Beyond the Comfort Zone: An Autoethnographic Study of Implementing Augmented Reality in Vocational Education

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Abstract
The primary objective of this autoethnographic study is to investigate how lecturers' attempts to use augmented reality (AR) in the vocational educational context contribute to their transformative learning (TL) journey. The first author of this paper, referred to using the pronoun 'her/she', is a vocational lecturer pursuing her doctoral degree in technology-enhanced learning (TEL), has examined the evolution of her pedagogical perspectives by critically analysing and reflecting on her experiences learning and adopting AR technology in her anatomy classrooms. She also explored and unpacked her educational experiences in the past and the social and cultural contexts in which they occurred to gain deeper insight into her previous and current beliefs about TEL. Her autoethnographic writing in this paper shares her struggles and growth, underscoring the significance of scaffolding and professional networked learning opportunities in nurturing transformative learning in lecturers. In collaboration with the second author, her doctoral supervisor, the first author has drawn more meaningful and robust findings from collecting and comparing other lecturers' experiences implementing AR in similar pedagogical situations. The authors' discussion sheds light on the often obscure process of how educational professionals challenge and change their long-held pedagogical perspectives on the usefulness of technology for their teaching and student learning. The paper also reveals the cognitive, emotional, and social dimensions of professional learning and highlights the role of professional networks in facilitating transformative learning experiences.
The findings, derived from personal reflective narratives, self and member-checking interviews, and TL analysis, suggest that a 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. 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.

Keywords
Autoethnography, transformative learning, professional networks, augmented reality, anatomy.

Introduction

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 (Chiang et al., 2022; Trust et al., 2021). Lecturers' unwillingness to learn and use new technology has repeatedly been blamed for such slow movements (Dovbenko et al., 2020; Dunleavy et al., 2009). Although there has been much research effort to understand better the challenges and difficulties that lecturers face when implementing technology in their classrooms, in literature, there is a lack of holistic accounts of how they learn and use new technology for teaching, through which how long-held pedagogical perspectives are challenged and changed. This paper aims to address such a gap in our current understanding of teacher professional development.
Among the diverse approaches potentially useful to research teacher experiences with technology-enhanced learning (TEL), we, the two authors of the paper have decided to use autoethnography as it can reach and engage multiple audiences by offering holistic accounts capturing both emotional and cognitive aspects of the researchers' (and authors') lived experiences (Chang, 2016). This paper is written based on the autobiographical writing of the

first author, who is a lecturer within a vocational education and training institution in Malta, currently pursuing her doctoral degree in TEL. She has explored her experiences with learning and implementing augmented reality (AR) technology to teach human anatomy to lower-level students in a vocational education setting in Malta. In her novice account, she has detailed her thoughts, emotions, and behaviour and documented gradual changes in them during the class period as she built competencies. The authors have also collected other teachers' narratives of their learning experiences facilitated by using AR for similar pedagogical purposes to draw a more solid understanding. Such autobiographic narratives have been analysed and interpreted using transformative learning (TL) as a theoretical lens.

To situate this inquiry in a more specific pedagogical (and personal) context, the first author presents her autoethnographic narratives below:

For most, technology is integrated into everyday life to the point that its usefulness is taken for granted. However, coming from a background in health care, I have tried to limit the impact of technology in my life to minimise its individual and societal harm. Even in my classrooms, technology had not played a significant role until most recently during the COVID-19 pandemic. In 2019, I had little to no experience with teaching and learning with technology and underestimated its purpose. Ironically, I chose to embark on my doctoral study in the field of TEL, which suggests my complicated positionality toward the uptake of technology for teaching—somehow, I had mixed feelings (or pressures) about TEL.

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 to switch to the virtual classroom as I had had no previous training, and all my attempts were on trial and error. Moreover, being an extrovert, I always enjoyed classroom dynamics, physical conversations, moderating debates, and meeting students. Reflecting on those two academic years, however, I recognise and appreciate that education continued thanks to digital technology; fast forward, now, we are back on campus, and I feel that the need for technology has already faded into the background, and my virtual classroom experience seems like a distant memory.

Nevertheless, I still have a strong desire to better understand and conceptualise how my feelings towards TEL evolved during my online teaching experience, leading me to rethink my initial perceptions and seek opportunities to contribute as part of a team testing and providing feedback on an AR application (app) designed for our vocational context, where network learning can play a pivotal role in collaborative and interactive education.

Thus, the fundamental motivation for me to commence this study was to be clearly and critically aware of my original positioning of TEL by unpacking my long-held pedagogical and technological perspectives and laying out the situations that led me to experience mixed feelings about TEL. Secondly, reflecting on my own lived experiences, I aimed to examine the shifts in my perspectives and feelings. I used TL theory to determine whether a transformative process had occurred and to what degree. Ultimately, to develop more balanced arguments and nuanced discourses about TEL, I strived to create a holistic and comprehensive account of how it feels and looks like for lecturers, who are unfamiliar and unconvinced with TEL, to learn and use new technology for teaching.

The authors wish to reach and engage lecturers who seek a change in their perception of technology for educational use. Thus, this study aims to speak to the reader through a personal and evocative form of research writing to answer the following research questions (RQ).

RQ1: What past experiences lead teachers to hold long-held pedagogical perspectives?
RQ2: What experiences are expected using AR for the first time as a teacher?
RQ3: What factors, if any, enable feelings and perspectives to shift?
RQ4: How does this experience compare to others who have also undergone this process?

Literature review

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.

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 et al., 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). The availability of numerous tools and resources has facilitated the customisation of learning and the development of network learning processes (Saadatmand & Kumpulainen, 2012). 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).

In recent years, there has been a growing fascination with multiple reality technologies like AR within many sectors (Schmidthaler et al., 2023). 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 (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).

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; Wen et al., 2023). AR has found applications across various domains, however, its most intriguing apps have emerged in educational contexts (Chanlin, 2018), where they serve to bridge the divide between the real and virtual realms, enabling learners to actively participate in this fusion (Jwaifell, 2019). Thus, 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 technological-mediated learning 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). Furthermore, this tool promotes networked learning by facilitating connections among learners, human and content resources, and human communities (Saadatmand & Kumpulainen, 2012).

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). Traditionally, anatomy has been typically taught through classroom lectures featuring slideshow presentations, verbal explanations of concepts (Bork et al., 2021; Moro et al., 2017) employing videos, diagrams, and plastic models as instructional aids, however, they tend to offer limited interactivity and lack a sense of realism (Geerlings-Batt et al., 2022).

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) by incorporating 3D virtual components into reality in real-time, presenting the spatial relations (Demircioglu et al., 2023). In subjects, such as anatomy, AR 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). Nevertheless, the widespread adoption of AR technology for educational purposes in schools remains relatively rare, primarily due to the ongoing need for teachers to possess digital competence and confidence to embrace these methods (Serrano-Ausejo et al., 2023) Teacher's beliefs also play a role in the uptake of technology (Hedayati & Marandi, 2014). Earlier 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; 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).

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, interaction and outcomes. However, studies that showcase educators' journey implementing technology in the classroom are scarce. Despite the existence of these studies, there are still significant shortcomings to consider. While we know that teachers are incorporating technology in their classrooms, personal storytelling through autoethnographic inquiry is lacking thus in-depth teacher experiences are omitted from the literature, especially those highlighting transformations and how these transformations created networks. Hence, what successful technology integration in the classroom looks like remains unclear.

Methodology

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 the first author's experiences as a complete member researcher (Anderson, 2006) to produce a relatable self-narrative of her journey. The research design included all considerations to protect the privacy and ensure the confidentiality of others in this autoethnographic story.

Research context

Since 2019, the vocational institution has collaborated with an international educational technology company to develop a range of digital tools, including an AR mobile app, aimed at enriching the educational experience for students at lower levels. The initial focus was on integrating AR technology into various subjects, including anatomy. Following consultations with lecturing staff to ensure alignment with the curriculum and subsequent assessment and evaluation of the AR mobile application prototype, the app reached completion in 2022.

The anatomy segment of the app was meticulously crafted with 3D digital representations of the human anatomy enhanced by AR overlays with additional assessment sections. The digital content is intended for in-classroom use, providing students with a dynamic visual representation of all the body's organ systems. This innovative approach allows students to better comprehend and visualise organs while engaging with lecture material. Starting from the academic year 2022/2023, lecturers responsible for teaching anatomy to students across levels one to three in all institutes had the opportunity to integrate the AR mobile app into their teaching methodologies.

The first author played an instructional role during the academic year 2022/23. She was responsible for teaching anatomy across eleven classes, spanning a range of lower-level courses, with a primary focus on imparting knowledge related to human anatomy. During this period, the author successfully integrated a custom mobile-based AR app designed specifically for the institution's curriculum.

Data sources and collection

Data collection spanned eight months, concluding in February 2023. The data collection for this study was conducted in three distinct phases, which 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.

Collecting self-reflective data, textual artefacts, and member-checking for corroboration occurred from July to October 2022. Reflexivity as a research method involved introspection on personal experiences that shaped the author's cultural and pedagogical beliefs. Visual images and texts were used to trigger memories, and member-checking conversations were employed for validation. Systematic self-observational data (field notes) were gathered from October to December 2022 within the classroom setting recording observations of feelings and emotions throughout the integration of AR. Data was collected systematically, combining narrative writing and keyword-based guidance, with retrospective on-site field notes to balance immediacy and authenticity. A self-interview was conducted after the implementation phase to assess TL and growth, revealing changes in perspectives when compared to personal memory data (Chang, 2016). Employing member-checking made it possible to incorporate diverse perspectives within the study, enabling the triangulation of results. This practical application of member checking helped mitigate the potential for systematic bias, commonly associated with studies utilising specific data collection methods (Candela, 2019). All member-checking interviews, including the self-interview, took place from January until the end of February 2023.

Recruitment of member-checking interviews

For the member-checking interviews, the selected participants were chosen from among the lecturers working with the institution that had utilised the tool. The author reached out to lecturers teaching anatomy, levels one to three, via email, and after describing the study and its involvement, and obtaining consent, eight were willing to partake in online semi-structured interviews, each lasting approximately 50 to 60 minutes. The member-checking process took place in February 2023 and served to validate the study's findings and identified themes.

Data analysis and validity

Data collected were analysed using Nvivo 12 Plus software, employing a hybrid approach that combined inductive and deductive thematic analysis. Themes emerged through pattern recognition in the data, influenced by Mezirow's TL Theory. The analysis process involved constant refinement of codes and utilised Nvivo tools for idea management and theme visualisation. Both authors independently conducted the analysis, focusing on themes comparison. In cases where disparities arose between the authors, a collaborative effort was initiated to reconcile and refine the interpretations.

Findings and Discussion

The findings examine the rich and personal tapestry of autoethnographic narratives, initiating a reflective exploration into the researcher's lived experiences. Part one focuses on the author's unpacking of perspectives regarding educational technology before her AR journey. Thus, this section reveals a reflective voyage to the researcher's past where three themes emerged that include: *A displacement experience during childhood*, *Experiencing and coping with feelings of ambivalence*, and *Later reconnecting experiences with technology* answering RQ1. Here we can also see the author going through TL stages one to six.

Part two focuses on the journey of implementing AR in the classroom unveiling three overarching themes that encompass: *Meaningful planning and exploration of the provisional role; Recognising self-resourcefulness within the provisional new role*; and *Mastery experience through the cultivation of confidence and competence*, wherein the last four phases of transformative learning are intricately interconnected.

The researchers have chosen to infuse a sense of nostalgia and retrospection into the subtitles, by deliberately drawing upon the retro aesthetics of the past, aiming 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.

Part 1 Understanding my positioning

The move

The first theme gives insight into how separation and the cultural transition experienced during the move from the United Kingdom to Malta, and the resettlement challenged the author's sense of coherence regarding her identity, and the various aspects that identity encompasses. The theme *A displacement experience during childhood* centred on the experience of relocation, highlighting the profound connection between the author's personal history and her educational beliefs, which hold particular significance in the realm of TL. This theory acknowledges past emotional experiences as influential factors in decision-making processes (Mezirow, 1998). As she delved into her positioning towards technology, a deeper understanding of the held perspectives, rooted in actions and emotions, impacted her beliefs and values. This theme recognises how the process of relocating and adapting to cultural and educational changes led to a sense of unfamiliarity and disconnection. Moreover, the author herself underwent feelings of marginalisation (Crea & Sparnon, 2017). This sense of marginalisation is manifested through experiences of inequality, isolation, and a feeling of alienation. The following sentence encapsulates this essence:

> In 1991, at seven, I relocated with my mother to Malta to care for my grandfather. Having been raised in London, I underwent significant cultural adjustments. Relocating 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. When I enrolled in primary school that year, I found myself the sole foreign student in the school. In the early '90s, children at my school barely spoke English, so making friends was hard. I stood out from the rest, which made me feel excluded and I couldn't resist comparing my current circumstances to my previous way of life. I yearned to

> return to London, where I felt a sense of belonging in a diverse classroom. There, everyone was actively involved in the lessons, and we weren't relegated to the back of the classroom and forgotten. I had access to computer rooms and various technological resources like audio cassettes for English comprehension exercises whereas, in my new school, I was given flashcard exercises as the rest of the class carried out lessons mostly in the Maltese language. 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.

Consequently, these experiences prompted her to construct a new identity, often referred to as a 'project identity' (Koç, 2006), using the available cultural resources. The narratives paint a picture of her juxtaposition between her 'lost' and 'new' identity, resulting in inner conflicts that align with the concept of dual identities (Brunton et al., 2019). This notion involves the merging of past selves with newly formed identities. Hence her loss during displacement resulted in the formation of new ideologies and values emerging through novel experiences in nature, influencing my 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 author's case, the familiar technology, including EdTech, was lost, and her new surroundings became a source of solace, connecting the author to the ideologies associated with the 'physical' world rather than the 'virtual' world. This discovery holds significant importance in understanding her inclination towards the dynamics of the physical world, including the classroom and the human connection it fosters, as suggested in the following text:

> With the move to Malta not only did I encounter difficulties at school, but I also struggled to figure out how to occupy my free time, seeing how my Amstrad hadn't made it to Malta. Watching television became a challenge due to the language barrier. Lacking ample indoor activities, I discovered a newfound love for the outdoors, which was never an option when living in London. Following our relocation, my childhood was immersed in outdoor pursuits. 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.

Regaining a network

The authors'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. The second theme, *Experiencing and coping with feelings of ambivalence* focuses on later experiences showcasing the author's evolving relationship with technology showing curiosity and excitement, but also apprehension due to her earlier regression away from technology. However, the reality of limited access to personal resources and minimal time allocated to using the school's computers hindered the development of a strong relationship with technology, as the ensuing paragraph serves as an embodiment of the following concept.

> Upon starting secondary school in 1995, I was introduced to technology within an educational context for the first time in Malta. 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 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 author's perspective and view of technology were significantly influenced by the changing presence of technology in her life. This evolution included moments when technology was temporarily withdrawn during her college years and maintained at a minimal level during her undergraduate studies at University. These experiences ultimately solidified the notion that education tends to be a passive endeavour, largely directed by teachers, and further intensified her immersion in consumer culture (Buckingham, 2007). At a subsequent stage, technology was reintegrated into the educational process, but this reintegration led to an unfavourable experience during a Top-Up Degree program. The essence of that is distilled in this paragraph:

> When entering college, the facility exhibited the same dilapidated condition as my primary school which transported me back to my first memories of school in Malta. In this setting, there was a complete absence of modern technology, relying solely on traditional chalkboards and erasers. All lecture materials were transcribed manually, and assignments were submitted in written format. Entering University in 2002, kept my interaction with technology limited, as all assignments were allowed to be handwritten and submitted via a pigeonhole, enabling any motivation to use technology. Upon my return to University after a two-year gap, I noticed that teaching methods remained predominantly traditional. 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. I encountered significant challenges throughout this experience, which included juggling tight daily deadlines. The boundaries between my work time, study time, and time spent with my son often blurred, ultimately resulting in my failure to achieve a passing grade in this unit.

A subsequent episode of technology integration in education occurred during her reading for a master's degree, which was ultimately positive. This paragraph features a direct quote that brings to life the following idea:

> Enrolling in the Master of Science in Biomedical Sciences program marked a new chapter in my academic journey. I attended traditional lectures and had clinical and laboratory work. However, there was a notable exception in the form of one unit, Medical Genetics, that presented with an opportunity I had not encountered previously. The teaching approach for this module involved remote viewing of lectures abroad via webcast. I found this experience captivating; being able to participate in such an enticing event without the need for travel expenses and having the opportunity to actively engage. This experience made me reassess the role of technology in education as I excelled in my performance and thoroughly enjoyed the overall experience.

Earlier experiences created the author's perceptions or schema, as referred to by Mezirow (1991) towards technology usage for education. Feelings of ambivalence towards technology ultimately shaped her perspective and relationship within academia and beyond. The developed schemes were habituated in responses and caused a cause-and-effect relationship, that determined how she herself taught in her later classroom (Kitchenham, 2008). 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 author's experience played a pivotal role in shaping her initial frame of reference. Even though her experiences with technology throughout her later years as a student at university were few, they are still critical, in providing the author 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.

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

The third theme, *Later reconnecting experiences with technology*, shows us evidence that the author came across a *Disorienting dilemma*, the first phase of Mezirow's TL theory. When the author changed careers and became an educator, we saw feelings of ambivalence towards technology that instigated the first phase of TL learning. This paragraph embodies the essence of that:

> Upon taking an academic role in 2017, I found myself relying on traditional methods of teaching. Although I used presentations during my lectures, I believed that the conventional teaching approach was sufficient, after all, that was how I was taught. However, 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 I was not enough! Here I realised that how I learnt as a student was no longer relevant and that students required engaging experiences to learn, specifically using devices that they already had available. 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.

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 &

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 and lacked the motivation to want to try something new. I don't want my students to miss out because of me. I have learnt that lesson 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 author'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 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

Broadening the bandwidth

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' (Dewey, 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. As this theme implies, these phases of TL were how the author coped with her ambivalent feelings. In this fourth phase, *recognition*, she undertook professional development where she met educators alike 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 author coped through this discovery that many like her sought change, which prompted the author to desire further exploration. The subsequent paragraph serves as a depiction of the aforementioned:

> 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. That same year, I embarked on professional development training. 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.

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 researcher expected this time to be a theoretical enquiry, however, the global COVID-19 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 as suggested in the following paragraph:

> In March 2020, Malta entered a nationwide lockdown and suddenly, I was the online educator. 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. In 2022, as we transitioned back to a semblance of normality, virtual teaching lost its momentum. Nevertheless, what lingered after this learning journey was an enduring curiosity about how I could further integrate technology to foster collaboration and enhance my lessons. I felt more open and ready to learn, but lacked knowledge of technology in the classroom.

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 author did not want to miss further opportunities, she actively sought an internal role to collaborate with a selected EdTech company, placing her amid technological change and actively setting goals to address her initial disorienting dilemma of utilising technology in the classroom. Even though the pandemic resided, education globally had a taste for technology (Bligh et al., 2021), and with it, the authors' scope of awareness also became more defined, making tacit judgments to move towards technology in the classroom. The author's engagement with the EdTech company allowed her to plan effectively and offered a technological solution to her dilemma, as shown in the following paragraph:

> As I transitioned back to a semblance of normality in September 2022, and back to the classroom, I once again reflected on my previous ways of classroom teaching and contemplated how my new knowledge could be applied. 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. 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 overcome my imposter syndrome and feel like a TEL researcher. I felt more open and ready to learn but lacked knowledge of technology in the classroom. 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'.

Part 2 A Lecturer's journey into augmented reality

Preparation of a digital transformation

The first theme, *Meaningful planning and exploration of the provisional role* highlights the significance of the initial planning phase before the implementation, part of the learning process that aided in building competencies and confidence before entering the classroom. This preparatory phase extended over four months, providing time to adapt and gain a deeper familiarity with AR. 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 and self-motivation came from the researcher's partially transformed attitude, which had already undergone a significant metamorphosis from the beginning of the journey. Accordingly, this section aligns with Mezirow's seventh phase, *Acquisition of knowledge and skills for implementing one's plans*. The following paragraph represents a quintessence of that:

> During the summer, I took the opportunity to explore the AR application, acquainting myself with its design and features. I delved into the application's assessments, focusing on the three quizzes designed to test users' knowledge of body organs. I played them repeatedly to anticipate students' learning paths. My goal was to identify any potential issues and gain a deeper understanding of the question algorithm employed by the app. Additionally, I amended my lecture presentations and included a custom-made QR code that would lead students to the app. I also conducted a mock lecture to ensure I could smoothly integrate AR within the lesson timeframe. During this process, I noticed minor remaining problems with the app which I promptly reported to the developer for resolution. After several weeks of using the application and envisioning how my lessons would unfold, I felt 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 instilled in me a sense of readiness and excitement for what was to come in the next academic year.

During this preparatory phase, the author gained insights into potential challenges that might arise in the classroom. In the absence of training, this phase was important as foreseeing challenges boosted confidence and facilitated learning through the gaining of skills using the app. A notable finding indicates she gained a sense of

ownership through her involvement in the mobile app's development, which led her to play a pioneering role in mentoring other lecturers to use AR by sharing her experiences gained in the AR development stages and the preparatory phase. Her sole sense of ownership resulted in a sense of self-efficacy for change and the formation of professional networks. The forthcoming narrative embodies this essential element:

> In preparation for the science department meeting, I reached out to the 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 pedagogy. Here I volunteered to share my experiences with the development of the app, preparation and intentions to use in the classroom. 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. 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. We engaged in productive discussions, evaluating potential benefits and identifying possible challenges, showcasing a genuine eagerness to experiment with this technology. Although not an AR expert, I believe I succeeded in fostering enthusiasm among my colleagues to seriously consider this app, and after the meeting, a few consulted with me, as they were willing to try the app themselves, however, wanted to explore the app more in-depth, so I planned to offer my support and be the point of reference so that we could support each other and share difficulties.

The author 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, ultimately 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 during our meeting and the app had remained on my phone. I did try it out a couple of times at home but only used it once in the classroom – Educator 2

AR in education: Testing the Digital Waves

Mezirow's eighth phase, *Provisional trying of new roles*, can be seen as the author embraces her new role as an educator using AR in the classroom. Here she encountered and surmounted various challenges in the classroom, that until then were unfamiliar to the author. Early experiences show the 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.

Although a thorough preparation had been done, still unforeseen challenges occurred that created a myriad of emotions, evident in the representative below quote:

> Throughout the ten weeks, I encountered a variety of situations that felicitated a range of emotions due to challenges and opportunities that arose. Across the eleven classes, I progressively bolstered the 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. On 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. To my dismay, the AR mobile application was not compatible with all students' mobiles, and only 10 students out of the 17 could download the mobile app. Of these 10 students, another 3 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. I quickly reacted and told students to group up, however, 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, making some students impatient and allowing them time to use their phones for other uses.

These struggles proved to be opportunities in disguise, as they facilitated the development of problem-solving skills, enabling her to analyse situations, identify potential solutions, and make informed decisions to overcome obstacles in real time. 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 as shown in the following paragraph:

> While I knew there could be compatibility issues with different mobile phones, I didn't expect it to affect as many students. This unexpected challenge forced me to think on my feet. I decided to group students, with each group sharing a working application. Initially, this solution proved effective. This solution 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. The mobile incompatibility scenario recurred in every class, additionally, even with international numbers, which some of my students possessed. Nevertheless, it gradually became less unexpected and more manageable.

Collecting field notes also proved to be indispensable for learning, as this method enabled critical self-reflection in the face of difficult circumstances, allowing time to contemplate the most effective ways to address and conquer these challenges as she fine-tuned her classroom approach and empowering her to think swiftly on her feet and adjust her actions accordingly. This process cultivated a sense of enduring determination, allowing her to remain dedicated and motivated despite the challenges.

The second theme, *Recognising self-resourcefulness within the provisional new role*, highlights the author stepping outside her comfort zone and confronting challenges head-on, leading to the recognition of developed skills and her transformation in her role to that of facilitator of technology within the classroom. This is in line with Mezirow's ninth phase *Development of Competence and Self-Confidence in New Roles and Relationships*, where overcoming challenges provided the author with opportunities to recognise growth illustrated in the subsequent text:

> I had a lecture in a room with black vinyl floors intended for dance students. When students tried to scan the floor with 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.

This data provides convincing evidence that first-hand struggles are a vital component of a transformative journey. In terms of transformative learning, the challenges allowed personal growth, as from crises came an opportunity to emancipate a *frame of reference* described by Mezirow (1991) to a perspective transformation. This in turn contributed to the development of a growth mindset. Moreover, self-motivation played a crucial role in this phase and helped development of competence in the new role. In this paragraph, one can encounter the fundamental essence of that:

> 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. As I persist, I notice a transformation in my skills, I have gained confidence and have become proficient in troubleshooting, which had been a primary concern. Despite moments of doubt, I recognised that these challenges and the subsequent growth are part the journey toward effectively integrating AR into the classroom setting.

Adopting change became a fundamental aspect of her profession, as her role evolved from that of a lecturer to that of a facilitator, guiding students by imparting skills and obtaining valuable feedback from them, which proved pivotal in shaping the author's convictions and confirming her actions, ultimately enhancing her self-assurance, evident from the ensuing passage:

> Today we used the app to create a quiz competitive. I also found this game to be enjoyable and the bonding experience gained was different from the 'normal' lesson setting. Students were overjoyed with the set up. I acted as the referee and gave them hints by writing clues on the board. I feel that I did a good job in this session.

The author achieved a level of mastery and unwavering confidence in her acquired competencies through dedicated learning and continuous engagement with AR technology, indicating the third theme, *Mastery experience through the cultivation of confidence and competence*. This sense of accomplishment was also influenced by her independent problem-solving, a factor recognised as highly important for teacher learning by Ersoy & Bozkurt (2015). The sense of assurance, exemplified below, 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 author'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 below quotes show that the learning process extended beyond the mere implementation of AR in her pedagogy; it also encompassed the genuine enjoyment in engaging with this technology:

> 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.

This feeling of pleasure suggests that the experience of using AR in her teaching had a positive and meaningful impact on her initial perception towards technology, potentially leading to personal growth and transformation. Time in the classroom, and gaining experience influenced the author's perception of her technological abilities, transitioning from a state of limited usage to a strengthened conviction in her aptitude for technology-enhanced teaching, instilling greater self-assuredness in facing future adversities.

> I've noticed a change in some students, who typically struggled to concentrate previously in the lecture. After recent classes, they have become enthusiastic, and more receptive and actively seek the app to support their learning. I feel that using this app has helped me diversify and evolve my teaching methods. This experience also makes me feel effective as an educator in a new way, that I had never experienced. I have the ability now to show students how to become independent learners, as I feel confident that they have the skills and knowledge necessary to take control of their learning journeys. I'm already thinking of how I can make this app work even better in the coming year.

A sense of accomplishment and transformation

The final phase, *Reintegration*, is seen in the author's ability to incorporate technology in her classroom and make plans to invest in other technologies without internal conflict. The author 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.

> Overall, the journey of utilising AR in the classroom was rewarding and made me aware of how much sooner I could have utilised technologies if I had known the outcome sooner and had this newfound confidence. I felt I had gained personal and professional growth and a new perspective for the future, which led me to extend my role and apply to be part of the gamification phase of the project due in 2023.

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.

The resaercher's transformative journey differed from fellow educators in member-checking interviews. While some validation occurred, the unique TL journey of the author set her apart. Despite shared experiences due to the pandemic, the educators missed crucial app development, crucial for feelings of ownership. The researcher's emotional connection drove motivation, leading to skill development and mastery. Member-checking educators

validated the importance of building a connection to AR for personalised use and effective integration. Additionally, they affirmed the value of reflective practice, enhancing learning through observational insights and refining performance.

Conclusion and recommendations

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. This narrative effectively addresses the literature gap 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.

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.

To conclude, the main author aims to provide educators with recommendations based on personal experience to enhance their technology integration in the classroom. Firstly, it is crucial to be mindful of personal biases and to recognise ambivalent emotions towards technology that may hinder the integration process. Secondly, cultivating resilience and adaptability in the face of challenges is essential. Overcoming obstacles and developing creative solutions contribute significantly to professional growth. Utilise these learning experiences to collaborate with peers, share insights, exchange ideas, and learn from each other's successes and challenges in technology integration. Encouraging a positive mindset towards difficulties frames them as valuable learning experiences. While ongoing professional development is vital for staying current with technological advancements, actively taking ownership of the integration process through meaningful planning and exploration fosters dedication and perseverance, ultimately leading to a successful implementation.

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