traced by my acquaintances; thus, using a pseudonym or “publishing *nom de plume*”, as mentioned by Morse et al. (2002), will not suffice. Chang (2008) recommends that when participants’ real identities are disclosed, the researcher should gain informed consent after informing them honestly and thoroughly about how they will be exposed through this writing. This includes

exposing their privacy through past experiences and conversations, which places them at risk of emotional harm. My responsibility as the researcher is to ensure that participants are protected from harm, including physical, emotional or any other harm. To minimise such liability and ensure their privacy is safeguarded, I utilised member-checking (i.e., returning verbatim transcripts) to ensure they were comfortable with what was being disclosed. Member-checking gave these participants, mentioned in the narrative, an opportunity to engage and mediate with the researcher to assess whether they agreed with the data. Anything in the data they would not wish to disclose could be known, promoting beneficence, and preventing maleficence (Carlson, 2010).

The study also involved conducting member-checking interviews with educators going through the same implementation process of AR to teach human anatomy. Each participant could check their story through verbatim transcript returning (member-checking). Through the process of returning transcripts to participants, the researcher balanced the power dynamics and provided equality and openness, allowing participants to have a voice in the study through this triangulation (Candela, 2019), moreover allowing them to reflect on their lived experience and have control over how they were represented (Koelsch, 2013). Participants in this phase of checking the transcripts could still withdraw from the study, which was made clear in the participant information letter and by myself. Moreover, participants could verify the verbatim, and if they felt they were misinterpreted, the verbatim could have been edited to the participants' accuracy.

Obtaining consent from those involved in the study, directly or indirectly, is imperative (Méndez, 2013). However, appropriate planning can help protect the privacy and identities of those close to the author (Hughes & Pennington, 2017). Those participants whose identities could not be concealed have been previously discussed. However, anonymity was retained through confidential data storage for participants (educators) who underwent member-checking interviews. Hence all interviewee data was retained and was only managed by the researcher. All transcripts were given a number cross-referenced to the participants on a separate file to avoid having transcripts with participants' names disclosed. All data were stored on a password-protected personal laptop in an encrypted file that was only accessible to me. According to the Lancaster University Research Data Policy, I, the researcher, took sole responsibility for data storage management. Following the General Data Protection Regulation (GDPR) and the UK Data Protection Act 2018, the data generated shall be retained for a

minimum of ten years and stored electronically. A backup was held in Lancaster University's institutional data repository to prevent data loss.

All participants were fully informed regarding the study's aim and how the data shall be disclosed. This information was discussed verbally on a one-to-one basis on recruitment and disclosed in a written information sheet. This informative sheet includes the following data to allow proper consideration:

- The researcher's details (personal background/institutional affiliation), the nature of the study, including that the investigation is for a PhD study; the role expected from them and why they were selected for the study.
- Information regarding the interview (including that it would occur online, audio recorded only, the duration, and who has access to the recordings).
- That the study is strictly voluntary and that they may withdraw even after the interview is done within the permitted period (two weeks after the confirmation of the transcript).
- Confidentiality and anonymity shall be maintained (Member-checking interview-remain anonymous). Those mentioned in the narrative identity may be traced.
- Data may be distributed through a publication or conferences; shall be stored on Lancaster University's institutional data repository; be retained for a maximum of ten years.

Prospective participants had the opportunity to read the informative letter at their own leisure and had two weeks to contact me if they wished to participate. Moreover, participants carrying out the interview had a two-week lapse in receiving the transcript for transcript member-checking and a further two weeks from this date to decide whether they would like to withdraw from the study. The member-checking interviews were conducted online, and audio recorded for transcribing verbatim. All participants were aware of this and included in the written consent form and informative letter. Once the interviews were transcribed verbatim, all audio recordings were discarded to protect the participants to ensure utmost privacy (Morse et al., 2002).

Finally, the last consideration taken was safeguarding the researcher, thus myself. Autoethnography is a methodology to care for the self, work through an experience, and better understand yourself (Adams et al., 2015). However, the author can also expose themselves to personal and professional risk (Chang, 2016); hence one must acknowledge the methodology for what it is beforehand and be willing to share experiences with a larger audience. This in

mind, I entered this study acknowledging that I will need to expose my emotions and feelings to a broader audience and that the writing may trigger nuances that may be personal; however, I felt that the study in itself is an important study to share. Ethical approval was granted from the FASS/LUMS ethical committee before the commencement of the study. Moreover, ethical permission was given by the educational organisation where I work, thus where the study took place and where the member-checking interviewees were recruited.

This chapter provided a detailed overview of the methodology used to conduct this study, the data collection methods, the thematic analysis process, the deductive coding derived from the theoretical framework, and the inductive coding from where the themes were derived. In the next chapter, the study's findings are disclosed in subsections.

Chapter 5: Findings

In this findings chapter, we examine the rich and personal tapestry of autoethnographic findings. The following presents a reflective exploration into the researcher's lived experiences with educational technology before her AR journey. This section of the findings addresses RQ 1: What were my experiences with educational technology before embarking on the AR journey? -a question that not only serves as a foundation for the subsequent discussion chapter but also invites the reader to join the researcher on a reflective voyage through the introduction to the researcher's past. The narratives within this chapter shed light on diverse encounters, challenges, and insights that have shaped her earlier relationship with educational technology.

The researcher has chosen to infuse a sense of nostalgia and retrospection into the subtitles, by deliberately drawing upon the retro aesthetics of the past. These subtitles aim to bridge the gap between the present state of technology and the formative moments shaping the researcher's experiences with technology. Moreover, these subtitles serve as a visual and thematic representation of the journey, reflecting on the evolution of technology and the researcher's growth. Hence, they represent more than a stylistic choice, however, a deliberate attempt to contextualise the findings within the broader narrative of the past.

Moreover, to guide readers through this introspective narrative, italicised sentences are strategically incorporated to underscore critical nuances of my encounters with technology, providing contextual indications of their importance, and facilitating a more seamless comprehension of the evolving narrative.

5.1 Part 1: Understanding my positioning

5.1.1 I left my Amstrad in the UK

The move

In 1991, at the age of seven, I relocated with my Mother to Malta to care for my terminal Grandfather. It was a challenging transition for me, having been raised and educated in London, I underwent a significant cultural adjustment. The climate, cuisine, language, and educational system presented notable differences on this small Mediterranean island.

Relocating from the UK resulted in significant losses in my life: separation from my Father's relatives back in Wales, which after his death was my last connection to him, a departure from my school and friends, and surprisingly (to me), parting from my Amstrad CPC 464. Due to

my Grandfather's declining health, we had to relocate suddenly and there was a limit to how much I could bring along, so many possessions were left behind and eventually sold with the apartment. My Amstrad, primarily used for gaming did not make it onto the list of belongings my Mother deemed necessary to bring along. Consequently, I had to leave this computer, which I used extensively during my leisure hours, behind in the UK.

Early educational experiences in Malta 1991-2000

Malta had only gained independence seventeen years before, but the British naval bases were still apparent and had been transformed into educational institutions and government facilities (Thake, 1995). The governmental primary school I attended was a small dull building on the island's northern coast, that had previously served as a British army base. The outside of the school was gloomy, and the interior lacked any semblance of modernity. Most lessons were conducted in the official language, Maltese, making it difficult for me to comprehend most of the classes. *Apart from a few lessons conducted in English, I spent most of the day, isolated at the back of the classroom doing mathematics and English classwork from cardboard flashcards.* When I enrolled in primary school that year, I found myself as the only foreign student in the entire school, and in the early 1990s, Maltese children primarily conversed in their first language, so making friends was hard. *I felt excluded and mourned my life in London, where I felt a sense of belonging and was able to be actively involved in the classroom, instead of being invisible.*

Another aspect that I mourned was the teaching tools like the computer rooms and various technological resources like audio cassettes for English comprehension exercises that were not apparent in my new school. I constantly complained to my Mother that I felt we had travelled back in time, even the desks at school were ancient relics, featuring unused ink potholders ingrained in the wooden desks that had been vacant for at least four decades. *The school lacked technology; even the administrative staff worked using pen and paper, not a computer in sight. I gradually distanced myself from education due to the unwelcoming atmosphere and lack of inclusiveness, causing me to lose interest in actively participating in class.*

The move resulted in more than academic difficulties, I also struggled to fill my leisure time. Watching television presented language barriers, as most of the broadcasted television stations were from overseas, particularly Italian channels, which were more affordable to acquire than producing local content (Gouder, 1994). Among the limited options, there were a few Maltese stations that aired programs in the local language. It was not until the middle of 1992 that cable

television was introduced to Malta (Vigar, 1993). However, it took another three years for cable services to become available in our household. *Lacking ample indoor activities, I discovered a newfound love for the outdoors, which was never an option when living in central London.* Following our relocation, most of my childhood was immersed in outdoor pursuits, seeing how my Amstrad hadn't made it to Malta. I relished playing in fields, swimming in the sea, and venturing in abandoned British military bunkers. A few years later, I vividly recall receiving a Micro Genius console as a Christmas gift from my uncle. *While I enjoyed playing on this console, my preference still leaned towards outdoor escapades. I had grown accustomed to exploring the physicality of nature, embarking on real-life adventures, rather than assuming the role of a virtual ghost buster or dungeon master.*

5.1.2 Regaining a network

Upon starting secondary school in September of 1995, entering year seven, I was introduced to technology within an educational context for the first time in Malta. The experience was a remarkable shift for me. The school itself was a breath of fresh air, boasting a modern structure unlike my primary school, and it was equipped with a dedicated computer room that we were granted access to for forty-five minutes per week. Despite the promising outlook, the availability of personal computers was notably limited, leading to a rather low computer-to-student ratio. Consequently, opportunities for individual use of personal computers (PCs) were infrequent at best. *This scarcity, however, revitalised my connection with technology and prompted me to initiate a conversation with my Mother about enrolling in a computer course.* The time I had spent away from using a PC had left me with a fading memory of even the most basic commands, such as how to shut down a computer. *Consequently, during the summer break of 1996, I took the initiative to enrol in a twelve-week course specifically tailored for children. With access to a PC entirely to myself, I undertook the task of relearning the fundamentals. When the course concluded and I underwent assessment, I was gratified to achieve a grade of C, signifying the progress I had made in reacquainting myself with the world of computers.*

However, not having a PC at home, coupled with the limited training and usage at school, caused me to regress in my computer skills again. *Thankfully, the situation gradually improved as the school acquired more computers, and in my tenth year, a second computer room was introduced.* Despite the increase in computers, my performance in IT by the end of year eleven remained average and I passed by the skin of my teeth. I started noticing individuals with bulky

mobile phones during this time, which marked the beginning of a new technological era. In the last few months of my secondary school experience in 1999, I acquired my first mobile device—a sleek black Motorola StarTAC flip phone.

Later educational experiences in Malta (2000-2017)

In the subsequent academic year, I commenced my studies at a small college, and the facility exhibited the same aged and dilapidated condition as my primary school. *In this setting, there was a complete absence of modern technology, relying solely on traditional chalkboards and erasers, which transported me back to my first memories of school in Malta. All lecture materials were transcribed manually, and assignments were submitted in written format.* After a span of two years, in 2002, I received acceptance to the University of Malta. Although the University had been established in 1968 (University of Malta, n.d.) the main campus had a pleasant building aesthetic which boasted modern computer labs. However, as a student in the Faculty of Health Sciences, then the Institute of Health Care, my department was situated off-campus within the premises of the historic St. Luke's Hospital, originally constructed in the 1930s (Tanti 2005), and retained its vintage décor and lack of technology. *Transparency projectors became prevalent during my time at the University, replacing traditional chalkboards, while whiteboards took their place.* The acquisition of clinical skills took shape in a skills laboratory, where students practised and demonstrated procedures on one another. *My learning experience was far from what I was used to in terms of content and teaching methods, but my interaction with technology stayed unchanged, as all course notes were conveniently sent to nearby stationery stores where hard copies were available for purchase, assignments were allowed to be handwritten and submitted via a pigeonhole. Even though I purchased my first computer at the beginning of my course, anticipating the necessity, I found myself utilising it not for educational resources, however, for the sole purpose of visits to Amazon and eBay.*

Two years after completing my Diploma, I subsequently embarked on a journey to earn a degree through a top-up academic program in nursing in 2008. This endeavour would run in parallel with my full-time commitment to the intensive therapy unit (ITU) at the general hospital, working long shifts alongside being a single Mother to my then-eight-year-old Son. *Upon my return to University after a two-year gap, I realised that teaching methods remained the same. However, one module was delivered in a hybrid approach, which initially seemed daunting due to its novelty. Locally, the utilisation of online resources, particularly within the*

health discipline, was still a relatively new concept. This prompted me to acquire my first portable laptop. Within the module ‘Learning Practice’, we were tasked with utilising a web-based platform, specifically the virtual learning environment (VLE). For this hybrid unit, lectures took place in a face-to-face manner and individual and/or group activities occurred virtually on the VLE. *The encounter was unfamiliar to me, as it marked my first time utilising a web-based platform for learning.* Managing this experience proved to be a challenge, seeing my workload already included a full-time commitment to the demanding healthcare sector, and my part-time studies holding tri-weekly face-to-face lectures. Additionally, students were required to actively engage in forum discussions, further intensifying the time constraints. The module consumed all my available time and energy, as I struggled through reading long forum discussions and contributing to unique insights. *I encountered significant challenges throughout this experience, which included juggling tight daily deadlines. The boundaries between my work, study, and time spent with my son often blurred, ultimately resulting in my failure to achieve a passing grade in this unit.* Consequently, I had to retake the unit’s assignment, which led me to achieve a passing mark of 45 (equivalent to a D+), the highest grade attainable after a re-examination. This marked my first encounter with a resit at University, and I couldn’t help but feel a deep sense of disappointment in myself. *It led me to conclude that electronic instruction might not be well-suited for me. Fortunately for me, this was the only unit that necessitated the use of technology in such a manner.*

In pursuit of research for the dissertation, I used the library, finding solace in its serene atmosphere, a sanctuary free from distractions (and technology) bathing in the comforting scent of books. In that era, the library at the University of Malta did not provide Wi-Fi, as many other local places, and smartphones, as we recognise them now, were beyond our reach. Consequently, it remained a dedicated space for quiet contemplation. *I relied on physical books as my primary source of inquiry for assignments and my dissertation. Although we were informed about the online database accessible through the library computers, I hesitated to venture into that realm. It felt intimidating and unfamiliar, not to mention the Health Sciences library branch, located within the current general hospital only three computers, making it challenging to find an available one.*

I observed that certain lecturers I encountered also conveyed my point of view on the use of technology. A clear example of this was evident when it came to the dissertation supervisor (referred to as they/them). *While the requirement was to compose the dissertation electronically using a word processor, my supervisor refused to accept chapters sent via email. Instead, they*

insisted that each chapter be printed as a hard copy and physically delivered to their pigeonhole. Furthermore, all their feedback and comments were provided directly handwritten on the printed document. During that period, such practices were commonplace and formed an integral part of our academic reality. *Both of us maintained a sense of detachment from electronic tools and instead relied on physical means and resources available to us. Interestingly, even the act of typing up the dissertation was something I resisted. To be honest, I ended up writing my entire degree dissertation by hand and sought the assistance of a secretary at my workplace to transcribe the entire document.* Her proficient typing skills allowed for a faster and more efficient process, as opposed to my method of ‘hunt and peck’ typing.

Following my graduation, I switched faculties within the University and enrolled with the Faculty of Medicine and Surgery to pursue a Master’s degree in biomedical sciences. This marked a new chapter in my academic journey, however, still my educational encounters in this program mirrored my previous academic experiences. I attended traditional face-to-face lectures, engaged in group discussions, and participated in clinical, and laboratory work as before. *However, there was a notable exception in the form of one unit: Medical Genetics. In this unit, I was presented with an opportunity to follow lectures broadcasted live from a genetics laboratory in Italy, whilst working in our workshops locally following the lecture virtually in real-time via webcast.* We could participate actively by asking questions to our lecturer, who would then send a message to the team via email, and they would reply promptly. *For the first time in my education, I found this experience captivating; being able to participate in such an enticing event without the need for travel and having the opportunity to actively engage. This experience made me reassess the role of technology in education from a student’s point of view, as I excelled in my performance and thoroughly enjoyed the overall experience.* Following my 2015 graduation, I left nursing and secured a research position at the University of Malta as a medical researcher. This role enabled me to evaluate medical diagnostic tools and undertake a second MSc in anatomy with the same faculty. Despite this, my experience remained research-focused, offering no new insights into educational technology for pedagogy.

5.1.3 We do not have Wi-Fi. Talk to each other, pretend it is 1991

Tech integration: Balancing work and home

Throughout my adult life, my relationship with technology underwent a complex transformation. Having worked in the ITU for seven years, I witnessed how most of the medical

equipment relied on technological advancements to monitor patients' vital signs. The constant symphony of beeps from ventilators and ringing monitors, alerting us of irregular readings, became a familiar background noise that I gradually grew accustomed to. *However, it was the emergence of smartphones that truly propelled me into the world of technology in my personal life. Despite feeling like a latecomer, especially when it came to joining social media platforms, I eventually embraced the smartphone as my go-to device. As smartphones progressed, so did my personal use and I found myself relying on mobile apps for tasks ranging from banking and organising cooking recipes to booking flights and hotels, and even enjoying movies.* Nevertheless, I couldn't shake off a sense of weariness regarding the extent of control this device held over my life. I longed for a simpler era when people engaged in face-to-face conversations or made phone calls as I felt text-based chats were superficial. *Additionally, I harboured concerns about the impact of technology on our mental wellbeing. Witnessing firsthand how social media affected teenagers' self-esteem, leading to increased anxiety and depression, I made a conscious effort to limit technology usage at home, particularly around my teenage son.* I consistently encouraged him to embrace the joys of exploring and experiencing real-life interactions, similar to my childhood, rather than being confined to a virtual existence.

Navigating a pedagogical paradigm

Upon taking a full-time academic role in 2017, I found myself relying on traditional methods of teaching in the classroom. After spending years working with immobilised patients, it was invigorating to be in a lively campus environment, surrounded by enthusiastic students in the classroom. Although I did use PPP during my lectures, I believed that the conventional teaching approach was sufficient, after all, that was how I was taught. *It became evident that students were more engrossed in their smartphones, prompting me to recognise the need to enhance my teaching practices through technology. I felt that the PPP was not enough, I was not enough! Here I came to a realisation that how I learnt as a student was no longer relevant in this era and that these students required more engaging experiences to learn, specifically using devices that they already had available, their mobile phones. This dilemma made me take a long hard look at myself as an educator and seek strategies that could engage my audience effectively. This realisation made me feel unworthy as an educator.* These emotions of guilt transported me back to when I started primary school in Malta and realised that I had become those teachers that taught in the way that suited them and not the students. This realisation instigated feelings deep feelings of shame. I always envisioned myself as a relevant educator using real-life

experiences, and frankly, I always considered the content of the knowledge the most important part of my role rather than through the medium it was done. Following this realisation, I began exploring various tools that would enable me to incorporate students' smartphones into the learning experience. *The uptake of technology did not happen overnight, in fact, it was not until the next academic year that I started to dabble with some technologies, such as Kahoot! and Mentimeter, following asking other educators about mobile applications they found useful in the classroom.* I created some games to use at the end of the lesson, and I was enlightened to see a positive response from my students, where they asked for more such games in each lesson. Still, these games did not help with making the overall lesson more engaging.

That same year, in 2018, I embarked on a professional development training, the vocational teacher training programme, within my educational organisation, to enhance my pedagogy in vocational training (Times of Malta, 2006). Here I hoped to gain answers and instructions on how to be a more relevant educator. *I graduated a year later but still felt that although I knew more about pedagogy and instruction, I realised that they failed to describe how we could implement technology, what the process would look like and what resources we could use, so during the academic year of 2019 my methods remained unchanged.* What I did find during this time were other educators, like me, that considered undertaking technology, for different reasons, but felt unsupported and undertrained to do so. *Determined to expand my horizons, I decided to embark on a journey of further exploration and learning.*

5.1.4 Broadening the bandwidth

TEL journey

In January 2020, I enrolled in an online doctoral program focused on TEL at Lancaster University in the UK. *The main motivation behind selecting this doctorate was to deepen my understanding of technology in education. My goal was to gain enough knowledge on TEL to enhance my teaching practice and evolve as an effective practitioner in the field.*

Embarking on my first-ever fully online learning experience, I found myself stepping out of my comfort zone. Meeting the cohort proved to be overwhelming, as most of my peers were seasoned educators in the field of TEL or had prior experience teaching with technology. Not only did I feel physically distant from the educational institution, having never visited the city of Lancaster or the University, but I also experienced a sense of isolation among my peers due to my limited background in TEL. *Establishing connections and interacting with esteemed educators made me acutely aware of my perceived outsider status, leading to feelings of*

imposter syndrome within this technology-driven group. Concurrent with this newfound journey, a worldwide surge in COVID-19 cases was on the rise, thus the University cancelled the residential, and my only hope of making the connection that I needed. Instead, we were offered an online residential that did not spark a sense of excitement. To make matters worse, just a few days prior, Malta entered a nationwide lockdown and suddenly, I was the online educator. Meanwhile, the Ministry of Health was urging former ITU nurses, to return to service. With the weight of these circumstances pressing down on me, I felt that I would break and resign from the doctorate. However, *despite the challenges I faced and experiencing feelings of not belonging, I connected with my peers, and I realised I was not alone in my struggle, and that others bore the same feelings. There were others like me who, although not inherently technologically inclined, shared the desire to become better practitioners in the field of education.* We discovered that we had similar perceptions, struggles, and goals. Moreover, experiencing online teaching during the COVID-19 pandemic brought about a deeper realisation of the importance of technology for education. *Although this time had its share of challenges, I overcame them the best I could and had the opportunity to merge the theoretical with the practice.*

Taking action

As I transitioned back to a semblance of normality in September 2022, and back to the classroom after a year and a half teaching online, I once again reflected on my previous ways of teaching in the classroom and contemplated how my new knowledge could be applied to the classroom setting. *It was undeniable to me (and others) that technology played a crucial role in ensuring the continuity of education during such uncertain times and I was not ready to lose what I had learned.* Without that pivotal experience, I would not have had the opportunity or the courage to venture into virtual teaching. Moreover, it was this experience that equipped me with the confidence to explore ideas of technology potential to revolutionise the way we teach and learn, making me feel like a TEL researcher and overcoming my imposter syndrome.

I found myself in a speculative state, contemplating how I could be more technologically relevant now in the classroom and what tools I could use. I felt more open and ready to learn but lacked knowledge of technology in the classroom. *Uncertainty loomed over me as I pondered how unfamiliar technology would affect my teaching and whether it could truly enhance the learning outcomes for my students now that technology was my choice rather than obligatory.* Feelings of emptiness washed over me as I felt that my online journey and all my

new skills would diminish to nothing within the classroom, so I set out to seek new opportunities. *It was this frame of mind that led me to apply for the role to be part of a pioneering team of educators, to consult with an EdTech company designing tools (AR, VR, and gamification) specifically for our educational institution. Feeling more confident I applied for the role that covered the first phase, which consisted of the AR technology, and was placed in charge of the anatomy topic.*

At the onset of the academic year, a group of eight lecturers teaching different topics, including myself, were chosen to *consult, test and provide feedback on* applications specifically developed for lower-level students. The objective was to solicit input from educators regarding a tailor-made AR mobile application and a VR software application, aiming to ensure alignment of the app to reach the criteria of multiple units. This endeavour aimed to improve usability and guarantee the attainment of learning outcomes. This development was part of a bigger project that was underway, that aimed to create applications and later games for the institution's students. *I was privileged to be among the few educators granted access to the Beta version of the AR mobile app which included three sections, a chemistry section, a construction engineering section, and a section for anatomy. The role allowed us to offer valuable insights on how to improve the content and visuals of the app, making them specific to our teaching needs, making this a valuable tool to complement the lesson.* My role was specifically on the anatomy app in AR, that initially contained the fundamental structures of the human body, with the agreement of an assessment section to be added later. The feedback process extended over two months, as communication between the educators and the software developers took place through an email thread. With the commencement of a new academic year, feedback was slow. Nevertheless, by December of that same year, we successfully concluded the feedback process and shared our recommendations with the software developers.

It was during this time that I decided that I wanted this experience to be more and that I wanted to explore AR in the classroom myself and use this experience as part of my research. As we waited for developers to implement the suggested changes, I started to plan a timeline so that this experience could align with my anatomy subject and simultaneously be my data collection phase. Although my initial observation of this app created mixed feelings, as I did encounter limiting features, I felt that it was worthwhile to take on and that by being creative I would be able to make the lesson more engaging and interactive.

5.2 Part 2: An educator's journey into augmented reality

This section explores the researcher's experience employing AR within the classroom environment, using autoethnographical writing as a method of self-representation. It directly addresses RQ2: What was my initial experience as an educator when using AR for the first time? Through a nuanced narrative, a strategic use of italicisation is used to highlight critical moments in encounters with AR technology, including preparations, challenges, opportunities as well as emotions experienced. Moreover, direct quotes from the field notes are incorporated, aiming to provide contextual indications of the significance of various aspects of the AR experience.

5.2.1 Preparation of a digital transformation

Several months passed, and the anatomy AR application underwent further adjustments. Just before the summer recess in June 2022, we received confirmation that the application was deemed ready for implementation with our students. *During the summer break, I took the opportunity to download and explore the new AR application, acquainting myself with its design and features.* During this time, I gained most of the knowledge I needed on the application, but still had no experience with teaching using this type of technology, thus I wanted to be well prepared.

Physical preparation

The preparations for implementing AR began several weeks before our return to campus. *During the summer, I started reviewing the PPP that I typically use to teach the unit. It became evident that these presentations would need to be updated to align with the graphics created for the AR experience.* Considering the integration of this new technology alongside the presentations, I aimed to ensure a smooth and seamless process. To achieve this, I decided to remove all the images of body systems and organs from my presentations. These images, typically in JPEG format, were replaced with 3D models available in Microsoft PowerPoint. By incorporating these 3D models, I aimed to create a creative 3D animation effect that would provide a more realistic impact. Students could now witness the movement of organs and I could even rotate them for students to view them from different angles. This transition to using 3D body organs and systems in my presentations served as a seamless introduction to the 3D AR human body that would be implemented in the classroom.

I manipulated the presentation to begin with an overview of each system, where I would provide a brief description of the system's function and highlight the main organs within it. Following that, I designated two separate slides in the presentation for QR codes that would direct students to the relevant mobile app platform for downloading. To generate the QR codes, I utilised a free QR code generator. This tool allowed me to create two codes—one for iOS and another for Android—by entering the URL provided by the software company, which was accessible on Moodle. I believed that using QR codes would offer a quicker and more user-friendly approach for students compared to manually searching for the mobile app. With the presentations now prepared, I completed the necessary resources for implementing AR as a teaching tool for human anatomy. *However, I recognised that I still needed to mentally prepare myself for the upcoming implementation.*

Mental preparation

To ensure a seamless implementation of AR, I fully immersed myself in the mobile app, dedicating time to becoming as proficient in its use as I am with other apps on my phone. I was determined not to be caught unprepared in the classroom, so I made it a priority to familiarise myself thoroughly with the application. *I delved into the application's assessments, focusing on the three quizzes designed to test users' knowledge of body organs. These quizzes required participants to tap on the correct organs, and I played through them repeatedly during my preparation. My goal was to identify any potential issues and gain a deeper understanding of the question algorithm employed by the app. Additionally, I conducted a mock lecture to test the assessment's integration at the end of a lesson.* Given that my lessons were typically only one hour long, I carefully timed myself to ensure that the assessment could be smoothly implemented within the allotted time frame. During this process, I noticed that the application lacked suggestions or hints for the correct answers. This meant that users were not provided with any guidance when attempting to answer the questions. Additionally, I encountered a specific question that had an issue, which I promptly reported to the developer for further attention and resolution. *After several weeks of using the application and envisioning how my lessons would unfold, I experienced a significant boost in confidence. The more I familiarised myself with the application, the more comfortable I became with its features and functionalities. As a result, I started to feel mentally prepared for the upcoming implementation phase.* The combination of becoming well-versed in the application and visualising the potential outcomes of my lessons made me feel prepared and excitement for what was to come in the next academic year.

Formal training

Returning to campus in late September, just two weeks before the start of the academic year, a mandatory formal training session was organised for all lecturers who taught lower-level students, regardless of their field. The purpose was to familiarise us with digital pedagogical tools created by the tech company. Anticipating that the focus would be solely on the AR, I was surprised to discover that the session covered a wide range of tools that I had previously been unaware of. The session, led by the managing director of the EdTech company, lasted two hours. This experience revealed that the company had developed more than just the AR app I had been introduced to. During the introductory portion of the meeting, it was emphasised that while the use of these applications was strongly recommended, it was not mandatory.

During the training, I observed the introduction of various other tools, which left me feeling overwhelmed since my primary focus was on the anatomy AR application. The presenter presented several tools designed to engage students, including individual learning planners, smartboard applications, communication apps, as well as AR and VR technologies I knew of. The segment dedicated to the AR application was relatively brief, providing a swift description and demonstration of its usage. *Had I not been involved in the Beta testing, I would have struggled to grasp the intricacies, a sentiment shared by some of my colleagues who engaged in discussions about the training session afterwards in the staffroom.* For many, this was their first exposure to any of these digital tools.

I found the timing of this training session to be somewhat inconvenient, considering that we would be back in the classroom in just ten working days. *It left me with mixed emotions, as I was both excited about the new opportunities presented by these technologies and frustrated by the lack of adequate time for planning and training if I wanted to use the other tools.* The session itself did not meet my expectations, as it primarily provided an overview of the available educational technologies rather than offering hands-on training. Although we were informed that manuals would be accessible on Moodle, outlining the application download process and their respective features, I felt that online manuals alone could not replace the need for practical training, that was not offered. We merely scratched the surface during the meeting, leaving us in need of more comprehensive instruction. Considering the approaching topic of human anatomy in my teaching curriculum, I decided to focus solely on implementing the anatomy AR application for the upcoming year.

Informal training

Shortly after the initial training session, we convened a department meeting to discuss the new laboratory and resources acquired. In preparation for the meeting, I reached out to the department coordinator and requested that AR technology be included on the agenda, as it was a relevant topic for all lecturers who might be interested in implementing AR in their teaching. *Here I volunteered to provide informal training on the app, from what I had learnt myself over the past months.* During the meeting, we were pleased to see that new microscopes, histology slides, and some anatomical models had arrived. These resources were valuable for teaching human anatomy, however, more recently, the laboratory and all these resources, had been relocated to a new institute. Consequently, now, the lab has become even more restricted and posed geographical limitations for our satellite campuses. For lecturers who taught off the main campus, using the lab would not be feasible due to the distance. In my case, this posed a significant challenge as over half of my classes were scheduled in a satellite institute (Institute of Creative Arts), where a laboratory facility was not available. Therefore, I regarded AR as a valuable teaching resource to explore for the upcoming year.

During the science meeting, when the topic of AR arose, I shared my experience using the app, being the only person from this department who had been involved in the development and testing phase. Despite my lack of classroom experience with AR, I elaborated on my active role in app development and detailed my comprehensive exploration of the application during its development phase. I highlighted my intention to incorporate the app into my anatomy classes, outlining my strategy for addressing the anatomy criteria across various, ranging from levels one to three. Reflecting on my thorough preparation for app implementation, I underscored my plans for integrating the app within classroom settings, especially when the laboratory was unavailable or when teaching off-site without access to conventional anatomy models. With the AR application now available for download on Google Play and the App Store, I guided my colleagues on how to install the app and provided a live demonstration of its features and functionality. Every lecturer attending the meeting downloaded the application, and together we navigated through its features (Figure 5.1). *Although not an AR expert, I believe I succeeded in fostering enthusiasm among my colleagues to seriously consider this technology. My introduction felt fitting, despite the formal training, and I felt that this session also helped me build confidence sharing the app with others.*

We reached a consensus that the educators would dedicate a weekend to in-depth exploration of the app. The plan was to regroup the following week for a discussion on any challenges they faced, and I would try to offer support before we started lectures. Upon reconvening, several colleagues voiced reservations about adopting AR, particularly given the non-mandatory nature of digitising teaching resources, with the semester’s commencement just days away.

Still, several colleagues displayed curiosity about the anatomy AR application and signalled their intent to incorporate the app into their anatomy teaching. Motivated to rally fellow educators on this venture, I proactively spurred their engagement and adoption of AR as a pedagogical aid. *Following the weekend of comprehensive AR application testing, a group of three educators, including myself, collaborated to compile suggestions to amplify the overall student experience. I assumed a leadership role by aggregating and submitting feedback to the developers.* Nevertheless, it is important to acknowledge that not all suggested enhancements were implemented by the developers during that period.



Figure 5.1: Engaging with AR at the informal science meeting, September 2022.

5.2.2 Augmented reality in education: Testing the Digital Waves

In early October, prior to delving into the anatomy segment, I introduced an overview to my classes. I covered the teaching approach, and assessment process, and highlighted the integration of AR as a learning tool for the topic. Students displayed curiosity and posed a few questions regarding this innovative approach, which reassured me as I had anticipated this interaction. During the initial week of the course, I noticed the diverse array of mobile phones and models. *To ensure the app compatibility across devices, I engaged my Son and Husband.*

They downloaded and tested the app on their personal and work smartphones. While a comparable trial occurred during the science departmental meeting, I aimed to proactively foresee potential classroom challenges.

In the first weeks of teaching anatomy to my classes, I employed traditional teaching methods to introduce the fundamental concept of cells. Progressively, I transitioned to the complexities of the human body's systems. I used presentations and supplemental videos for this phase, preceding the exploration of human body systems. Even after extensive summer preparations, I vigilantly monitored updates to the mobile application on my phone, concerned about overlooking any changes.

Overview of experience

In the last week of October 2022, I commenced the implementation of AR in my teaching practice. Throughout this period, I had a total of eleven classes, consisting of three classes at level one, four classes at level two, and four classes at level three. Each class met for one hour per week, and we concluded the module by the 23rd of December. In total, I conducted seven sessions per class using AR, amounting to a cumulative seventy-seven lessons utilising this technology. After each session, I diligently collected field notes to analyse and reflect upon my personal narratives.

Throughout the ten-week period, I encountered a variety of situations that elicited a range of emotions due to challenges and opportunities that arose. Across the eleven classes, I progressively bolstered my app proficiency, a journey that demanded persistence and ongoing exploration. The process was taxing, particularly in the initial week when I grappled with unfamiliar hurdles and the pressure of being in the spotlight.

Early experiences with AR- Challenges and opportunities

The initial week of integrating AR marked the period of my strongest adverse emotional response.

“As this was my first attempt, I felt discomfort and nervousness, which caused me to feel out of character. The pressure reminded me of what I felt before taking an exam” -24/10/2022

This was also the week where I experienced the greatest challenges. As we advanced through the PPP, we arrived at the slide featuring QR codes, I instructed the students to download the AR application, but the room's slow WiFi resulted in ten minutes being consumed. Realising time was slipping away in a short lesson intensified my tension, as I had not expected this

prolonged process. While I knew the persistent WiFi problem, I had not predicted another issue: over half the students could not download the app. *This unexpected turn left me in a state of panic, given I had previously tested the app successfully on different phones.* Upon closer examination, I discovered that most of my students possessed outdated smartphones, rendering them incompatible with the application designed for newer models.

“To my dismay, the AR mobile application was not compatible with all student’s mobiles, and only ten students from the seventeen could download the mobile app. Of these ten students, another three could not access the AR feature as their mobile did not support AR. This made me panic as I felt a wave of warmth wash over me and my heart beat out of my chest”-24/10/2022

While I knew there could be compatibility issues with different versions of the app, I did not expect it to affect so many students. *This unexpected challenge forced me to think on my feet, drawing upon my prior classroom experiences.* I decided to group students together, with each group sharing a single working application. Initially, this solution proved effective for most of the students.

“The app presented an opportunity for students who usually worked alone or did not integrate with others to team up, as they were unlikely to integrate otherwise. A student on the autism spectrum, teamed up with another student and they took time to explore the body and complete a quiz together. It was the first time I saw him working with another student”-27/10/22

The mobile compatibility scenario recurred in every class, additionally, I also found that the AR was incompatible with international numbers, which some of my students possessed. *Nevertheless, it gradually became less unexpected and more manageable. Although teaming up served as a viable workaround, it presented its own set of challenges.* Since it was still in the early stages of the academic year, students were relatively new to each other, and communication between them was minimal. As a result, I found myself acting as the intermediary, constantly moving between groups, prompting them to ensure that all students felt included and were able to participate.

“I felt that keeping up with all groups and supervising their progress in exploration was tiring and draining as I could not be with all students simultaneously. As this was a large class, it took longer to reach all students causing them to grow impatient and allowing them time to use their phones for other uses”-31/10/22

On the other hand, I observed that phone-sharing facilitated teamwork, and the assessment (quiz) contributed to the development of relationships between students and the educator. This

shift turned the classroom into an enjoyable setting where learning occurred through playful engagement.

“Today we used the quiz, and the students reacted very positively to this fun game. I also found this game to be enjoyable and the bonding experience gained was different from the ‘normal’ lesson setting. I enjoyed that students included me as part of the quiz group, as I gave them hints and wrote clues on the board. I feel that I did a good job in this session”- 2/11/22

Throughout the weeks, I encountered various technical challenges that added to the complexity of implementing AR in the classroom, such as missing components vital to answering the set assessment questions on the app. *Such points had been pointed out to the developer but remained unchanged, causing frustration.* While being able to contact the development team did alleviate some issues related to downloading problems on certain phones, it did not resolve all the problems.

“This was quite frustrating as I wish I had chosen an established app, but this was the app that was made for our students, so at least I feel the choice of technology is validated. I understand how someone may feel like giving up at this point, but I need to carry on”- 14/11/22

One recurring issue was students having insufficient storage on their phones, making it difficult for them to download the necessary applications. Additionally, other challenges were met including logistical factors such as cramped classrooms that did not provide sufficient space for AR experiences. In one performing arts classroom with black floors, the application failed to detect the floor, forcing us to relocate outdoors.

“This class is located in the performing art studio that has black vinyl floors intended for dance. When students tried to scan the floor for the AR, the camera could not detect it. As I only see this group for one hour a week, I did not want to lose this session, so I improvised and seeing it was a lovely day, we did the session outside”17/11/22

Advancing skills

Due to the lack of formal training in AR implementation, and not having others lived experiences to guide me, I had to devise my own solutions for the challenges experienced. Furthermore, since none of my colleagues were engaged in this process at the time, as I had planned to implement the app for the whole topic, I had no support. Although uncertainty occasionally crept in, especially when dealing with the lowest levels, I realised that this experimentation and exploration of AR as a teaching tool were integral to the learning process. *As I persisted, I noticed a transformation in my skills, gradually gaining confidence and*

becoming proficient in troubleshooting, which had been a primary concern. Despite moments of guilt and doubt, I recognised that these challenges and the subsequent growth were part of the journey toward effectively integrating AR into the classroom setting.

“Today, the classroom experienced a power outage due to ongoing construction in the building. Rather than becoming frustrated by the lack of prior notice, and the inability to use my laptop for the presentation, I found myself comfortable with the situation. The availability of the app was enough to do the lecture impromptu, and students could rely on the app for the visualisation”-25/11/22

These experiences served as *powerful motivators*, spurring me to persevere. My own learning process evolved gradually as I encountered and overcame various challenges, *instilling a sense of competence and confidence within me.*

A sense of accomplishment

At the end of each day, I experienced a sense of accomplishment, having triumphed over small challenges that gradually transformed into manageable tasks as my confidence and experience grew. The once daunting obstacles seemed less formidable, and I became less apprehensive about stepping into the classroom, knowing what to expect. Nevertheless, implementing the app continually pushed me beyond my comfort zone, demanding ongoing mental preparation for each lesson. I had to constantly brainstorm ways to utilise the app creatively, ensuring that it remained engaging and avoided monotony. Throughout the entire process, I made mental notes of areas that could have been improved to prevent certain challenges from arising. This reflective practice allowed me to refine my approach and prepare for the next academic year, aiming for a smoother implementation process. It was evident that this journey served as a valuable learning experience, enabling me to grow both professionally and personally. This can be said, especially for the lowest level, that I struggle the most to teach.

“Today’s session felt improved as students embraced the app, bringing a sense of structure and ease. I take pride in knowing that I managed a measure of self-directed learning at this level, which I feel I never achieved in my eight years of teaching this level. Students reading the pop-ups, selecting notes, and managing their notetaking made me proud, as I am sure these skills beyond anatomy will help them in their future studies”- 28/11/22

Gaining confidence in a new role

During this phase, I was able to disprove my initial thoughts that the app was just a ‘one-time use’ tool. The challenges and opportunities kept me motivated to seek the app’s full potential.

Over the course of a few weeks, utilising the app's use became second nature to me and to the students, and I found myself wondering why I had been so adamant about the process.

"I feel satisfied that the app has successfully helped students understand the endocrine system better. I realised that I do not even think about the process anymore, I just do [use the app]. I feel good about what we have covered, and I think that what we managed to cover is even more detailed than what I usually do. I feel confident that they [students] will do well in their exam"- 6/12/22

I also observed a notable transformation in my role as an educator. Apart from the lessons being more fun, I witnessed my role evolving from that of an educator to that of a facilitator. As students embraced their roles as independent learners, exploring the intricacies of the human body through the app and creating their own notes, I could support and guide their learning journey. It was remarkable to experience how seamlessly and naturally this shift occurred within the classroom setting, and I was in awe of the overall transformation.

"I no longer worry when I see them using their phone. I have built confidence that even the students feel that the app is helping them with their learning. Together we have grown over the last few weeks and the students have developed a sense of reliance on the app. While collecting notes, they only ask me questions when they feel unsure"-12/12/22

"Their confidence makes me feel competent that I might have even opened doors for these students to be more technologically inclined in their education. One student is absent but has still sent me the notes on Teams that she has collected from the app to validate"-15/12/22

I took immense pride in witnessing my students become more active and engaged in their learning, instilling a sense of growth and development within me. I realised that I played a pivotal role in driving this change, providing me with a unique opportunity to establish connections with students on an individual level. Operating in small clusters enabled me to discern individual students' strengths and growth areas, particularly those students requiring additional assistance. This approach nurtured a holistic connection compared to the conventional whole-class approach. I was able to adapt the pace of instruction to suit the specific needs of each group, resulting in a more comprehensive learning experience.

*"I have noticed a change in *(student A), who is typically reserved, struggles to concentrate, and requires prompting to take notes (due to ADHD). Recently she's become enthusiastic, encouraging peers to join in the quiz and excited about using her phone. While she does not usually interact directly, she is now sharing progress and taking notes independently. This experience makes me feel effective in a new way- the AR format has truly suited her learning style"- 16/12/22*

Trying new tools and preparing for the future

As the topic drew to a close, I utilised the AR as a revision tool, experiencing a sense of pride in my ability to consistently and effectively incorporate it throughout the entire teaching process. It was bittersweet to reach the end of this journey, as it had proven to be surprisingly pleasant and highly effective. Reflecting on the past ten weeks of implementation, I recognised a shift in my perspective, and a wave of nostalgia washed over me, reminiscent of my own days as a student.

“I find myself envious of not having such a valuable tool during my student days. While it takes more time to cover this topic comprehensively, I believe it is worth it. I am considering allowing more time before the initial exam next year to alleviate time constraints. I am already mentally preparing to incorporate this app in the coming year”-19/12/22

As the exam date approached, I found myself introducing another application from my phone to one of my smaller classes. This app by Lancaster University, the Benekit app, offered a short meditation session that I incorporated into the last five minutes of our anatomy lesson. Introducing this app had not been planned, however, I had been using it myself and thought it would be useful for the students to de-stress. I found that incorporating this app was seamless and did not need much preparation, apart from knowing which session to select and screening it beforehand. Once again student feedback was positive and I found myself effortlessly incorporating these sessions with all my classes till the exam date which proved valuable and personalised, a learning experience that I felt had been missing previously.

As the students prepared for their exams just a few days before the Christmas break, I felt a deep sense of satisfaction in the success of my learning journey into the realm of technology and the fulfilment of overcoming my initial fears. *Looking ahead to the new year, I eagerly began preparing for my next units, actively seeking out other apps that could accompany me in the classroom and further enhance the learning experience for the students and myself.* It was an exciting prospect, and I was determined to continue making the journey as engaging and captivating as possible. With this newfound personal and professional growth and a new perspective for the future, I applied for the role to be part of the gamification phase due for 2023.

In retrospect, my journey towards implementing AR in the classroom has been one marked by a complex interplay of enthusiasm, skepticism, and ultimately, growth. As someone not inherently technological, I initially harbored reservations about the utility of AR in educational

settings. However, through the process of implementation, I have come to recognise the potential biases that may have influenced my perceptions. It is important to acknowledge that my initial skepticism could have colored my interpretations of the outcomes, potentially leading to a selective focus on validating preconceived notions. To mitigate this risk of self-indulgence, I took deliberate steps to engage in critical reflection throughout the data collection process. I continuously challenged my own assumptions, seeking diverse perspectives and feedback to ensure a balanced and nuanced understanding of the results. By acknowledging my initial biases and actively working to counteract them, I aimed to maintain the integrity and authenticity of the autoethnographic inquiry. Through this reflexive approach, I strived to contribute meaningful insights not only to the field of education but also to the ongoing discourse surrounding the integration of technology in pedagogical practice.

Chapter 6: Discussion

6.1 Introduction

This chapter delves into the themes derived from the autoethnographic story presented in the previous chapter, which explored the educators' initial perceptions of technology and her experience of implementing AR in the classroom. For the purpose of this study, the researcher will be referred to as 'her/she' within this analysis.

To address the first research question, 'What were my experiences with educational technology before embarking on the AR journey?' which pertains to the factors that have influenced my longstanding pedagogical perspectives, the initial section of this research, part one, is dedicated to discussing the earlier experiences, prior the implementation of AR directly impacting my initial perspectives. In this section, three themes are discussed that are derived from the first section of the findings. These themes include *A displacement experience during childhood; Experiencing and coping with feelings of ambivalence; and Later reconnecting experiences with technology*. Moreover, the first six phases of TL are highlighted in this section.

The second section of this discussion embarked on a comprehensive exploration of the four consecutive phases of TL (phases seven to ten) as experienced by the researcher in the classroom and beyond. Below, Figure 6.1, illustrates a visually captivating timeline that maps out the intricate stages of the transformative journey. The discussion and identification of the TL phases surrounding the classroom experiences respond to the second RQ: 'What was my initial experience as an educator when using AR for the first time?' Through a detailed examination of emotions and changes in perceptions by these experiences the third RQ 'To what extent, if any, have my feelings and perspectives undergone a transformation?' is resolved. Finally, by incorporating extracts from the member-checking interviews, the fourth and last RQ is answered 'How does my experience compare to that of other individuals who have undergone a similar process?' Investigating the content in this section, allowed the identification of three themes: *Meaningful planning and exploration of the provisional new role; Recognising self-resourcefulness within the provisional new role; and Mastery experience through the cultivation of confidence and competence*. These themes show valuable insights into the researcher's initial experience with AR in an educational context, while highlighting the centrality of experience and discourse with others, an essential component at the heart of TL (Mezirow, 1997).

While the researcher’s TL phases commenced prior to the introduction of the AR app, the member-checking educators also exhibit signs of TL manifestation. However, it is noteworthy that their TL appears to unfold at a different timeline, specifically during the phases involving the AR application.

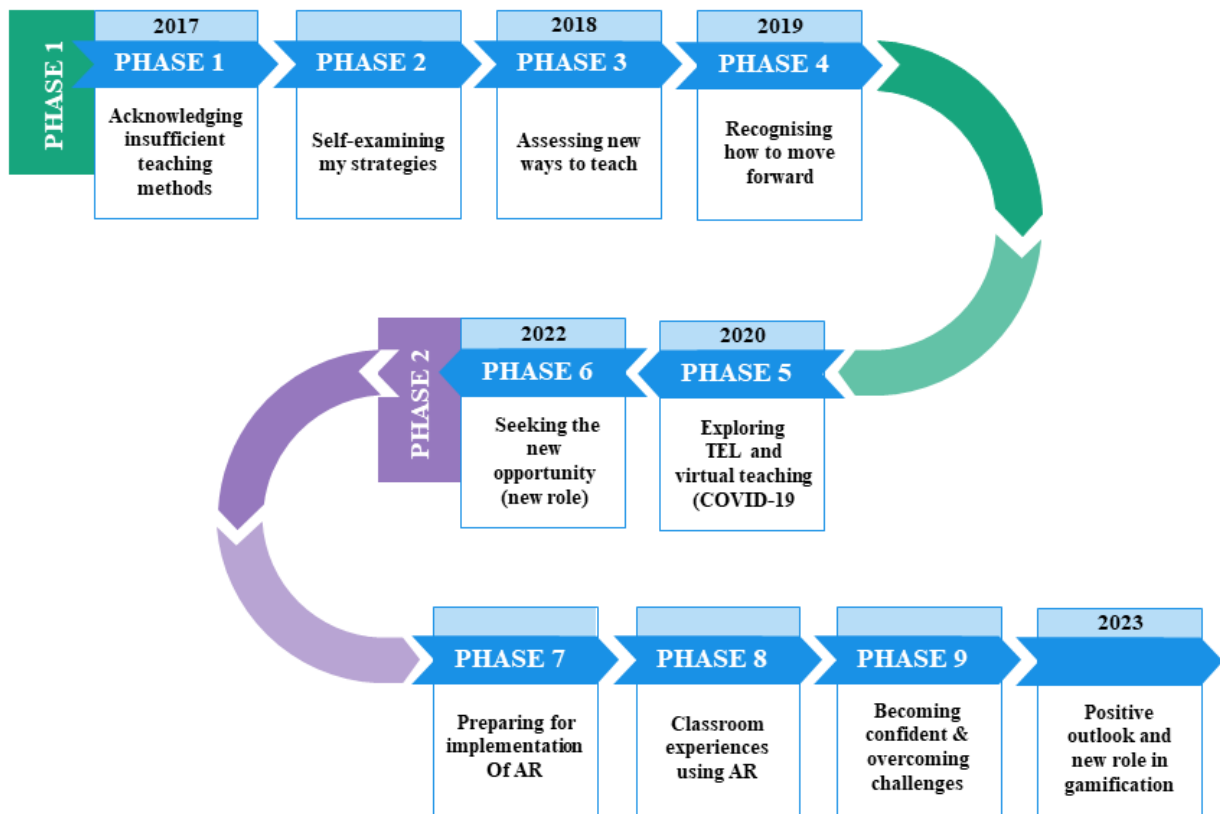


Figure 6.1: Transformative learning journey timeline

6.2 Part 1: Establishing pedagogical perspectives and technological resistance

Part one of the findings described the shaping of perspectives, allowing interpretivism of the researcher’s memories to gain a positioning of the built perspectives the researcher held towards technology. As the main character unfolded, the narratives gave a deeper understanding of her position situated in cultural experiences. This part of the storytelling is important for a visceral connection (Scott, 2018) that in autoethnography, holds significance as they allow the reader to portray the character effectively and ensure that the narrative carries a moral lesson (Ellis, 2004). As the researcher delved into her positioning towards technology, a deeper understanding of the held perspectives, rooted in actions and emotions, that impacted her beliefs and values are shown. This element is at the core of TL, as it involves grasping

one's frame of reference, recognising the role of disorienting dilemmas, and understanding the significance of critical reflection and self-reflection (Mezirow, 1997). Analysing the narratives in this section unveiled three themes.

6.2.1 Theme one: A displacement experience during childhood

The first theme gave a good insight into how separation and the cultural transition experienced during the move and the resettlement challenged the researcher's sense of coherence regarding her identity, and the various aspects that identity encompasses. The researcher's *lifeworld*, as defined by Mezirow (1991), was shaped by the collective experience, akin to a frame of reference, albeit shaped by cultural, social, and personal factors. The following describes experiences that disrupted the aforementioned *lifeworld*.

A sense of marginalisation (Crea & Sparnon, 2017), accompanied by feelings of alienation occurred at the researcher's new primary school, due to the language barrier and alternative teaching aids. Authors Brunton et al. (2019) contend that the experience of inequality, isolation, and a sense of non-belonging significantly influences the development of one's identity. In educational settings, these experiences can be identified through non-participation, which was evident in the narrative descriptions. Thus, the researcher's narratives painted a picture of her juxtaposition between her 'lost' and 'new' identity. If one uses a discursive approach to understand identity, then the researcher's identity can be seen as not changed, but under transformation within the social and cultural developments (Hall, 1996). To avoid confusion, the current transformation discussed is that of identity and not the imminent evolution of the learning process, nevertheless they are linked. Indeed, according to Bauman (2001), identity is described as 'liquid' and in a constant state of transformation, which when considering the narratives, the researcher constructed a new identity based on the cultural resources available, referred to as a 'project identity' (Koç, 2006). Hence the researcher's loss of technology from the 'previous life' during displacement resulted in the formation of new ideologies and values emerging through novel experiences in nature (and with limited technology), influencing the researcher's perception of the social world (Castells, 2011). Existing literature has documented how individuals can adopt dual identities, merging their past selves with their newly formed identities (Brunton et al., 2019). However, in the researcher's case, the familiar technology was lost, and her new surroundings became a source of solace, connecting the researcher to the ideologies associated with the 'physical' world rather than the 'virtual' world, restoring a sense of belonging. This discovery holds significant importance in understanding the researcher's

inclination towards the dynamics of the physical world, including the classroom and the human connection it fosters. Even though the researcher was the only one to have this displacement experience, which contributed to her initial perception towards technology, some member-checking educators also held such initial mixed perceptions towards technology, indicating that growing up during the same timeframe with minimum technology may play a role in shaping this outcome. The subsequent passage exemplifies this feeling:

'Most technology was absent in the 90s. We mainly had the blackboard. I do not even recall having whiteboards in the classroom at secondary [school]. The only piece of technology available I remember was the recorder that the music teacher would bring in the classroom. So obviously the level of enhancement of learning up to secondary was limited. Even beyond' - Educator 3

6.2.2 Theme two: Later reconnecting experiences with technology

We witness the researcher's encounters with technology over the years, which although vary, do not have much positive impact on her ideology of technology. The narratives highlight how the ability to embrace technology was hindered due to earlier set ideologies. However, more recent personal experiences and influences from working in health care, also made her more cautious about adopting technologies for personal use. Still, the few encountered experiences with technology throughout her later years as a student at university, can be seen as critical by providing the researcher with a source of information on innovative teaching strategies. On the other hand, the lack of technology exposure also offers an empathetic perspective towards students' schooling experiences. Keeping in mind that teachers often employ teaching methods similar to the ones they were exposed to in their own educational experiences (Park & Son, 2009) the researcher's experience played a pivotal role in shaping the researcher's initial frame of reference. Although disconnected from technology, she was not entirely dismissing the significance of technology despite the lack of encounters with technology. These experiences all lead up to the last theme of part one. The paragraph below is indicative of how the member-checking educators also had similar experiences to those of the researcher:

'When I was studying at university, it almost remained the same [teaching method], a very traditional way, talk and chalk. We never had the apps, so it is not like the students now. When I was a student, it was a very poor experience, especially in my subject [science] that even up until today they [teachers] are still very traditional' -Educator 5

6.2.3 Theme three: Experiencing and coping with feelings of ambivalence

It was not until the researcher changed careers and became the educator, that we saw feelings of ambivalence towards technology that instigated the first phase of TL learning. Although in the past, there were mixed feelings surrounding the experiences using technology, these were not sufficient to initiate the ambivalent feelings that led to the disorienting dilemma of introducing technology. Moreover, since it was the first time the researcher was in control of the teaching strategy. This third theme highlights the first six phases of TL. The resolution of the *disorienting dilemma* stemmed from a desire to adapt to become a more effective educator, which involved becoming technologically inclusive, similar to the rationale mentioned in the study by Ersoy and Bozkurt (2015). Similarly, other member-checking educators had such a distinctive disorienting dilemma. The following passage serves as a representation of this sentiment:

'I have missed opportunities in the past because I was afraid or lacked the motivation to want to try something new. I do not want my students to miss out because of me. I have learnt that lesson [missed opportunities]and I am trying to overcome challenging opportunities, even if I need to try new experiences' – Educator 4

Consequently, this realisation that the researcher might become irrelevant in the classroom served as an epiphany (Adams et al., 2015), a catalyst that shook the researcher's initial viewpoint and instilled a revelation within her. This upheaval led her to experience emotions of shame and guilt over overlooked possibilities, frequently encountered in the second phase of TL, *a self-examination*, as the researcher examined her experiences and perspectives as a direct result of the dilemma at hand, linking her earlier childhood experiences and insufficient knowledge to her current way of teaching. The member-checking educators also had a self-examination transition when learning about the possibilities of the AR app. The following section is an illustration of that:

'During the meeting, when I first learnt about the AR app, I felt slightly ashamed and out of touch with technology, as I only use [pause] 2D objects in the classroom. Through the meeting, I started feeling empowered and confident that I would be more advanced and up-to-date on technology in my classroom if I try this technology out' – Educator 1

Other studies have also observed that teachers' lack of awareness about the benefits of technology has resulted in missed opportunities for integrating technology in their classrooms (Hedayati & Marandi, 2014; Pamuk et al., 2013; Park & Son, 2009). The researcher's past

encounters, shaped by historical factors as outlined by Zhao (2020), confronted the *meaning perspectives*, by Mezirow (1991), and disrupted all preceding experiences, resulting in a state of existential ambiguity and underscoring the need for TL. As a result, this finding contributes to the existing body of knowledge, expanding upon the research conducted by Zhao et al. (2020) on the influence of culture on users' adoption of technology, highlighting its direct impact on learners' attitudes and behaviours towards technology. Hence this finding deepens the understanding of how culture shapes the adoption and utilisation of technology in educational settings, providing valuable insights for researchers and practitioners in the TEL field. Through self-examination, the researcher acquired a fundamental comprehension of her stance or, as Mezirow (1991) describes it, her schema, which influenced how she viewed technology.

This newly discovered understanding moves to the third phase in TL, a critical assessment, where the researcher reevaluates her pre-existing beliefs about teaching methods, embracing the concept of 'not knowing' as defined by Dewey in 1916, seeing that the researcher was experiencing 'loss of normalcy and connection' also described as anticipatory grief (Eschenbacher & Fleming, 2020). Specifically, this process involved questioning the role of technology in the classroom. The reluctance of educators to embrace technology in the classroom has been well-documented over the years (Hannafin & Savenye, 1993; Howard, 2013; Howard & Mozejko, 2015; Westberry et al., 2015), however, these results indicated that despite the researcher having ambivalence towards introducing technology she was motivated to go against her perceptions and actively seek ways to accommodate student's needs. Although within a different timeline, other member-checking educators describe a similar sentiment of ambivalence when they were first introduced to the AR app:

'My first thought was I am not going to use something that I know nothing about. I did not even want to try it [AR], I did not like it and I did not want to use it. I did not want to use it without having even tried it! After more consideration and our department meeting, I reconsidered, as I thought why would I allow my students to miss such an opportunity?' - Educator 4

As this theme implies, these phases of TL were how the researcher coped with her ambivalent feelings. In this fourth phase, *recognition*, the researcher undertook professional development where she met others like her seeking validation and knowledge. Although the skills she sought were not acquired, she did realise that she was not alone in her predicament. Thus, the researcher coped through this discovery that many like her sought change, which prompted the

researcher to desire further exploration. The member-checking educators similarly demonstrated instances of the phases of *recognition*:

'Coming back to the classroom after the pandemic [COVID-19], I was up to the challenge to continue to use technology in the classroom, but once I was back in the routine, I did not have time to seek something new [tool]. Hearing about the app [AR] made me revisit my wish for a new approach.

Having something endorsed by our own education institution was a plus' - Educator 3

This realisation moves the researcher through the next fifth phase, *exploration*, where the researcher undertook the doctorate in TEL to explore how technology enhances and supports learning. The narratives suggest that the researcher expected this time to be a theoretical enquiry, however, the global COVID pandemic led her to explore TEL in practice as she transformed into a virtual educator utilising digital tools and platforms to deliver her lessons. This complete phase was truly deemed as the essence of exploration. Although the initial emotions highlight feelings of disconnection from her fellow doctorate peers and experienced feelings of unfamiliarity teaching online, the researcher also expressed how these feelings were overturned during this venture leading to profound learning. The sentiment of the pandemic being a transformational time for education has been well-documented in the last few years (Al-Ali, 2021; Bligh et al., 2021; Dovrat, 2022; Sturgeon Delia, 2023). This journey turned out to be such as positive learning opportunity, that the researcher crossed the threshold into the sixth phase of TL, *Planning of a course of action*. This phase was a result of using technology and coming to the realisation that it might be lost again once back in the classroom. As the researcher did not want to miss further opportunities, she actively sought the role of working with the EdTech company, placing her amid technological change and actively setting goals to address her initial disorienting dilemma of utilising technology in the classroom, through this role. Even though the pandemic resided, education globally had a taste for technology (Bligh et al., 2021), and with it, the researchers' scope of awareness also became more defined, making tacit judgments to move towards technology in the classroom. The researcher's engagement with the EdTech company allowed her to plan effectively and offered a technological solution to her dilemma.

Thus, this study suggests the global pandemic to be an important instigator of, at least, part of the TL process. This study is not the first to highlight how a global crisis can become an opportunity to learn within this paradigm. Eschenbacher and Fleming's (2020) research also revealed how the aftermath of such a worldwide event, COVID-19, can create opportunities for TL.

6.3 Part 2: Embarking new challenges and reshaping perspectives

6.3.1 Theme one: Meaningful planning and exploration of the provisional new role

In the initial theme of part two, we delve into the seventh phase of TL, *Acquisition of knowledge*. Here we observe how the researcher created a customised learning path that fostered effective planning of the introduction of AR in her classroom through the preparation of skills by investigating the tool that enhanced the development of skills. Buckingham (2007) suggests educators should develop a comprehensive understanding of technology and explore how to effectively integrate it into their teaching methods. This study emphasises that educators can achieve systematic and effective technology application in education by establishing a collaborative relationship between pedagogy and technology, through self-exploration, equipping educators with the specific digital skills required, and easing resistance due to preconceptions. This study acknowledges that self-exploration came from the researcher's partially transformed attitude, which had already undergone a significant metamorphosis from the beginning of the journey. A similar finding was also acknowledged by Ersoy and Bozkurt (2015) who disclosed how educators first need to overcome their bias towards technology to be open to change. This builds on the work of Pamuk et al. (2013) which emphasises the importance of teachers having faith in the potential advantages of technologies for increased engagement, in this current study, the researcher had already established a level of trust in the AR.

As no training was provided to the researcher before the classroom implementation, the researcher had to take the initiative to independently prepare and explore the app to ensure sufficient readiness before implementation, a step also highlighted by Kovalik et al. (2014) and Pamuk et al. (2013) to ensure effective integration. The researcher's motivation to dedicate time to preparation arose from the sense of ownership she gained through her involvement in the AR development, a finding consistent with that of Patterson and Han (2019). Although not all educators have opportunities to participate in EdTech development, and thus gain a sense of ownership, this finding accentuates the importance of teacher training to ensure that educators are well-equipped to use the tools effectively and form a connection with the technology. This sentiment was also emphasised by Schmidthaler et al. (2003) and Serrano-Ausejo & Mårell-Olsson (2023). Nonetheless, Allsop & Jessel's study in 2015 underscores that management does not prioritise teacher training in the use of new technology.

As the researcher was the sole educator involved in the AR development, she uniquely possessed a sense of ownership, rendering her journey as a singular occurrence. Consequently, she was the only educator to extensively prepare for the implementation process, aligning her level of preparation with her connection to the technology. In contrast, the member-checking educators undertook minimum to no preparation, resulting in largely unchanged perceptions of technology on their part. The following paragraph serves as a representation of this:

‘Unfortunately, I did not have much time to prepare nor was there much opportunity for training. I had downloaded the app [AR] during our meeting [departmental] and the app had remained on my phone. I did try it out a couple of times at home and showed my kids, but I wanted to explore it in the classroom with the students’ – Educator 2

In training absence, the researcher strategically mapped out the steps necessary to implement AR in the classroom through thorough preparation for the future, developing digital skills and having a better understanding of the role AR will have in her classroom. This research underscores the value of comprehensive groundwork as the substantial time and effort invested in planning serve as a powerful motivator, reducing the likelihood of giving up when confronted with obstacles. This result is corroborated by the research by Patterson and Han’s (2019) that underscores the significance of the teacher’s meticulous pre-implementation preparations. This investigation demonstrates how the teacher’s thorough trial run preparations enabled them to recognise any deviations from the instructional objectives and acquire the skills necessary to effectively incorporate this technology into their teaching. Regrettably, since this study did not entail a firsthand exploration, it lacks information regarding the teacher’s emotional response to this comprehensive preparation process.

The researcher’s gained sense of ownership also led her to support others in the face of a lack of training availability. The researcher voluntarily acted as an innovative teacher, as described by Ersoy and Bozkurt (2015), to share her new openness to technology with other educators seeking collaboration and best practices with colleagues. Such acts align with the social and collaborative aspects of TL, highlighting how this process is not isolated to an individual change but involves a broader community (Kitchenham, 2008).

Mezirow’s eighth phase, *Provisional trying of new roles*, can be seen as the researcher embracing the new role that involves the use of AR in the classroom. Mezirow’s interpretation of TL underscores the significance and central role of experience (Mezirow, 1997), whereas adopting this new role involved encountering and surmounting various challenges in the

classroom, until then unfamiliar to the researcher, despite rigorous preparation. Reinforcing established results, this study revealed that the new role led to unfavourable experiences, often stemming from technical issues, classroom logistics, and adverse emotional responses to the technology (Akçayır & Akçayır, 2017; Allsop & Jessel, 2015; Alzahrani, 2020; Bacca et al., 2015; Ersoy & Bozkurt, 2015; Hedayati & Marandi, 2014; Pamuk et al., 2013; Park & Son, 2009; Schmidthaler et al., 2023). Despite the app being tailor-made for the anatomy unit and the researcher's input during its development, significant content-related challenges persisted, as certain issues remained unresolved. These challenges were also addressed by other educators participating in the member-checking:

'The fact that app did not work on all phones was frustrating, and the internet was slow. I had issues concerning mobile space that just made me feel helpless. I think the last straw was when using the quiz, the right answer had to be the skin but we couldn't even find it. I just felt like giving up at that point. How could I help students out if I am getting stuck myself?' – Educator 6

In this aspect, the educators faced greater challenges compared to the researcher, mostly stemming from allocating insufficient time for preparing the implementation. These difficulties triggered negative emotions among these educators, and lacking a sense of ownership, their overall experience was less satisfactory. Pamuk et al.'s (2013) study, which examined teachers' perspectives on implementing new technology in the classroom, underscores how the content of technology can influence teachers' attitudes and influence technology adoption. Nonetheless, the main results presented show that despite these digital challenges, having direct contact with the development process proved motivational in the self-resolution of certain technical issues. In fact, in the case of the researcher, these struggles proved to be opportunities as they facilitated the development of the ability to assess and analyse challenging situations, develop problem-solving skills, the ability to identify potential solutions and make informed decisions to overcome obstacles in real-time. These opportunities in disguise played a crucial role in driving the learning process and were found to be just as significant as the positive experiences reported. A similar phenomenon was observed in the study by Serrano-Ausejo and Mårrel-Olsson (2023), where such learning instances were referred to as 'knowledge associations'. In a recent investigation into teacher learning transformation, the significance of both changes and challenges was underscored, highlighting that TL goes beyond the acquisition of mere information (Kovacs, 2018). Moreover, Mezirow, in his definition of TL, employs the term 'problematic' to emphasise that changing frames of reference can be a difficult process with challenges along the way (Mezirow, 2009a). However, in the case of the member-checking

educators, this was not evident. Their adversities were not turned into opportunities, as this study observed challenges being transformed into favourable opportunities within an extended timeframe. Hence, it was the researcher who invested the most time (seventy-seven hours compared to the mean 6.6 hours of the educators) using the AR in the classroom, and thus her learning expanded proportionally within the extended period and challenges she encountered.

Engaging in critical reflection enabled the researcher to evaluate her progress as she navigated through the process. Mezirow emphasises that the lifeworld can undergo a metamorphosis through introspection and learning, leading to a reconnection with one's capacity for self-guidance, as individuals learn to act in alignment with their personally chosen values, emotions, and objectives. This study also identified the method of data collection to be important to the TL process, enabling critical reflection on the past as the collection of field notes allowed the researcher to reflect on the classroom experiences, highlighted as an important component by Brookfield (2005). Similarly, Patterson and Han's (2019) study also underscored that note-taking in the classroom while using technology-enabled professional development and growth throughout the process of technology implementation.

Furthermore, the researcher observed several positive experiences during the study. Notably, AR displayed the potential to enhance interactivity in lectures through content visualisation, a conclusion supported by previous studies (Chanlin, 2018; Habig, 2020; Mendez-Lopez et al., 2022; Şimşek & Direkçi, 2023). Another positive finding highlights a shift in the researcher's role toward that of a facilitator, a transformation also noted by Allsop and Jessel (2015). This transition is considered crucial in helping students achieve their educational objectives. Integrating AR into the classroom required a significant adjustment in the researcher's teaching methods, a challenge acknowledged by Bell and Gresalfi (2017) in their examination of teachers' experiences with technology integration. By transferring the digital competencies acquired during the preparatory phase to students, she empowered students to become independent learners, despite their foundational level, adopting a guiding and supportive teaching approach.

This recognition of the need for a change in the role to effectively implement AR introduced an essential aspect of adaptability in the learning process (Mezirow, 1997). Interestingly, the emotional impact seen in this study, including satisfaction, enthusiasm, and acceptance that ultimately empowered the researcher, remains unexplored in the existing literature. While the educators engaging in member-checking did acknowledge certain positive experiences, their

limiting timeframe resulted in a comparatively less established position than that of the researcher.

6.3.2 Theme two: Recognising self-resourcefulness within the provisional new role

This theme acknowledges the culmination of the ninth phase of TL *Development of competence and self-confidence*. This phase reflects the culmination of extensive classroom experiences, resulting in the validation of abilities that led to the acknowledgement of gained competencies that ultimately bolstered self-confidence using technology. The overcoming of challenging experiences weighed a lot in the acknowledgement of competencies, as it demonstrated not only the possession of relevant skills but also the ability to adapt, persevere, and grow in the face of adversity. Overcoming classroom challenges demanded critical thinking and process reflection (Mezirow, 2000) that involved incorporating awareness of the problem-solving strategies (Wang et al., 2021) being complied with, thoroughly evaluating options, and formulating informed decisions. This entailed analysing problems from various perspectives, contemplating diverse viewpoints, and identifying effective solutions. Remarkably, the solutions devised showcased creativity, encouraging the development of inventive thinking skills and the ability to generate novel and resourceful resolutions boosting the researcher's skills in using AR in the classroom setting.

Navigating these emerging problems and struggles proved instrumental in fostering resilience, perseverance, and the ability to rebound from setbacks, underscoring the significance of negative experiences alongside positive ones. This process cultivated a sense of enduring determination, allowing the researcher to remain dedicated and motivated despite the challenges. Consequently, these instances of struggle facilitated adaptability and flexibility as she fine-tuned the classroom approach. Embracing change became a cornerstone of her practice, empowering her to think swiftly on her feet and adjust her actions accordingly. Embracing change as a part of learning was also confirmed by Patterson and Hans (2019) as they observed that confronting challenges when implementing technology in the classroom facilitated a reconfiguration of the learning process. As a result, in subsequent lessons, the teacher was better equipped and ready to optimise the utilisation of the tool to its fullest potential.

Confronting and overcoming challenges nurtured a capacity to derive valuable lessons from failures, prompting self-reflection on mistakes and transforming them into opportunities for

personal growth and advancement. The challenges faced in the process of change serve as sources of motivation, sparking endurance, and once successfully surmounted, they offer validation and further strengthen the initial foundation (Mezirow, 2009a). While not all experiences hold equal transformative power, Dewey (2008) contends that each experience should equip an individual for future encounters of greater depth and expansiveness. In this situation, learning through encountered problems and struggles in the classroom engendered a robust skill set, encompassing key attributes such as problem-solving, resilience, adaptability, critical thinking, creativity, self-confidence, collaboration with students, emotional intelligence, and the ability to learn from failures. This multifaceted skill repertoire proved invaluable in overcoming immediate challenges and fostered holistic growth and development. Consequently, confidence was fostered by the researcher's self-awareness of acquired strengths and the recognition of areas requiring improvement. The researcher's confidence grew to the extent that she believed she could bridge the gaps by drawing upon her past achievements, motivating to actively address areas in need of enhancement.

This study shows self-motivation played a crucial role in this phase of embarking on the new role and establishing clear objectives during the planning stage facilitated the attainment of goals and the development of competence in the new role. According to Mezirow (1999), educators should take on the responsibility of defining goals that explicitly incorporate independent thinking. They should also acknowledge that achieving this necessitates creating experiences that promote critical reflection and engagement in meaningful discourse. Thus, the data logging was much more than the mere data collection, this method proved invaluable in fostering self-awareness and reflection on the progress in this role. Since TL is not an additional component or an extension (Mezirow, 1997), the field notes, part of the data methods in autoethnography, served as a conduit for reflective learning, prompting the researcher to assess areas for improvement and draw valuable lessons from successes and challenges. Consequently, the researcher's performance and competence in the role were honed. Moreover, soliciting feedback from students (discourse) regarding their overall experience during the lecture provided an alternative perspective and constructive insights to refine strategies and to validate her ongoing actions. Discourse is essential for confirming one's comprehension and determining the soundest judgment concerning a belief (Mezirow, 2000). Within this setting, a dialogue was established with students, affording them an equal chance to acquire knowledge, while the educator attentively listened to formulate preliminary assessments for shaping future

classroom actions and addressing students' needs. Moreover, hearing positive feedback also served as a catalyst in bolstering her self-confidence.

This study concluded that the educators involved in member-checking failed to acknowledge their self-resourcefulness in implementing AR in the classroom, primarily due to their lack of commitment to the process. Being brought in at the last minute without establishing prior connections diminished their self-motivation to dedicate time to the implementation. In contrast, the researcher, who initiated the process with a specific challenge and goal, had more to gain. The educators, possibly driven by curiosity and lacking full investment, did not share the same level of commitment which was key to reaching this phase of TL.

6.3.3 Theme three: Mastery experience through the cultivation of confidence and competence

The third and final theme, demonstrates the ongoing progression of the ninth phase of TL with the researcher evolving and maturing as she masters the acquired skills and excels in the classroom. Through successfully navigating through difficulties, the researcher mastered using the AR app to teach anatomy, which significantly amplified her self-assurance in this endeavour, further propelling her along the transformative journey. The learning journey went beyond simply using AR in the researcher's teaching methods. It also included the authentic pleasure derived from involving this technology, indicating a shift toward an approach that prioritises learning over technology. This shift aligns with the adopted theory, emphasising that TL should originate from the learners themselves (Wang et al., 2021).

The researcher achieved a level of mastery and unwavering confidence in her acquired competencies through dedicated learning and continuous engagement with AR technology. This sense of accomplishment was also influenced by her independent problem-solving, a factor recognised as highly important for teacher learning by Ersoy and Bozkurt (2015) in their research on understanding teachers' experiences with implementing technology in the classroom. This sense of assurance corresponds to Mezirow's ninth phase of TL, where one transcends the initial stages of cognitive dissonance and personal growth to fully integrate and apply the newfound knowledge and skills. The researcher's journey underscores the transformative power of learning, culminating in a deep sense of self-assuredness in her abilities to harness AR effectively for educational purposes. The final phase, *Reintegration*, is seen in the educator's ability to incorporate other technologies in her classroom and make plans to invest in other technologies without internal conflict. The findings show the researcher

seamlessly integrating a new mobile app as it aligns with her learning objective and fosters a student-centred learning environment. The researcher also applies to collaborate and participate in the gamification team showing active involvement in exploring and embracing new possibilities in EdTech. This final phase is integral to the TL journey demonstrating a successful internalised and incorporated new perspective into her existing belief and practice. Mezirow (2000) signifies such acts as a deep and lasting transformation in an individual's approach and understanding.

Contrasting the researcher's initial demeanour of self-doubt and ambivalence toward technology with the evolved perspective portrayed in the subsequent self-interview paragraph, it becomes apparent that the researcher has undergone a realisation, resulting in a transformative shift in her stance through the process of TL.

'I do feel a change within. Maybe it is not something apparent, but I feel braver for taking the challenge and I feel that I am a better educator after the experience. Not just because I feel like I can introduce innovative technologies in the classroom, but because a veil has been lifted from over my eyes, and I am not stuck in my past, hung up on my insecurities'. - Cassandra Sturgeon Delia (Main researcher-7/1/23)

6.4 Learning from and with others: Aligning perspectives

From the discussion, it becomes evident that the researcher's transformative journey stood apart, displaying uniqueness compared to the encounters of her fellow educators engaged in the member-checking interviews. Although these member-checking educators did partially validate the researcher's experience, not all outcomes could be validated as the researcher's experience stood out as a TL journey, whereas the other educators did not integrate new perspectives regarding technology. The rationale for this conclusion lies in the evidence that although these educators might have had a disorienting dilemma resulting from the COVID-19 pandemic, leading them to willingly try AR in their classroom, they missed out on the development of the app which this study deemed imperative for building a sense of ownership towards the technology. This emotional connection was the trigger the researcher's motivation to prepare for the implementation process. Through this dedication came a chain of events that led the researcher to persevere in the face of challenges, and recognising these challenges as opportunities to flourish, which ultimately led to the building of skills and finally the mastering of such skills.

Although the member-checking educators did not manage to develop new perspectives, their involvement did validate two points. Firstly, the importance of building a connection to the technology. This study provides convincing evidence that educators building a connection to EdTech allows educators to personalise their use and effectively integrate the technology into their curriculum resulting in effective integration. This connection also sparked motivation, reducing the likelihood of surrendering in the face of challenges.

Secondly, the member-checking educators also validated that using reflective practice, through the collection of fieldnotes enhanced the learning process. This practice allowed a type of observational learning, allowing the researcher to look back on her behaviour, classroom dynamics and challenges, allowing her to refine her performance and tailor accordingly. The results yielded that this practice allowed the researcher to refine her learning through reflection, contributing to the development of skill and confidence.

6.5 Conclusion

In conclusion, this chapter provided a thorough exploration of the themes derived from the autoethnographic story detailed in the preceding chapter, focusing on the educator's initial perceptions of technology, her journey of implementing AR in the classroom and finally the researcher's transformative shift in her perception.

In summary, the study's results revealed that displacement and loss played pivotal roles in the formation of ideologies and values. These emerged through novel experiences that influenced perceptions and the researcher's inclination towards the physical world. Later experiences, both positive and negative, when technology was introduced left the researcher with mixed feelings towards technology, stemming from lack of know-how and lack of competencies to handle the situation. When the researcher started her career in teaching, she was faced with the first phase in TL as she came to the realisation that her teaching methods might not be enough. Striving to be a better educator, the researcher went through phases of TL as she sought validation and growth, leading her to start a doctorate in the TEL field. It was, however, the onset of the COVID-19 pandemic that allowed the researcher to put theory to practice gaining the confidence to seek a new role and explore AR in her classroom. The findings suggest that the COVID-19 pandemic was an important learning event, that pushed the researcher further in the TL phases. Indisputably, being part of the technology development process was a critical factor that contributed towards her sense of ownership which led her to become motivated and well-prepared for the implementation process. This emotional connection also instigated her to take

on the role of innovative teacher, encouraging others to implement AR in their classroom. Being well-prepared, both physically and mentally, for the implementation, proved imperative to overcome challenges, build confidence and persevere. The negative and positive experiences were shown to be critical in the TL process aiding in building expertise through adaptability, problem solving, critical thinking, skill refinement, and continuous improvement identified through the collection of fieldnotes allowing the researcher to re-examine and challenge her evolving perspectives. The general picture emerging from the analysis is that the extended use of AR in the classroom allowed the researcher to acquire the skills and confidence shaping the researcher's beliefs and validating her actions, further boosting her confidence. This journey brought pleasure to the researcher, emphasising how TL originates from the learner, as personal growth becomes evident.

Chapter 7: Conclusion

7.1 Chapter overview

This conclusion chapter opens with an introduction, setting the stage for a comprehensive overview of the research's key elements. A concise summary of the main findings is presented, highlighting the focal discoveries and themes derived from the study while revisiting the research questions and objectives, the chapter demonstrates how the findings directly address and contribute to these aspects. Following this, the chapter delves into the contributions of the research to the existing body of knowledge in TEL, emphasising how it fills gaps and introduces novel perspectives. The broader implications of the findings are explored, considering both theoretical frameworks and practical applications. Acknowledging the study's limitations, the chapter then moves to suggest future research directions based on identified gaps. Reflecting on the research process, it discusses challenges faced, lessons learned, and adjustments made. Personal insights gained during the journey are shared, adding a reflective dimension. A closing section offers final remarks, summarising the overall significance of the research.

7.2 Summary of key findings and connection to research questions

This research aimed to gain a detailed account of the researchers journey from a novice implementing AR technology in the classroom, by documenting thoughts, emotions, and behaviour as competencies were built leading to a TL process. The research was presented in a two-part thematic narrative, where each segment contributed an essential piece to the overarching story. Each theme encapsulated a distinct aspect of the research, forming a cohesive and comprehensive understanding of the research objectives. As the story unfolded across these themes, it weaved together a rich tapestry of knowledge, offering a nuanced perspective on the transformative journey.

Part one, presented through the unpacking of autobiographical narratives, the study presented three themes: *A displacement experience during childhood; Experiencing and coping with feelings of ambivalence; and Later reconnecting experiences with technology.* The first theme explored the impact of being uprooted from one place to another during childhood. It delved into the emotions, challenges, and changes that came with displacement, and the effect on identity as a result of displacement. The narratives describe loss, however, due to the study's context, focuses on the loss of technology. Surprisingly, displacement emerged as a key

finding. The challenges of adapting to new surroundings, navigating a lack of technology both at school and at home within a different culture, and coping with feelings of isolation and a lack of sense of belonging, led to the pursuit of alternatives and the cultivation of resilience. These experiences played a crucial role in shaping new ideologies.

The second theme focused on experiences of reconnection to technology and the conflicting emotions, thoughts, and attitudes towards technology in education and explored the complexity of emotions and the challenges of navigating conflicting feelings. The primary insight gleaned from this exploration reveals that, despite prior encounters with technology in education being predominantly passive, lingering ambivalence towards technology persisted. This observation opened the door to the potential reintegration of technology, underscoring the nuanced and evolving nature of the researchers relationship with educational technology.

The final theme, of part one, focused on exploring the rekindling relationship with technology, encompassing mobile phones, social media platforms, technology within the health care system, and technology within education, both as a learner and educator. A pivotal and nuanced moment emerged when the researcher recognised that her pedagogy might be not enough to keep students engaged and motivated. This gave way to an understanding that the traditional approach might not resonate with today's students, especially in this digital era and marked the recognition as the first phase in TLT, a disorienting dilemma. The experience recounted in this theme triggered TL phases that, when taken together, constitute the first part of addressing the initial RQ 'What were my experiences with educational taechnology before embarking on the AR journey?' This theme underscores the significance of the COVID-19 pandemic as a crucial catalyst for learning.

Part two presented the classroom experience where three themes emerged: *Meaningful planning and exploration of the provisional new role; Recognising self-resourcefulness within the provisional new role; and Mastery experience through the cultivation of confidence and competence.* In this part, the initial theme acknowledged that cultivating a sense of ownership by being part of the beta testing phase ultimately heightened the researcher's perseverance and dedication towards the implementation process. This in turn contributed towards the thorough preparation towards the AR implementation that fostered resilience towards challenges that occurred in the classroom. The adequate preparation for the classroom experience contributed to the cultivation of confidence and competence as the learning process unfolded. The theme

explores the process of gaining skills and its influence on personal development, growth, adaptability to new roles and self-perception.

The second theme underscores the significance of discovering personal meaning and purpose during the transition to facilitate holistic growth. This theme delved into the commitment invested to learning experiences, recognising opportunities for personal growth, resilience and professional development within the new role. Here both the negative and positive experiences were seen to contribute to learning. Simultaneously, critical reflection through data logging was identified as contributing to achieving comprehensive growth. While student feedback also played a role in the researcher's development, its impact was not as substantial as the data logging exercise.

The third theme centres on advancing acquired skills to a level of mastery as competencies grow, instilling steadfast confidence in the new role and deriving satisfaction from the experience. It delves into the feeling of achievement through overcoming challenges and devising creative solutions, all the while nurturing a sense of assurance in the new role. Additionally, it addressed the difficulties and obstacles faced in the pursuit of mastery, highlighting how these challenges were ultimately perceived as learning experiences as the researcher fine-tuned her pedagogy. This perspective was gained through critical reflection on the compilation of field notes, a method underscored as crucial in the transformative process. Collectively, these themes addressed the second research question: 'What was my initial experience as an educator when using AR for the first time?'

Narratives from the self-interview were used to support the noticeable shifts in the researchers thoughts and emotions in response to RQ 3: 'To what extent, if any, have my feelings and perspectives undergone a transformation?' Additionally, the discussion incorporated perceptions of six other educators offering a comprehensive perspective and validating the authenticity of the findings ultimately responding to the fourth research question: 'How does my experience compare to that of other individuals who have undergone a similar process?'

7.3 Contribution to knowledge, theory and practical relevance

To date, this autoethnographic inquiry represents a pioneering endeavour, offering a nuanced and comprehensive exposition presenting the TL experiences of an educator in the context of integrating AR in her classroom. It illustrates the unpacking of personal experiences that initially contributed to mixed perceptions towards technology and, ultimately, the

transformation of these perceptions to that of the embracement of technological tools within the educational domain. This narrative effectively addresses the gap underscored in Chapter One, wherein the discernible absence of comprehensive and holistic research to support and prepare educators to use new technologies to teach is noted. The dissemination of such pivotal insights becomes imperative for educators, empowering them to make judicious and well-informed decisions, thereby fortifying their preparedness for a transformative journey that, if embarked on without adequate support, may prove elusive.

This investigation contributes to the TEL field by shedding light on the intricate dynamics of an educator's journey toward embracing and integrating AR. The study serves as a roadmap for educators, offering insights into the challenges, revelations, and transformative processes involved in adopting innovative technological tools. By sharing the personal narrative of this transformative journey, the study bridges the gap between theory and practice, providing a nuanced understanding of the educator's evolving relationship with technology. Consequently, this adds to the discourse on effective pedagogical practices in technology integration, providing a holistic perspective that can inform educational policies, curriculum development, and teacher training programs. It fosters a more nuanced approach to technology integration in classrooms, acknowledging the multifaceted nature of educators' experiences with emerging technologies.

The findings, derived from personal reflective narratives, self and member-checking interviews, and TL analysis, suggest that strong sense of ownership, extensive classroom experiences, and commitment to critical reflection played crucial roles in supporting the learning journey. However, this experience transcended the mere acquisition of new knowledge; the study depicts a transformative journey wherein theory recognised a fundamental shift in perception through instrumental learning, emphasising the evaluation of cause-and-effect relationships via critical reflection of actions. Therefore, within the realm of TL, this study may contribute to theory by asserting that critical reflection not only serves as a medium for learning, but also functions as a tool for shaping the process of learning itself.

This study also makes a valuable contribution to the expanding field of autoethnography. The approach employed here not only emphasises the technical aspects of AR implementation but also delves into the emotional and cognitive dimensions of the educator's experience. Hence, this use of storytelling adds a personal element that in the educational field is not as common.

Therefore, more educators alike might feel intrigued to follow suit and take on such a methodology sharing their practices through this highly personalised style.

Moreover, this study also contributes to the field of educational practice. Through evocative accounts described in the findings, aspiring educators could envision the experience of implementing technology in the classroom, motivating and governing others to question their beliefs, feelings, and assumptions about technology. The study also provides hope to educators who may be questioning their own practice, offering insights into the transformative potential of integrating technology and encouraging a reevaluation of their perspective.

7.4 Limitations of the study

This study builds upon the researcher previous experience with autoethnography, highlighting her familiarity with the method. While the study's findings are valuable, it is essential to recognise its limitations.

Firstly, the selected methodology, relies on autoethnographic account. While this study primarily offers support for TL journeys rather than specific strategies for implementing AR in the classroom, it is essential to acknowledge the limitations inherent in its methodology. The reliance on a single dataset derived from memory and personal experiences, alongside the constraints of the application, may warrant caution when extrapolating its findings to broader contexts. Nonetheless, by openly addressing these limitations, the study aims to provide valuable support for educators navigating similar transformative learning experiences, fostering a collaborative environment for reflection and growth. Moreover, it is important to note that this study is situated within the context of an educator operating in a vocational educational setting. Its findings should be interpreted with consideration for this specific context.

When employing autoethnography, issues of validity and credibility can be complex. Although member-checking on reflexivity and member-checking interviews were conducted to ensure credibility, it must be mentioned as a limitation. Additionally, despite all efforts to maintain confidentiality and respect for those who have participated directly and indirectly in this study, autoethnography does expose the researcher and others who participate.

Secondly, the researcher acknowledges the limitation of employing TL theory as a theoretical framework for the study. Given that transformation is inherently subjective and recognising the criticisms of Mezirow's TL theory discussed in Chapter Three, debates may arise regarding the

theory's capability to fully capture the complexities of TL. However, the methodology employed in this study prioritises reader transparency to the complete experience, potentially mitigating such limitations.

Lastly, it is imperative to acknowledge that the data analysis was conducted solely by the researcher, and given the personal investment in the study, the potential for bias cannot be overlooked. As the primary investigator, involvement in the analysis process could introduce subjectivity or unintentional partiality. In an effort to mitigate this, a crucial step was taken to enhance the objectivity and rigour of the analysis. The study benefitted from a thorough examination by a supervisor, providing an external perspective and an additional layer of scrutiny. This collaborative review process, involving the supervisor's expertise and insights, aimed to minimise the impact of individual bias and strengthen the validity of the analytic outcomes. While this measure contributes to addressing potential bias, it is essential to acknowledge the inherent subjectivity that can accompany the researcher's involvement in data analysis. To counteract this, having a supervisor look over the work did reduce bias.

7.5 Future research and recommendations

Initiating the exploration of future research endeavours, this study underscores potential areas of inquiry emerging from the findings that could contribute to the ongoing evolution of this topic. This study identified that half of the member-checking educators in this study, held mixed feelings towards technology, despite not having the displacement experience with technology earlier on. What this study did not address, as it was not within the scope of the study, was what led to their mixed feelings. Moreover, while this study identified reasons why the member-checking educators did not reach the TL status, it is imperative to delve deeper into their perspectives, experiences and feedback concerning the research outcomes. Specifically, exploring the factors contributing to their lack of motivation, challenges in preparation, and their experiences throughout the duration of using the AR application would provide valuable insight in to understanding these challenges and identifying potential areas of improvement in the implementation of the technology process and the sustainability of AR integration in educational setting.

Moreover, while this study provided an in-depth understanding the researchers TL journey, a recommendation for a longitudinal study on TL, which could be an extension to the final phase in TL, *A reintegration* would be interesting. Given that the researcher continues to use AR in

her classroom, it would be intriguing to observe how her perspectives have evolved during this settling-in stage.

In particular, utilising the TPACK model could offer valuable insights. This study could investigate the evolution of how the researcher's knowledge regarding AR, the development of skills and insights with new technologies, and any shifts in the researcher's content knowledge regarding the anatomy topic. The longitudinal approach would evolve using this study as a baseline and conducting narrative data collection at specific intervals, tracking changes, and highlighting the trajectory of TPACK development over time. The TPACK model, which can be incorporated into theoretical frameworks, traced over time, and extended, presents an opportunity to delve deeper into the nuanced interplay between technological knowledge, pedagogical knowledge, and content knowledge (Han & Patterson, 2020) within the context of AR integration in education.

7.6 Reflection on the research process: Autobiographic Narratives

Embarking on the journey of crafting this thesis, I encountered a myriad of challenges, some academic, others personal and many stemming from the widespread impact of the COVID-19 pandemic. Despite these obstacles, I persevered, emerging not only as a more proficient educator but also as a seasoned researcher in TEL, with the aspiration of attaining a PhD.

This thesis presented a formidable task, especially when given my transition from a different field. Reflecting on my four-year journey, I am grateful for the substantial growth and knowledge acquisition that collectively shaped my experience. One pivotal aspect of growth is my newfound ability to critically reflect. While I initially believed I understood the concept, unpacking my past experiences during the PhD journey has truly honed my skills in critical reflection.

Having previously worked predominantly with quantitative data methodologies in my role as a researcher and during my master's degree, I underwent a paradigm shift when introduced to autoethnographic writing by my current supervisor. This methodology resonated with me, allowing my thoughts to roam freely and exact meaningful insights. Today, I feel more confident as a researcher, especially after completing this thesis, which holds a special place in my heart. However, I am conscious of the fact that autoethnography may face criticism and scepticism in certain academic circles.

Despite the overall gratifying nature of this journey, there were instances where reconsideration and external guidance proved invaluable. Initially, I lacked a clear vision for the subject matter, but guidance from my supervisor steered me in a new and fruitful direction. An adjustment for which I am deeply grateful. Overcoming challenges during the proposal stage further fueled my determination to refine and perfect my research design. Additionally, unforeseen circumstances, such as smaller than usual class sizes due to COVID-19 restrictions during the data collection, ultimately worked to my advantage. While initial concerns loomed, the outcome was remarkably positive.

In sum, this reflective journey underscores the transformative nature of the research process, marked by challenges met, lessons learned, and personal and professional growth achieved along the way.

7.7 Concluding autobiographical remarks

In summary, this study has delved into the multifaceted dimensions of my TL journey, not only as an educator integrating AR in the classroom but also in terms of my overall professional growth. My aspiration is that this research instils hope and provides a sense of reassurance to fellow educators contemplating the integration of technology in their classrooms. I want to convey to these educators that internal change is attainable, but it necessitates taking that initial step toward transformation. Reflecting on my own experience, I wish a study of this nature had been available years ago to offer me comfort. Consequently, I sincerely hope that this research proves beneficial for other educators embarking on their transformative journeys. Trust me, if someone like me, who initially harboured reservations about technology, can embrace it successfully, so can you.

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Appendix 1: Participant information sheet



Participant information sheet

Title: [Implementing augmented reality technology in teaching human anatomy: An educator's autoethnography](#)

I am a PhD student at Lancaster University and I would like to invite you to take part in a research study about your experience teaching using the augmented reality mobile application. Please take time to read the following information carefully before you decide whether or not you wish to take part.

What is the study about?

This study's main aims is to investigate my (the researcher's) learning experience of implementing technology in my teaching to observe a transformation in my perception of educational technology. Moreover, I am interested in your experience also so that I can validate the findings of my experience.

Why have I been invited?

I have approached you because you as you also are implementing augmented reality as a educational technology to teach human anatomy to lower level students within the vocational higher educational context, thus I am interested in your experience using such technology. Moreover, I am interested in the change, if any, in your perceptions towards the educational technology, from the start of the process till the end. I would be very grateful if you would agree to take part in this study.

What will I be asked to do if I take part?

If you decided to take part, this would involve taking part in a one time online interview set at your desired date and time, where I would ask you a set of questions about how you felt before, during and after using the educational technology. Moreover, you will be asked about your transformation in perception, that is the way you perceive the educational technology experienced. The interview shall take place online so that you may participate in your own settings and should not take longer than 50-60 minutes. I shall be recording the audio of the interview so that I may store for my data collection, however, I shall not record the visual.

What are the possible benefits from taking part?

Taking part in this research can allow you to reflect on your experience and see how your perceptions have changed over the course that you had used augmented reality. If you take part in this study, your insights will contribute to our understanding of how we learn by using educational technology.

Do I have to take part?

No. It's completely up to you to decide whether or not you take part. Your participation is voluntary. **If you are a student and decide not to take part in this study, this will not affect your studies and the way you are assessed on your course. If you are a fellow employee, if you decide not to take part in this study, this will not affect your position in the company and your relations with your employer.**

What if I change my mind?

If you change your mind, you are free to withdraw at any time during your participation in this study. If you want to withdraw, please let me know, and I will remove your interview contributed to the study and destroy them. However, it is difficult and often impossible to take out data from

one specific participant when this has already been anonymised or pooled together with other people's data. Therefore, you can only withdraw up to 2 weeks after taking part in the study.

What are the possible disadvantages and risks of taking part?

It is unlikely that there will be any major disadvantages to taking part. However, you would be investing 50-60 minutes for the interview.

Will my data be identifiable?

After the interview only I, the researcher conducting this study and my direct supervisor, will have access to the ideas you share with me.

I will keep all personal information about you (e.g. your name and other information about you that can identify you) confidential, that is I will not share it with others. I will remove any personal information from the written record of your contribution. All reasonable steps will be taken to protect the anonymity of the participants involved in this project.

How will we use the information you have shared with us and what will happen to the results of the research study?

I will use the information you have shared with me only in the following ways:

I will use it for research purposes only. This will include my PhD thesis and other publications, for example journal articles. I may also present the results of my study at academic conferences.

When writing up the findings from this study, I would like to reproduce some of the views and ideas you shared with me. I will only use anonymised quotes (e.g. from my interview with you), so that although I will use your exact words, all reasonable steps will be taken to protect your anonymity in our publications.

How my data will be stored

Your data will be stored in encrypted files (that is no-one other than me, the researcher will be able to access them) and on password-protected computers. I will store hard copies of any data securely in locked cabinets in my office. I will keep data that can identify you separately from non-personal information (e.g. your views on a specific topic). In accordance with University guidelines, I will keep the data securely for a minimum of ten years.

What if I have a question or concern?

If you have any queries or if you are unhappy with anything that happens concerning your participation in the study, please contact myself on c.sturgeondelia@lancaster.ac.uk or you may contact my supervisor Dr Kyungmee Lee on k.lee23@lancaster.ac.uk from the Department Educational Research at Lancaster University.

If you have any concerns or complaints that you wish to discuss with a person who is not directly involved in the research, you can also contact: Professor Paul Ashwin by email on paul.ashwin@lancaster.ac.uk.

Thank you for considering your participation in this project.

Appendix 2: Consent form

CONSENT FORM

Project Title: Implementing Augmented Reality Technology in Teaching Human Anatomy: An Educator's Autoethnography

Name of Researchers: Ms Cassandra Sturgeon Delia

Email: c.sturgeondelia@lancaster.ac.uk

Please tick each box

| | |
|---|--------------------------|
| 1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily | <input type="checkbox"/> |
| 2. I understand that my participation is voluntary and that I am free to withdraw at any time during my participation in this study and within two weeks after I took part in the study, without giving any reason. If I withdraw within two weeks of taking part in the study my data will be removed. | <input type="checkbox"/> |
| 3. I understand that any information given by me may be used in future reports, academic articles, publications or presentations by the researcher/s, but my personal information will not be included and all reasonable steps will be taken to protect the anonymity of the participants involved in this project. | <input type="checkbox"/> |
| 4. PLEASE NOTE: Data will be deposited in Lancaster University's institutional data repository and made freely available with an appropriate license. Lancaster University uses Pure as the data repository which will hold, manage, preserve and provide access to datasets produced by Lancaster University research. | <input type="checkbox"/> |
| 5. I understand that my name/my organisation's name will not appear in any reports, articles or presentation without my consent. | <input type="checkbox"/> |
| 6. I understand that any interviews or focus groups will be audio-recorded and transcribed and that data will be protected on encrypted devices and kept secure. | <input type="checkbox"/> |
| 7. I understand that data will be kept according to University guidelines for a minimum of 10 years after the end of the study. | <input type="checkbox"/> |
| 8. I agree to take part in the above study. | <input type="checkbox"/> |

Name of Participant

Date

Signature

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

Signature of Researcher /person taking the consent _____ Date _____ Day/month/year

One copy of this form will be given to the participant and the original kept in the files of the researcher at Lancaster University

Appendix 3: Lancaster University ethics approval

29th September, 2022

Dear Cassandra Sturgeon Delia,

Thank you for submitting your ethics application and additional information for “Implementing augmented reality technology in teaching human anatomy: An educator’s autoethnography”. The information you provided has been reviewed and I can confirm that ethical approval has been granted for this project.

As principal investigator your responsibilities include:

- ensuring that (where applicable) all the necessary legal and regulatory requirements in order to conduct the research are met, and the necessary licenses and approvals have been obtained;
- reporting any ethics-related issues that occur during the course of the research or arising from the research (e.g. unforeseen ethical issues, complaints about the conduct of the research, adverse reactions such as extreme distress) to your Supervisor.
- submitting details of proposed substantive amendments to the protocol to your supervisor for approval.

Please do not hesitate to contact me if you require further information about this. Kind regards

Alice Jesmont

TEL Programme Administrator

Educational Research

County South

Lancaster University
Bailrigg Campus
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LA1 4YD

United Kingdom TEL: (+44) (0)1524 593572

Appendix 4: MCAST ethics approval



Dear Ms Cassandra Sturgeon Delia,

Reference is made to your research proposal number E014 2022 titled "Implementing Augmented Reality Technology in Teaching Human Anatomy: An Educator's Autoethnography." and dated 19th September 2022.

This is to confirm that your proposal has been accepted by the MCAST Ethics Committee, you are thus free to proceed with your research under the described ethical criteria.

Best regards,

Dr. Lorna Bonnici West

Acting Director Research and Innovation Malta College of Arts, Science & Technology

Tel: 00356 2398 7392

Email: lorna.bonnici.west@mcast.edu.mt

Web: www.mcast.edu.mt

Date: 30th September 2022

MCAST Main Campus, Corradino Street, Paola, Malta PLA9032

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Appendix 5: Interview questions

1. What were your initial thoughts on educational technology prior to this experience?
2. What were your initial thoughts on using augmented reality to teach human anatomy?
3. What was your general experience implementing augmented reality to teach human anatomy?
4. What was your learning experience throughout this process?
5. What challenges did you encounter throughout the process?
6. What opportunities did you encounter throughout this experience?
7. How have your pedagogical perceptions transformed throughout this experience?
8. Looking back on your initial thoughts on educational technology, have your perceptions of technology transformed?