Designing an Individualized Virtual Reality Environment for Training: A Design Case Study with Autistic Learners

by

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Thesis Submitted in Partial Fulfillment of the

Requirements for the Degree of

Doctor of Philosophy

in the

Educational Technology and Learning Design Program

Faculty of Education

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SIMON FRASER UNIVERSITY

Fall 2024

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Abstract

This doctoral dissertation investigates the development of a gamified, real-time, immersive virtual reality environment known as Virtual Reality Employment and Interview Training (VREIT)[1]. The study examines how autistic individuals interact with the design and features of VREIT, and it aims to answer "How do design features of a gamified VR environment like VREIT influence autistic learners' engagement and perceived learning experience in the context of job interview training?"

This research employed a design case study approach with a constructivist perspective to iteratively develop a novel VR job training platform. It focused on the perceptions of two autistic participants regarding engagement and their learning experiences. Rather than measuring the system's pedagogical efficacy, the study aimed to gather feedback to inform the platform's design.

This study examines the user experience of the VREIT application, a virtual training tool for individualized job interview skills. Data from pre-and post-VREIT interviews were collected during ten mock interview sessions. Findings indicate participants had a positive view of VREIT's design and usability, engaging actively with the virtual coach and environment. Observations matched their reflections in post-VREIT interviews, emphasizing the tool's helpfulness and positive learning experiences.

By adopting a constructivist lens, this study illuminates the potential of real-time virtual reality environments to enhance learning, particularly for improving interview skills among individuals with autism. VREIT highlights the value of customizable VR environments in supporting neurodiverse learners, promoting engagement and skill development. The implications highlight the need for adaptable VR designs in education and training for individuals with ASD, addressing unique learning needs. This study paves the way for VR to enhance engagement and support for diverse learners.

Keywords: real-time virtual reality; gamified training; Learning Experience; interview skills; individualized learning; neurodiverse learners; design case study

[1] This application was previously called Virtual Reality Job Interview Training (VR-JIT) and then Job Interview Preparation VR Platform (JIPVRP) which was used in the consent form and the interview questions attached in Appendix B and C.

Dedication

This work is dedicated to all my students on the autism spectrum and to all of the autistic artists and programmers working in the tech and entertainment industry.

Your resilience, creativity, and unique perspectives have constantly inspired me throughout my journey. I have witnessed your challenges in learning, job seeking, and working, especially in the gaming, VFX, and film industries. I have shared many of these challenges and have often felt a deep connection with you, leading me to believe I may also be on the spectrum.

This PhD in Educational Technology is not just an academic pursuit but a personal mission to find new ways to make learning and employment easier for people with autism. This research, titled “Evaluation of Development and Testing Real-Time Virtual Reality Video Modelling on the Perception of Interview Skills Training for People with Autism Spectrum Disorder: A Study,” is a testament to that mission.

May this work contribute to a world where your talents are recognized, your challenges are understood, and your potential is celebrated. You are not alone in this journey, and this dissertation is a tribute to your strength, your courage, and your indomitable spirit.

Acknowledgements

I am deeply grateful to the many individuals who supported me throughout my doctoral journey. This dissertation would not have been possible without their guidance, encouragement, and unwavering support.

I am immensely grateful to Dr. Natalia Gajdamaschko. Your encouragement to pursue my PhD in Educational Technology and your unwavering belief in my abilities have been a source of great motivation. I am deeply appreciative of your faith in me.

While speechless, I would like to express my heartfelt gratitude to my supervisor, Dr. Robert Williamson. Your belief in my potential and your willingness to give me the opportunity to pursue my PhD despite the challenges I faced have been instrumental in my academic journey. Your insightful feedback and constant encouragement have guided me through the complexities of my research, and for that, I am thankful.

To my committee members, Dr. David Kaufman and Dr. Yumiko Murai, along with external committee members, Dr. Margarida Romero and Professor Jim Bizzocchi, thank you for your invaluable advice and support. Your expertise and constructive feedback have significantly shaped my research.

I would also like to sincerely thank Dr. Kevin O'Neal and Dr. Engida Gebre. Your constant push for excellence and your support during times of need have been incredibly motivating, helping me to strive for and achieve higher standards in my work.

Of course, I cannot forget the support I received from two amazing tech developers who helped me build and prepare the VREIT application for this study. First, my amazing business partner and my close friend, Henry Leung. And second, my new friend and supporter in India, Rahul Sode. Without their help and support, this project would be almost impossible to complete in a timely manner.

A special thank you goes to the participants in my study. Your willingness to share your experiences and insights has been fundamental to the success of this research, and provided invaluable data and perspectives that have enriched this study. Thank you all for your unwavering support and belief in my journey. This dissertation is a testament to your contributions and encouragement.

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ACCEL	A program that provides education, behavioral, therapeutic, and vocational programs for individuals with special needs, including autistic people. [cite: 469, 470]
ACT	Autism Community Training. [cite: 465]
ADHD	Attention deficit hyperactivity disorder. [cite: 375]
ADL	Activities of daily living.
ASD	Autism spectrum disorder. [cite: 345, 346]
AS	Asperger's Syndrome. [cite: 395, 396]
ABA	Applied Behavior Analysis. [cite: 495, 496]
AAC	Augmentative and alternative communication systems. [cite: 363]
AR	Augmented reality.
AT	Assistive technology. [cite: 60, 119]
BC	British Columbia. [cite: 415]
CAVEs	Cave Automatic Virtual Environments. [cite: 269]
CIRVR	Career Interview Readiness in Virtual Reality. [cite: 144]
CSD	Canadian Survey on Disability. [cite: 428]
CTA	Call-to-action elements. [cite: 874]
CVR	Collaborative VR. [cite: 285]
DBR	Design-based research. [cite: 698, 699]
DSM	Diagnostic and Statistical Manual of Mental Disorders. [cite: 343]
DMF	Dan Marino Foundation. [cite: 468]
EARN	Employment Advocacy Resource Network. [cite: 439, 450]
EF	Executive functioning. [cite: 373]
EOS	Epic Online Services. [cite: 897]
HCI	Human-computer interaction.
HFA	High-functioning autism. [cite: 395, 396]
HMD	Head-mounted display. [cite: 269]
ID	Instructional design.
IPS	Individual Placement and Support.
JIPVRP	Job Interview Preparation Virtual Reality Platform.
MOOCs	Massive open online courses. [cite: 1999, 2000]
NLTS2	The National Longitudinal Transition Study-2. [cite: 420]
OBM	Outcome-based marketing.

PD	Professional Development. [cite: 102]
PECS	Picture exchange communication systems. [cite: 363]
PhD	Doctor of Philosophy. [cite: 2]
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses. [cite: 224]
POVVM	Point-of-view video modelling. [cite: 513]
SFU	Simon Fraser University. [cite: 238]
STEM	Science, technology, engineering, and mathematics. [cite: 245]
SVVR	Spherical video-based virtual reality. [cite: 263]
TCPS	Tri-Council Policy Statement. [cite: 88]
ToM	Theory of mind. [cite: 785]
UI	User Interface. [cite: 180]
UX	User Experience. [cite: 740]
VFX	Visual effects.
ViTA	Virtual Interactive Training Agents.
VM	Video modelling.
VREIT	Virtual Reality Employment and Interview Training.
VR	Virtual Reality.
VSM	Video self-modelling.
VPM	Video prompting.

Glossary

AAC	Augmentative and alternative communication systems
ASD	Autism spectrum disorder [ASD is a complex neurological condition that encompasses a wide range of social, verbal, and non-verbal communication challenges and behaviors.
CAVE	Cave Automatic Virtual Environments [CAVE Automatic Virtual Environments are immersive virtual reality environments consisting of a cube-shaped room with multiple walls onto which images are projected to create a 3D environment.
CVR	Collaborative VR [CVR is a type of virtual reality experience in which multiple users can interact with each other in a shared virtual space.
DBR	Design-based research [DBR is a type of research that involves designing and testing educational interventions in real-world settings.
DSM	Diagnostic and Statistical Manual of Mental Disorders [The DSM is a book published by the American Psychiatric Association that provides a standard set of criteria for diagnosing mental disorders.
EF	Executive functioning [EF is an umbrella term for cognitive processes that regulate, control, and manage other cognitive processes.
EOS	Epic Online Services [EOS is a set of online services for games that are provided by Epic Games.
HFA	High-functioning autism [HFA is a term that is often used to describe individuals with autism who have average or above-average intelligence and who are able to function relatively independently.
HMD	Head-mounted display [An HMD is a device that is worn on the head and that provides a virtual reality experience by displaying images in front of the eyes.
NLTS2	The National Longitudinal Transition Study-2 [The NLTS2 is a study that has collected data on the experiences of students with disabilities as they transition from high school to postsecondary education and employment.
PECS	Picture exchange communication systems [PECS is a type of augmentative and alternative communication system that is often used with individuals with autism.

PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses [PRISMA is a set of guidelines that are used to ensure that systematic reviews and meta-analyses are conducted in a transparent and reproducible manner.
SVVR	Spherical video-based virtual reality [SVVR is a type of virtual reality that uses 360-degree video footage to create an immersive experience.
TCPS	Tri-Council Policy Statement [The TCPS is a set of guidelines that are used by Canadian researchers to ensure that research involving humans is conducted in an ethical manner.
ToM	Theory of mind [ToM is the ability to understand that other people have their own thoughts, beliefs, and feelings that may be different from one's own.
VPM	Video prompting [VPM is a type of video modeling that involves breaking down a task into steps and then providing a video prompt for each step.
VREIT	Virtual Reality Employment and Interview Training [VREIT is a virtual reality platform that is designed to provide job interview training to individuals with autism.

Preface

This dissertation represents the culmination of my journey as a researcher and educator. I am deeply committed to exploring the intersection of digital technology and education, particularly for individuals on the autism spectrum. My extensive experience in educational technology, higher education, and digital transformation[2] has provided me with a unique perspective on integrating innovative tools and methodologies into teaching and learning environments.

Throughout my career, I have been an instructor and educational developer to a wide range of learners, each with distinct learning preferences. Amongst these learners, those diagnosed with autism spectrum disorder (ASD) have left a particularly profound impact on me. Initially, I faced considerable difficulties teaching and training this group of learners due to my limited knowledge of autistic characteristics; however, I observed that certain traits common among autistic learners could be leveraged to their benefit and enhance their learning experience. This experience, combined with my post-secondary coursework on educating autistic individuals, has given me insight into their learning needs, challenges, and the potential of educational technology to enhance their experience. It is essential to my research, grounding my theoretical insights and commitment to fostering an inclusive and effective learning environment.

This dissertation explores the development and testing of a gamified virtual reality environment designed to enhance job interview skills for autistic individuals. It addresses the challenges these adults face in employment and reflects my academic goals. Drawing on my background and experiences with autistic learners, I aim to contribute to understanding how virtual reality can effectively support their needs.

This dissertation is dedicated to all the autistic learners who have shared their experiences with me and to the broader community of educators and researchers committed to making education more inclusive and accessible for everyone. I hope that this work will pave the way for further innovations in educational technology and contribute to a more inclusive society.

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[2] Digital transformation: Refers to the integration of digital technologies to enhance learning experiences and improve operational efficiency in educational setting or workplace.

Chapter 1. Introduction

Engaging in post-secondary education creates opportunities not only to pursue professional goals but also to interact with learners from diverse backgrounds, each bringing unique cognitive strengths, characteristics, and preferences. Throughout my career as an educator and educational leader, I have had the privilege of working with a wide range of learners, each with distinct ways of engaging with content. Among these, autistic learners have had a particularly profound influence on my teaching approach, inspiring a deeper understanding of their unique needs and potential.

This dissertation adopts identity-first language ("autistic learners") rather than person-first language ("learners with autism"), recognizing autism as an inherent part of individual identity rather than a separate or external condition (Taboas et al., 2023). Many within the autistic community prefer identity-first language, viewing it as reflective of neurodiversity and self-acceptance (Gillespie-Lynch et al., 2017; Grech et al., 2024). This choice aligns with the primary aim of this research: to explore the experiences and engagement of autistic learners within the VREIT (Virtual Reality-based Interview Training) environment. While research suggests a general preference for identity-first language among autistic individuals (Gillespie-Lynch et al., 2017; Grech et al., 2024; Kenny et al., 2016; Taboas et al., 2023), the value of respecting individual preferences remains acknowledged.

In the early stages of teaching autistic learners, I encountered challenges, primarily due to limited knowledge of autism's complex characteristics. Over time, I observed that certain strengths common among autistic learners, such as visual processing, systematic thinking, and focused interests, could be harnessed to create more engaging and effective learning experiences (Bertrand et al., 2001; Christensen et al., 2018; Thrower et al., 2020a). Recognizing and supporting these strengths has been linked to improved educational outcomes in recent research (Baker-Ericzén et al., 2022; Christensen et al., 2018; Ramdoss et al., 2012). Unfortunately, autistic individuals still face considerable barriers in securing and sustaining employment (Baker-Ericzén et al., 2022; Dudley et al., 2015; Grandin & Duffy, 2008; Howlin & Magiati, 2017; Smith, Sherwood, et al., 2021).

Witnessing the difficulties that many autistic students encounter in the job market, despite their qualifications, has been a key driver behind this research. A central question emerged: why do autistic graduates, despite their demonstrated abilities, struggle more than their neurotypical peers to find employment? The literature suggests that social communication challenges often hinder autistic individuals in job interviews, affecting their employment prospects (Baker-Ericzén et al., 2022; Dudley et al., 2015; Smith, Fleming, Wright, Losh, et al., 2015). This study aims to test user experience within the design of a novel, personalized, gamified virtual reality learning environment that can support autistic adults in developing interview skills, with the goal of designing a useful tool for improving their employability and overall engagement in learning experiences.

1.1. Positioning myself as a researcher

This dissertation reflects a multifaceted approach to educational research, grounded in both theoretical and practical expertise in educational technology, higher education, and digital transformation. Extensive experience as a post-secondary program head, instructor, developer, and leader across various educational and technological initiatives has provided a pragmatic perspective on the integration of digital tools and methodologies in teaching and learning environments. This background has fostered a strong respect for empirical rigor and an innovative approach to applying technology to enhance learning outcomes.

Developing partnerships with industry leaders and academic institutions globally has underscored a commitment to bridging academic research with real-world applications—a perspective that is integral to this dissertation, which addresses the evolving role of digital technology in education. Additionally, involvement in diverse roles, such as serving as an External Subject Matter Expert for the Ministry of Advanced Education and contributing to the BC Creative Technology Education Committee, has honed skills in evaluating and influencing technology's role in education policy and curriculum development.

With over fifteen years of experience as a post-secondary educator, where classes consistently included one to two students diagnosed with ASD, insights have been gained into their unique learning characteristics, needs, and the pedagogical

challenges and opportunities presented by educational technology. This experience is foundational to this research, anchoring theoretical insights with a practical understanding of fostering inclusive and effective learning environments—core principles that drive this research philosophy.

This dissertation draws upon an extensive technical and academic background in educational technology and autism studies to investigate the intersection of virtual reality, personalized learning, and training outcomes for autistic individuals. Through the development and testing of a gamified virtual reality environment, this study aims to contribute to the understanding of VR's role in enhancing training engagement and learning for autistic individuals. Employing a design case study approach, the research examines how an individualized VR environment can support autistic adults in developing job interview skills. This work leverages a diverse range of experiences in education and academia, bringing a balanced perspective that values both theoretical innovation and practical application in advancing inclusive learning technologies.

1.2. Study description and purpose

The literature review highlights a substantial employment gap between individuals with disabilities and those without, underscoring a critical societal issue that requires both focused attention and actionable solutions (Baker-Ericzén et al., 2022; S. L. Burke et al., 2021; Dudley et al., 2015; Government of Canada, 2019; Hayes et al., 2015; Smith et al., 2022). In Canada, for instance, only 62% of individuals with disabilities aged 25 to 64 are employed, compared to 78% of those without disabilities (Government of Canada, 2023). This study addresses this disparity by focusing on the design and evaluation of the Virtual Reality-based Interview Training (VREIT) environment, a personalized virtual reality tool intended to support job interview skill development in autistic individuals. By investigating user engagement with VREIT, this research seeks to contribute to strategies that address employment challenges for autistic individuals, particularly within job interview preparation.

Virtual reality environments provide controlled spaces where social interactions and sensory experiences can be carefully managed, which may be especially advantageous for autistic individuals who experience sensory overload or anxiety in unpredictable, real-world social settings (Smith, Sherwood, et al., 2021; Smith et al.,

2022; Ward & Esposito, 2019). Furthermore, VR tools and game-like environments enable personalized pacing and repeated practice, offering autistic users a safe, controlled setting to develop social skills (All et al., 2021; Ern, 2014; Hayes et al., 2015).

Building upon these benefits, this study employs a design case study methodology to examine how a thoughtful design of VREIT can enhance autistic users' engagement and learning experience. A design case study is an in-depth exploration of a design project, providing a narrative that traces the designer's journey and problem-solving approach (Bakker, 2018). This approach involves identifying the initial problem and context, documenting the iterative design process, presenting the final solution, and, where possible, analyzing the design's impact (Bakker, 2018; Edelson, 2002; Sedlmair et al., 2012). Such case studies are invaluable for application development, allowing designers to reflect on successes and identify areas for improvement in future iterations (Bakker, 2018; Downton, 2003; Edelson, 2002; Sedlmair et al., 2012).

This study uses a Design-Based Research (DBR) framework to iteratively develop and refine VREIT, a system ultimately aimed at supporting job interview skill acquisition for autistic individuals. Guided by constructivist learning principles, VREIT was designed to provide a safe, structured virtual environment in which autistic users can practice essential interview skills and address social challenges commonly encountered during interviews. This dissertation details the iterative development and testing of VREIT with two participants, focusing on their engagement with the prototype and gathering feedback for ongoing refinement. Observations of participants' experiences suggested perceived improvements in confidence, self-awareness, and the ability to articulate skills, indicating the benefits of immersive, VR-based training for autistic individuals.

1.2.1. Theoretical foundation

Bandura's Social Learning Theory and Skinner's Behaviorist Theory provide foundational frameworks for developing effective learning programs for autistic children. Bandura's theory emphasizes learning through observation and imitation, making it especially relevant for individuals with strong visual processing abilities (Bandura, 1977; Corbett & Abdullah, 2005). Skinner's theory, on the other hand, focuses on shaping behavior through reinforcement and punishment, a technique demonstrated to be

effective in helping autistic children acquire new skills and reduce undesired behaviors (Baron-Cohen, 1989; Koegel et al., 2010; Lovaas et al., 1979; Skinner, 1985). Together, these theories underscore the value of structured, consistent, and individualized learning approaches, aligning well with the needs of autistic learners (Bandura, 1986; Skinner, 1985).

The VREIT application, designed and developed in this study, leverages these principles to foster engagement with job interview training for autistic individuals. By creating a controlled virtual environment, this design case study aims to explore whether VREIT could improve participants' engagement and learning experience within the specific context of job interview preparation.

Qualitative research, particularly in design case studies, often involves a limited number of participants, focusing on depth rather than breadth (Creswell & Poth, 2016; Gray et al., 2007; Stake, 1995; Yilmaz, 2013). While larger sample sizes are desirable for generalizability, an initial design case study with two participants allows for intensive analysis and targeted feedback, essential for refining the VREIT environment in its early stages. This approach facilitated detailed observations of participants' experiences and engagement, allowing iterative adjustments to be tested and assessed before potential expansion to a broader participant pool. By prioritizing a manageable scope, the study focused on building a reliable and personalized VR platform before scaling to larger samples in subsequent studies.

The design case study followed a constructivist approach, which is particularly suited to interpreting participants' subjective experiences. This framework enabled a qualitative analysis of participants' engagement and learning as they navigated the VREIT environment for job interview skills training. Comparing participants' responses in pre- and post-VREIT interviews provided insights into their engagement and perceptions of the environment. In this study, constructivism supports an in-depth exploration of how autistic individuals interact with and respond to the VREIT environment, illuminating the potential of VR-based tools to enhance engagement and learning experiences for autistic learners in real-world skill development contexts (McKinley, 2015).

1.2.2. Research question

While there is a growing interest in utilizing VR for job interview training, much of the current research has relied on video and animation overlays within VR environments rather than fully interactive, real-time simulations (Adiani et al., 2022; Smith, Fleming, Wright, Losh, et al., 2015; Smith, Sherwood, et al., 2021; Ward & Esposito, 2019). This reliance on scripted overlays presents several challenges, particularly when attempting to create realistic, interactive VR job interview scenarios that demand sophisticated technology and specialized expertise (Adiani et al., 2024; Beti et al., 2019; Stanica et al., 2018). Additionally, most studies have primarily focused on evaluating the general effectiveness of job interview training for autistic individuals through pre-scripted scenarios, with limited exploration of the impact of different delivery methods, such as pre-recorded videos compared to real-time, interactive VR (Adiani et al., 2022; Beti et al., 2019; S. L. Burke et al., 2018; Smith, Fleming, Wright, Losh, et al., 2015; Smith et al., 2022).

However, recent research highlights the potential advantages of real-time, interactive VR, including enhanced immersion and the flexibility to create unscripted and adaptive training scenarios that may better meet the needs of autistic learners (Adiani et al., 2024; Genova, 2021). This study leverages these insights to address the following research question:

"How can VREIT's design features enhance engagement and perceived learning experience for autistic users in job interview training?"

By examining this question, the study aims to contribute to a deeper understanding of how interactive VR features can enhance engagement for autistic individuals, moving beyond static or scripted content to a dynamic, personalized learning experience.

1.2.3. Purpose

The purpose of this design case study was to investigate the use of the VREIT application to enhance autistic participants' engagement and overall learning experience. This research examined how a VR environment, such as VREIT, can be effectively

designed and developed as an educational tool to facilitate learning and improve the engagement of autistic individuals. Employing a design case study approach (Bakker, 2018; Edelson, 2002; Sedlmair et al., 2012), this study assessed the engagement levels and learning experiences of autistic participants interacting with VREIT.

The study aims to contribute to the development of effective VR applications for education, training, and vocational rehabilitation tailored for autistic individuals. By evaluating learner engagement with VR technology, this work offers preliminary recommendations for accessible and appropriate design features that enhance educational and training experiences in virtual environments.

1.2.4. Methodological approach

Qualitative thematic analysis within user experience case studies enables a deep exploration of participants' experiences within specific contexts, revealing collective expressions such as perceptions, emotions, and shared encounters with a phenomenon (Creswell & Poth, 2016; Gallagher, 2012; Hays & Singh, 2012; Smeyers, 2008). This approach was selected to investigate the impact of an individualized VR environment on the engagement and learning experience of autistic individuals in job interview training.

Adopting a Stakian case study perspective within a constructivist framework, this design case study focused on understanding user engagement within the designed platform, rather than adhering to a predetermined theory (Stake, 1995; Yazan, 2015). VREIT, developed using a constructivist learning approach, provides a safe, structured, and customized virtual environment for autistic learners to practice job interview skills. This design-based research framework enabled an evaluation of VREIT’s impact on participants’ engagement, interactions, and confidence, underscoring the potential benefits of VR-based training.

To gather insights, unstructured interviews with open-ended questions were conducted. The initial interview assessed participants' perceptions of job interviews and related training before using VREIT. Following multiple mock interview sessions within VREIT, observational notes captured their engagement and interactions with the VR environment and virtual coach. A post-training interview included the original questions

along with additional inquiries on their experiences with VREIT and its influence on their engagement throughout the training.

1.2.5. Contributions

This design case study aimed to evaluate the VREIT application's design and its impact on autistic participants' perceptions of engagement within a gamified, customized VR training environment. The study focused on the advantages of a gamified, interactive, immersive, real-time VR tool tailored specifically for autistic individuals.

By offering a safe space to practice with the flexibility to make and learn from mistakes, VREIT was designed to reduce participants' fear of engagement, allowing them to build confidence in a controlled environment (Bekele & Champion, 2019; Coban et al., 2022; Solmaz et al., 2024; Torrens & Kim, 2024). The real-time immersive experience provides immediate feedback, helping users identify and correct errors, reinforce positive behaviors, and receive ongoing learning support (Marcus, 2016; Mazurek et al., 2015; Wendt et al., 2020).

Furthermore, by enabling realistic practice scenarios accessible from home, VREIT has the potential to democratize access to essential job preparation resources. This capability aligns with current trends in digital transformation and remote work, providing a flexible platform that may support the shift towards remote job training and employment preparation. These trends, along with the broader implications of VR-based training, are discussed in greater depth in Chapter 2, the literature review (Grzegorczyk et al., 2021; Rathi, 2024; Vyas, 2022; Wontorczyk & Rożnowski, 2022).

1.3. Outline of the remainder of this dissertation

Chapter 2 of this dissertation offers a literature review covering essential topics, including autism prevalence, characteristics, levels, subtypes, and the experiences of autistic individuals in adulthood, secondary and post-secondary education, and employment. This chapter provides a comprehensive examination of how autism spectrum disorder (ASD) impacts individuals' ability to secure and sustain employment, underscoring the employment gap between individuals with and without disabilities. It explores contributing factors to these challenges, such as social interaction difficulties,

communication barriers, and the need for workplace accommodations. Additionally, it considers how recruitment processes, particularly job interviews, can exacerbate employment difficulties for those with ASD. This review contextualizes the study's aim to design and develop a VR environment to support the transition of autistic individuals into the workforce.

Chapter 3 introduces the study's methodology, describing the design and development of the VREIT application and its role in engaging two autistic participants. It outlines the research design, criteria for participant selection, and procedures for implementing the application. The chapter details the assessment measures for evaluating VREIT's impact on engagement and learning experience, including pre- and post-VREIT interviews and observational analysis of participants during VREIT training sessions.

Chapter 4 focuses on the design and development of VREIT as an individualized VR platform. Accessibility for autistic users is emphasized through features like customizable light intensity, realistic avatars, color contrast, and sound. This chapter details the iterative design process, covering the creation and refinement of features to optimize user experience. It further explains the development process using Unreal Engine 5.2 and highlights advanced elements, such as real-time facial expression streaming and personalized avatar selection. The chapter concludes with an overview of testing and deployment, demonstrating the platform's accessibility and user-friendliness for autistic individuals.

Chapter 5 presents the study's results and findings. Analysis of data from pre- and post-VREIT participant interviews offers insights into VREIT's influence on participants' engagement and learning experiences within job interview training. Observational data on participants' interaction during mock interviews reflect increased engagement and interaction with both the trainer and VR environment. This chapter critically evaluates VREIT's potential as an effective teaching and learning tool to enhance engagement, particularly for individuals with ASD.

Chapter 6 addresses the broader implications of the study's findings for autistic learners, job interview training, educators, assistive technology, and application design.

It explores how VREIT can be integrated into transition programs for adults with ASD, potentially improving job interview outcomes and employment prospects.

The final chapter, Chapter 7, concludes the dissertation by summarizing key findings and limitations, alongside recommendations for VREIT's use in job interview training and potential applications in employer training and remote learning. It suggests directions for future research, advocating for studies with larger participant populations to further validate the effectiveness of VR-based training environments like VREIT. This chapter closes with a call to action for continued innovation in educational technology, aiming to create more inclusive, supportive pathways to employment for individuals with disabilities.

Chapter 2. Literature review

Introduction

This chapter begins by exploring the unique affordances of Virtual Reality (VR) for learning, examining why VR is particularly effective and how it can support various learning preferences. It will then delve into the intersection of autism and job interviews, outlining the characteristics of autism and the specific challenges autistic individuals face during the interview process. Drawing upon relevant research, this literature review will analyze approaches that can be leveraged in designing VR interventions to address these challenges. Key areas of focus will include video modelling, self-modelling, and the potential of VR to provide an immersive, safe space for skill development. Subsequently, this review of literature will examine existing research on the use of VR for autistic learners and identify gaps in the current literature, setting the stage for exploring a VR-based immersive learning environment like VREIT.

To effectively bridge the gap between the potential of VR and its application in addressing the specific needs of autistic learners, this research focuses on the importance of real-time interaction in VR environments. In the context of VR, "real-time" signifies the system's capacity to react instantaneously to user input and dynamically update the virtual environment, ensuring a seamless and immersive experience (Bogon et al., 2023). Essentially, real-time in VR is about creating a sense of immediacy where the virtual environment mirrors the user's actions without any perceptible lag. This is achieved through a combination of powerful hardware, efficient rendering techniques, and sophisticated software that can handle the complexities of real-time simulation and interaction (Bogon et al., 2023; Solmaz et al., 2024). This responsiveness is critical for various VR applications, from gaming and entertainment to training simulations and therapeutic interventions, as it enables users to feel truly present and engaged in the virtual world (Giannini et al., 2024; Torrens & Kim, 2024).

This literature review also explores the critical transition period for autistic individuals from high school to the more autonomous realms of higher education and the workforce. This transition is fraught with difficulties, especially in the recruitment and placement stage and, more specifically, the job interview, largely due to the inherent characteristics of autism, which can impede the adaptation to new environments at a

pace comparable to neurotypical individuals (Baker-Ericzén et al., 2022; Genova, 2021; D. R. Hendricks & Wehman, 2009; Ward & Esposito, 2019).

The transition from high school to further education or employment is particularly challenging for autistic individuals, with the job interview stage presenting significant hurdles (Flower et al., 2019; D. R. Hendricks & Wehman, 2009; K. et al., 2011; Walker, 2015). Difficulties in social communication, sensory sensitivities, and adapting to new environments can all contribute to these challenges (Hedley et al., 2018; D. R. Hendricks & Wehman, 2009). Studies indicate that young autistic adults face significantly lower employment rates compared to their peers, highlighting the need for innovative solutions (Baker-Ericzén et al., 2022; Flower et al., 2019; Hedley et al., 2017; Wehman et al., 2012).

Exploring the multifaceted challenges and considerations surrounding individuals with autism, particularly in the transition from high school to further education or employment, this review delves into the nuanced realities that these individuals face. The analysis begins by acknowledging the stark disparities in employment rates between young autistic adults and their peers with other disabilities, as well as those without any reported disabilities. This discrepancy not only highlights the societal and systemic barriers to employment but also underscores the importance of understanding autism's unique impact on an individual's ability to secure and maintain employment. Further, the review extends to the Canadian context, where recent surveys (Government of Canada, 2023; Hébert et al., 2022; Shahidi et al., 2023), reveals that despite a rise in employment rates for people with disabilities, a persistent gap remains: 62% of individuals aged 25 to 64 with disabilities are employed, compared to 78% without disabilities. The employment gap for individuals with autism is especially significant, with only 33% of autistic Canadians aged 20 and older reporting employment, compared to 79% of non-disabled Canadians. The substantial gap of 46% underscores that the challenges faced by autistic individuals are not just about disability but are likely tied to the inherent nature of autism itself (Statistics Canada, 2023).

Lastly, to design an effective real-time VR platform for training autistic learners, it is crucial to incorporate user experience principles tailored to the core characteristics of autism. These characteristics affect how individuals interact with their environment, especially in high-pressure scenarios like job interviews. The significance of carefully

selecting colours, themes, layouts, and fonts is highlighted in research to improve engagement and comfort for autistic users (Jones, 2021; Sherman & Craig, 2003). Approaches such as video modelling, self-modelling, and immersive environments have proven beneficial (Fitzgerald et al., 2018; Hayes et al., 2015; LaCava, 2008). A real-time VR setting can provide a safe, controlled space for practicing interview skills and building confidence (Corbett & Abdullah, 2005; Kabashi & Kaczmarek, 2017; Ke & Im, 2013).

2.1. Process and Methods

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines, ensuring a structured, comprehensive, and transparent approach. The scope of the review was defined using the PICo framework, a qualitative adaptation of the PICO model, which assisted in establishing the Problem (virtual reality), Interest (teaching, learning, and training), and Context (job interview training for autistic individuals) for this review.

Database Selection

The review was conducted using the following databases: Eric, Educational Technology, and Education. Additional searches were performed using Google Scholar to ensure comprehensive coverage of the relevant literature.

The search strategy involved using specific keywords related to both virtual reality and autism[3]. For virtual reality, the keywords included: "Virtual Reality," "Virtual Reality and learning," "Virtual Reality and Job interviews," "VR learning environment," "Affordance of VR," "History of VR," and "VR and autism." For autism, the keywords used were: "Autism," "Transition in Autism," "Autism and Learning," "Autism and Employment," "Autism Characteristics," and "autism and job interview training."

Inclusion Criteria

The inclusion criteria for the review were articles published in peer-reviewed journals, books, and book chapters. The timeframe for inclusion was set for publications

[3] Appendix F includes a list of keyword categories and their combination

within the last fifteen years (2008-2023) for virtual reality and educational technology, and the last thirty years (1993-2023) for teaching and learning related to the autistic population. Studies that did not meet these criteria were excluded from the review.

Study Selection

The initial search resulted in 88 articles, comprising 34 related to virtual reality and 54 pertaining to autism. Following the PRISMA (2020) guidelines, a thorough screening process was conducted to assess each article's relevance based on predefined inclusion criteria. During this stage, overlapping articles from the two fields were identified and appropriately managed. After applying the established inclusion and exclusion criteria, the final number of studies determined to be included in the review. The process and decisions made at each stage are visually represented in the PRISMA flow diagram (Figure 1), ensuring transparency and clarity in the selection of only the most relevant and high-quality studies for our analysis.

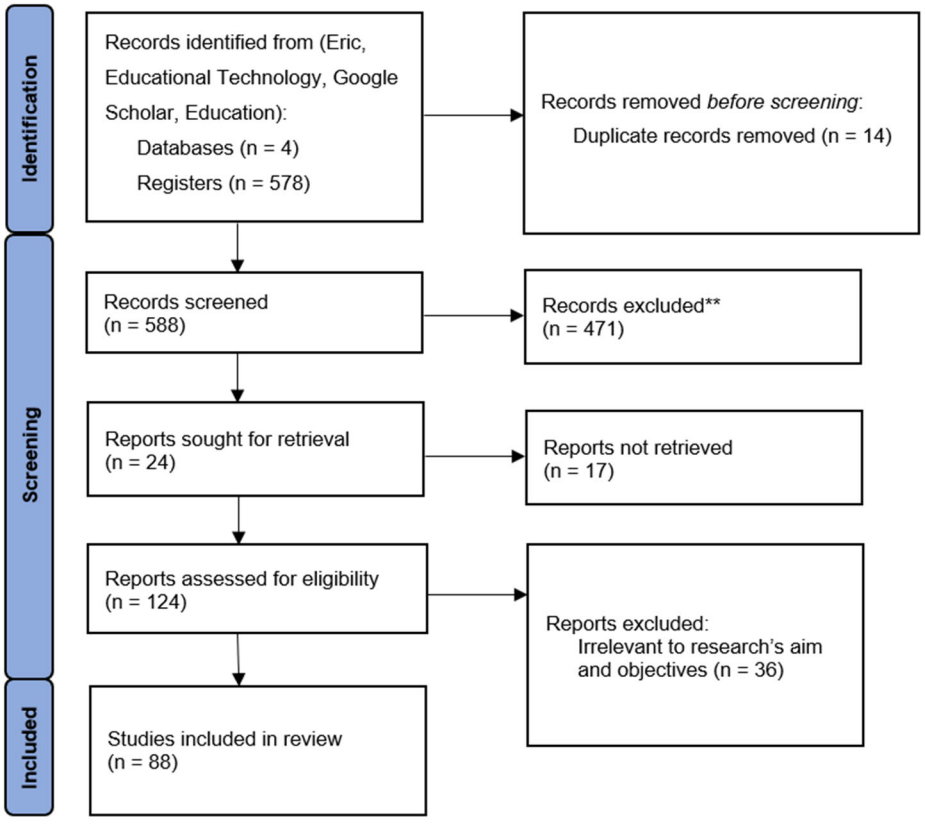

Figure 1. PRISMA Flow Diagram of Literature Search

2.2. Affordances for Learning

Virtual reality (VR) is rapidly emerging as a transformative technology in education, offering immersive and interactive learning environments that surpass the limitations of traditional methods. Several studies highlight the unique affordances of VR for enhancing student engagement, understanding, and retention. For instance, Campos (2022) and Pellas (2020) emphasize VR's capacity to create fully virtual settings that block out the real world, allowing students to experience and interact with three-dimensional environments. This immersive quality, facilitated through headsets and computers or mobile devices, proves particularly beneficial in STEM fields, where VR can effectively visualize abstract concepts (Campos et al., 2022; Dalgarno & Lee, 2010).

Building on this idea of enhanced visualization, research by Molina-Carmona (2018), Passig (2016), and Philippe (2020) demonstrate how VR enables students to manipulate abstract concepts within a virtual setting actively, leading to deeper understanding and improved knowledge retention. This active manipulation aligns with the principles of experiential learning, which is further supported by studies like Coban (2022) and Pellas (2020) that showcase VR's ability to provide authentic learning experiences and simulate practical tasks that would be otherwise inaccessible.

Furthermore, a common thread across multiple studies is the positive impact of VR on student motivation and learning outcomes. Campos (2022), Coban (2022), and Fromm (2024) all report increased student engagement and improved learning outcomes when VR is integrated into educational practices. This is attributed to the heightened sense of presence and interactivity that VR offers, creating a more engaging and effective learning experience compared to traditional methods (Campos et al., 2022; Fromm et al., 2024; Laine & Lee, 2024).

2.2.1. Uniqueness of VR

Virtual reality (VR) technology creates the illusion of being in a different place, immersing users in synthetic worlds with 360° views. The term "virtual reality" was coined by Jaron Lanier in 1987 during a period of intense research activity into this form of technology. Lanier, the founder of VPL Research Company, defined VR as “a computer-generated, interactive, three-dimensional environment in which a person is

immersed”. Despite its early conceptualization, VR was not introduced to the general public until 1989 (A. Anderson, 2019).

The first VR headset was developed by computer scientist Ivan Sutherland in 1968. However, it wasn't until the late 20th and early 21st centuries that VR technology became more accessible and affordable. In 2016, nearly 89 million VR headsets were sold worldwide, with 98% being mobile VR headsets (G. Burdea, 2003; J. Lee et al., 2019).

Several companies have played significant roles in the development and popularization of VR. Oculus Rift, launched as a Kickstarter project in 2012 and acquired by Facebook in 2014, is one of the most talked-about VR systems on the market today. Samsung partnered with Oculus in 2014 to build the Samsung Gear VR, which sold around 2.317 million devices in 2017. Sony also entered the market with its PlayStation VR, combining its VR headset with its gaming hardware. HTC Vive, launched in 2016, is known for its room-scale VR 3D painting application, Tilt Brush. Google has also significantly contributed to VR with its Google Cardboard headsets, which had 84 million devices in 2016. Google Cardboard was initiated as an experiment to let people experience virtual reality at a low cost, requiring only a mobile phone to operate (G. C. Burdea & Coiffet, 2024).

The recent resurgence of VR is largely driven by decreasing costs and significant technological advancements. This is particularly evident in the rise of spherical video-based virtual reality (SVVR), which utilizes 360-degree video to create immersive virtual environments. As Schmidt et al. (2019) highlight, the increasing affordability of SVVR has fueled its growing adoption in educational settings.

What distinguishes VR from other technologies is its capacity to create highly immersive and interactive experiences that significantly enhance user engagement and motivation. Anderson (2019) and Pellas et al. (2020) emphasize this unique ability of VR to construct three-dimensional, computer-generated environments where users can interact in real-time. This real-time interaction, coupled with the immersive nature of VR, fosters a sense of presence—the feeling of being physically present within the virtual world—that traditional media cannot replicate.

This sense of presence is largely attributed to VR's ability to engage users by immersing them in synthetic worlds with 360° views. Technologies like head-mounted displays (HMDs) and Cave Automatic Virtual Environments (CAVEs) play a crucial role in achieving this immersion by effectively cutting off connections to the natural environment, as described by Sherman & Craig (2003). This allows users to feel fully enveloped within the virtual world.

Furthermore, a high level of immersion is crucial for creating a convincing illusion of reality. By engaging multiple senses with realistic visuals, sounds, and haptic feedback, and by minimizing any discrepancies between the user's actions and the virtual world's responses, VR effectively "tricks" the brain into believing the virtual environment is real (Bekele & Champion, 2019; Solmaz et al., 2024; Torrens & Kim, 2024). This suspension of disbelief, as Slater (2018) explains, is fundamental to achieving a strong sense of presence in VR.

Virtual reality is proving to be a powerful tool for enhancing learning experiences. By providing immersive and engaging environments, VR allows students to move beyond passive observation and engage in active learning, mirroring real-world scenarios and interactions (Bekele & Champion, 2019; Dede, 2009; Pellas et al., 2020). As Dede (2009) suggests this shift towards "learning by doing" can significantly deepen understanding and knowledge retention. VR enables students to interact with complex concepts tangibly, offering authentic simulations of real-world environments and scenarios (Fromm et al., 2024; Pellas et al., 2020). This is particularly impactful in fields like STEM education, where VR can facilitate interactive experiments and experiences that would be impractical or impossible in a traditional classroom setting due to safety, cost, or logistical constraints (Pellas et al., 2020).

Beyond its capacity to simulate real-world experiences, VR fosters increased motivation and engagement by captivating learners’ interest and offering a novel platform for education. This immersive quality of VR promotes a more positive attitude towards learning, which can lead to enhanced knowledge retention and a deeper understanding of content, as noted by Anderson (2019), Laine & Lee (2024), and Torrens & Kim (2024).

Additionally, the interactive nature of VR environments enriches learning experiences by enabling users to engage with virtual objects and environments in ways that traditional media cannot replicate. Bekele & Champion (2019) highlight that VR facilitates a range of interactions, from device-based and sensor-based inputs to multimodal experiences, creating a dynamic and immersive learning space. For example, collaborative VR (CVR) allows multiple users to coexist and interact within the same virtual environment, promoting social interaction and collaboration—key elements in effective learning and skill development (Laine & Lee, 2024).

VR's ability to deliver real-time feedback and continuous stimuli enhances the user experience by creating a seamless environment in which students can visualize abstract concepts and observe otherwise inaccessible phenomena (Sahin & Yilmaz, 2020). This combination of immersion, engagement, and real-time interactivity positions VR as a transformative tool in educational practice (Campos et al., 2022; Coban et al., 2022; Fromm et al., 2024).

2.2.2. How VR supports learning?

Research findings consistently indicate VR's potential to enhance learning experiences by utilizing its immersive and interactive features, particularly in areas where traditional methods may be less effective (Fromm et al., 2024; Philippe et al., 2020). VR's core strength lies in its capacity to increase motivation and engagement by immersing learners in dynamic, realistic environments that capture attention and stimulate curiosity. Evidence from Dunleavy et al. (2009), Fromm et al. (2024), and Philippe et al. (2020) supports the positive impact of immersive VR on intrinsic motivation, fostering greater involvement in the learning process and contributing to active participation and improved retention of information.

VR enhances engagement by granting learners access to rich, immersive learning contexts that are otherwise challenging to experience. For example, studies by Campos et al. (2022), Coban et al. (2022), and Pellas et al. (2020) highlight VR's effectiveness in simulating complex real-life scenarios, such as industrial settings, particle physics events, or detailed brain anatomy. These simulations provide a level of experiential interaction that traditional learning environments cannot replicate.

In addition, VR supports active learning by enabling direct interaction with virtual objects and environments. This hands-on approach, as opposed to passive methods like lectures, facilitates deeper understanding and knowledge retention. Research by Campos et al. (2022) and Coban et al. (2022) underscores the positive impact of whole-body, immersive VR experiences on learning gains, engagement, and attitudes toward subjects such as science. By allowing learners to manipulate objects and navigate virtual spaces, VR encourages active construction of knowledge, making the learning process more effective and engaging (Dalgarno & Lee, 2010; Sherman & Craig, 2003).

One significant advantage of VR in education is its adaptability to individual needs and preferences. VR experiences can be tailored to create personalized learning pathways, catering to diverse learners with varying learning preferences and paces. This customization, as highlighted by Laine & Lee (2024) and Philippe et al. (2020), makes learning more accessible and effective for all students. For instance, VR can offer unique virtual identities through avatars, allowing students to engage in learning activities that suit their individual preferences and needs. This personalization, as described by Burdea & Coiffet (2024) and Dunleavy et al. (2009), enhances the learning experience by creating a more engaging and relevant environment for each learner.

Beyond supporting individualized learning, VR fosters collaborative learning experiences through multi-user environments, allowing learners to interact in shared virtual spaces, work together on tasks, and exchange knowledge in an engaging, immersive way. Research by Burdea & Coiffet (2024), Laine & Lee (2024), and Molina-Carmona et al. (2018) emphasizes the value of collaborative VR features in encouraging diverse perspectives and supporting the joint construction of knowledge. Collaborative VR enables participants to interact and communicate within the virtual environment, fostering a sense of community and enhancing collaborative problem-solving and knowledge sharing (Laine & Lee, 2024; Molina-Carmona et al., 2018; Philippe et al., 2020)s.

Integrating VR into education represents a pioneering approach to leveraging technology for powerful learning experiences. Studies by Campos et al. (2022) and Coban et al. (2022) demonstrate how VR can effectively enhance digital education by improving learning outcomes, providing realistic and engaging experiences, and increasing intrinsic motivation and interest in learning. By supporting access to diverse

resources and interactive learning experiences, VR exemplifies the transformative potential of technology in education (Pellas et al., 2020).

VR also offers a safe, controlled space for learners to experiment and learn from mistakes without real-world consequences, encouraging risk-taking and exploration, essential aspects of effective learning (Dalgarno & Lee, 2010; J. Lee et al., 2019). Studies by Burdea & Coiffet (2024), Coban et al. (2022), and Pellas et al. (2020) highlight VR's ability to simulate scenarios where learners can practice skills and receive feedback in a risk-free setting, enhancing the overall learning experience. The immersive quality of VR fosters a supportive environment where learners feel comfortable taking risks and exploring new concepts (G. C. Burdea & Coiffet, 2024; Coban et al., 2022).

A real-time VR environment supports learning by enhancing motivation and engagement, promoting active and personalized learning, fostering collaboration and social interaction, and creating a supportive environment for exploration. These attributes make VR a powerful educational tool, offering innovative ways to enrich the learning experience (G. C. Burdea & Coiffet, 2024; Coban et al., 2022; Molina-Carmona et al., 2018).

2.2.3. Related works using VR for learning

A substantial body of research highlights VR's potential to enhance learning by creating interactive and immersive environments. Studies by Fitzgerald et al. (2018) and Kandalaft et al. (2013) show that VR-supported instruction enables students to actively engage with learning materials and construct meaningful simulations or prototypes without the limitations of physical space or time. This approach fosters improved practical skills and conceptual understanding, particularly within K-12 education, where VR has been successfully applied across various subjects, especially in STEM.

Many of these K-12 studies, as reported by Smith et al. (Smith, Fleming, Wright, Losh, et al., 2015) and Smith & Jordan (2021), use quantitative experimental designs which indicate that VR-supported instruction leads to greater knowledge gains compared to traditional, non-VR methods. These applications often feature high-fidelity simulations and game-like prototypes, providing interactive and engaging learning experiences (Mazurek et al., 2015).

While research on VR in education is extensive, notable gaps remain. Although portable mobile VR devices are increasingly used in classrooms (Smith, Fleming, Wright, Losh, et al., 2015; Smith, Sherwood, et al., 2021), there is limited evidence on the use of real-time, 3D immersive VR that enables both teachers and students to interact within a shared virtual space. Most studies, including those by Anderson (2019), Pellas et al. (2020), Smith & Jordan (2015), Stanica et al. (2018), and Smith et al. (2022), have focused on scripted scenarios delivered by virtual characters or pre-designed instructional contexts.

Furthermore, there is a lack of longitudinal studies examining VR's long-term impact across different learning subjects. The predominance of science-based VR research restricts the generalizability of findings to other fields, such as engineering and mathematics, in K-12 education (J. Lee et al., 2019; Pellas et al., 2020; Philippe et al., 2020). This highlights the need for more interdisciplinary VR research to broaden our understanding of its potential across diverse educational contexts.

2.3. Autism and job interviews

The term "autism" was first introduced in 1911 by Paul Eugen Bleuler to describe what he then considered a childhood form of schizophrenia, identifying individuals who exhibited distinct characteristics and needs that differentiated them from the general population (Bleuler, 1911; Evans, 2013). At the time, however, limited research and understanding impeded the development of supportive measures to help these individuals integrate into mainstream society. It was only in the early 1970s that autism was more accurately recognized as a developmental disorder distinct from schizophrenia (Evans, 2013), a distinction formally established in 1987 with the introduction of new diagnostic categories in the DSM-III.

Today, "autism" refers to a range of conditions collectively known as autism spectrum disorders (ASD). Over the twentieth century, substantial progress in ASD research has led to significant insights and advancements, enabling autistic individuals to lead fulfilling lives and reach their potential despite the challenges associated with autism.

Autism spectrum disorder (ASD) is classified as a syndrome rather than a disease, characterized by limited interest in social interaction, communication challenges, and repetitive behaviors (Bertrand et al., 2001; Christensen et al., 2018). While autism has been recognized as a distinct category for over a century, much of the crucial information that has deepened our understanding of its characteristics has emerged only within the past three decades (Christensen et al., 2018; Thrower et al., 2020a).

In the late 1980s, autism was officially recognized as a clinical diagnosis in the DSM-III, defining it as a spectrum of behavioral characteristics with varying degrees of impairment (American Psychiatric Association, 1987). The DSM-IV, published in 1994, expanded this definition by incorporating several subtypes, including early infantile autism, childhood autism, Kanner's autism, high-functioning autism, atypical autism, pervasive developmental disorder not otherwise specified, childhood disintegrative disorder, and Asperger's disorder. The first three subtypes now fall under the umbrella of autism spectrum disorder (ASD) (1998).

The DSM-5, published in 2013, refined the classification of ASD as a single disorder but retained distinctions among previously identified subtypes, further establishing ASD as a complex spectrum that encompasses a wide range of developmental and behavioral manifestations (American Psychiatric Association, 2013, 2022).

2.3.1. Characteristics

ASD is a complex neurological condition and developmental disability characterized by a broad spectrum of challenges in social, verbal, and non-verbal communication, as well as specific behavioral patterns (Amaral, 2017; Christensen et al., 2018). While the exact origins of autism remain unknown, research suggests that it is often associated with irregularities in brain structure or function (Lord et al., 2018; Lord & Bailey, 2002). Autistic individuals, like neurotypical individuals, have unique personalities, yet they frequently exhibit certain common traits, including persistent challenges with social interactions and communication (Amaral, 2017). Additionally, they may display repetitive or restricted patterns in behaviors, interests, or activities, though these characteristics vary widely in intensity and expression among individuals (Amaral,

2017; Qi et al., 2020; Thrower et al., 2020a). According to the DSM-5, the challenges and characteristics associated with autism can be grouped into five primary categories (American Psychiatric Association, 2013).

Social communication and interaction differences

Typically, autistic individuals experience difficulties in social interaction. Early indicators of autism can include behaviours such as avoiding, or struggling with, eye contact, difficulty initiating or responding to joint attention[4], and difficulty sharing social experiences with peers (Coles et al., 2018; DeBoth & Reynolds, 2017; Lord et al., 2018). Additionally, autistic children may struggle with typical play skills, such as playing with other children and may even refrain from playing with peers (Lord et al., 2018; Lord & Bailey, 2002). According to studies by Bellini & Akullian (2007) and Qi et al. (2020), many autistic people tend to shy away from social situations and interactions, often avoiding group gatherings. Additionally, challenges in interpreting facial expressions, body language, and tone of voice have been observed among autistic individuals (Zwaigenbaum et al., 2015). Further research has also shown that initiating conversations, staying on topic, asking relevant questions, and predicting known information during conversations can be difficult for those with autism (Iovannone et al., 2003; Ke & Im, 2013; Rutter & Taylor, 2002).

Speech impairment

Specific difficulties in receptive (comprehension of language, like following directions) and expressive language (ability to express desires and thoughts to other persons) have been two areas in which autistic people may struggle (Bauminger et al., 2008; Rutter & Taylor, 2002). While some autistic people can express their thoughts verbally, others are nonverbal and require specific devices to communicate (Bauminger et al., 2008). Some of the commonly used communication devices include speech-generating devices, augmentative and alternative communication systems (AAC), picture exchange communication systems (PECS), visual boards, signs and gestures, tablets and smartphones (Lima Antão et al., 2018; Sampath et al., 2013). Autistic people

[4] When one person purposefully coordinates his or her focus of attention with that of another person, we refer to the behaviour as “joint attention.” Joint attention involves two people paying attention to the same thing, intentionally and for social reasons (UNC SCHOOL of MEDICINE, 2022).

who are verbal may demonstrate delayed or immediate echolalia (repetition of others' spoken word) to self-stimulate or self-manage, use inappropriate words in conversation (idiosyncratic), and use immature grammatical structure, intonation, rhythm or stress (Iovannone et al., 2003; Jaswal & Akhtar, 2019; Rutter & Taylor, 2002). Nonverbal autistic individuals may exhibit delay or even lack of language and speech development and in some cases this can lead to needing alternative augmentative communication (AAC) like visuals, sign language, or even audio playback devices (Shane et al., 2012; Stasolla et al., 2016).

Restricted repetitive behavioural patterns, interest and activities

Autistic individuals exhibit a range of preferences with respect to their activities of interest, akin to their neurotypical counterparts. However, the former may display differences in the levels of focus, interest, and intensity demonstrated, owing to their limited repertoire of alternative behaviours. Furthermore, some autistic individuals may exhibit a preference for performing certain tasks and activities repeatedly, which may provide them with a sense of comfort (Barahona Corrêa & van der Gaag, 2017; Coles et al., 2018; South et al., 2005).

Autistic individuals often display repetitive behaviours such as hand flapping, finger flicking, and arranging objects in a specific order (Lord & Bailey, 2002; Zwaigenbaum et al., 2015). They may also exhibit a strong adherence to routines and may become upset by any alterations to their established patterns or habits (Barahona Corrêa & van der Gaag, 2017; Zwaigenbaum et al., 2015) and display repetitive questioning and pacing behaviours and highly restricted and fixated interests in certain objects or information related to specific subjects. (Carr & LeBlanc, 2007; Coles et al., 2018; South et al., 2005).

Executive function impairment

Executive functioning (EF) is an umbrella term used to describe a set of cognitive processes that are essential for goal-directed behaviour. These processes include attentional control, working memory, cognitive flexibility, reasoning, and task switching, among others (Archibald & Kerns, 1999; Goldstein & Naglieri, 2013; Suchy, 2009). EF plays a critical role in guiding human behaviour, as it enables individuals to plan, initiate, monitor, and adjust their actions in response to changing environmental demands

(Goldstein & Naglieri, 2013). Studies have shown that deficits in executive functions (EF) are associated with a range of neuropsychological disorders, including attention deficit hyperactivity disorder (ADHD), schizophrenia, traumatic brain injury, and Alzheimer's disease (D.L Christensen et al., 2018). While EF in typically developed people contributes to social interactions, academics, learning, self-regulation, and daily activities, autistic individuals may have difficulty in a range of EF-related tasks such as sustaining prolonged attention to activities, paying attention to more than one activity at a time, and sequencing order in a different process (Adreon & Durocher, 2007; Kenworthy et al., 2005).

Learning characteristics

Although no two autistic individuals are identical, they often share common learning characteristics. Despite challenges in executive functioning, speech, and social interaction, autistic individuals frequently exhibit strong visual memory (rote memory) skills (Huang & Wheeler, 2006; Rubin & Lennon, 2004). Consequently, when information is presented visually, autistic learners can typically process it more effectively and benefit from images, behavioral modeling, and hands-on activities with examples (Randi et al., 2010; Tissot & Evans, 2003). Also, unstructured timelines and extended waiting periods can be particularly challenging for autistic individuals; tools like checklists and timetables can help mitigate the confusion caused by waiting (Tissot & Evans, 2003).

Transferring skills across different environments and settings, as well as organizing learning materials and activities, can also be problematic for autistic learners (Baric et al., 2017; Capo, 2001; Whitby & Mancil, 2009). Practicing skills in environments that closely resemble real-world settings through simulation can therefore be beneficial, helping to promote the generalization of learned skills across various contexts.

2.4. Levels and subtypes

The DSM-5 (2013) outlines the diagnostic criteria for ASD, emphasizing core characteristics and challenges. Unlike earlier versions, DSM-5 introduces a severity specifier that categorizes the impact of ASD symptoms on adaptive functioning, helping to distinguish the level of support required for individuals (Constantino & Charman, 2016; Elder et al., 2017). While many autistic individuals display these traits, symptom severity often varies and may go unnoticed, as only the core symptoms impacting social,

occupational, or executive functioning are measurable and only partially correlated (Constantino & Charman, 2016; Mehling & Tassé, 2016). Consequently, individuals with mild impairment may still meet core ASD diagnostic criteria, and vice versa (Constantino & Charman, 2016).

The DSM-5 classifies the spectrum into three levels based on social communication abilities and the presence of restricted, repetitive behaviors. It's important to note that, regardless of classification, individuals' symptoms and support needs are unique (Barnhill, 2007; Ozonoff, Rogers, et al., 1991).

Level 1 ASD: represents the mildest end of the spectrum, where individuals generally require minimal support. Individuals with level 1 ASD often have relatively strong social and communication skills, enabling them to maintain a good quality of life similar to neurotypical peers. However, they may face challenges in social interactions, planning, and organizing activities (Barnhill, 2007; S. J. Taylor & Brumby, 2020; Verbelchuk & Kwon, 2013). Level 1 ASD is sometimes referred to as "high-functioning autism" (HFA) or Asperger's syndrome (AS), although studies have shown that HFA and AS are empirically distinguishable, particularly regarding theory of mind impairments (Ozonoff, Rogers, et al., 1991; Szatmari et al., 1990).

Level 2 ASD: requires a substantial amount of support. Individuals in this category exhibit pronounced difficulties in both verbal and non-verbal communication, struggling with changes in routine, social cues, and interactions. They often rely on simple sentences for communication and require consistent support to manage daily tasks. Compared with level 1, level 2 individuals face more significant challenges in adapting to change and maintaining a high quality of life. However, with intensive occupational therapy and structured support, these individuals can develop skills for daily living and some job-related tasks (DSM-5, 2013).

Level 3 ASD: represents the most severe degree of autism, with individuals needing extensive support. According to DSM-5 (2013), level 3 individuals show severe deficits in social and communication skills, along with pronounced repetitive and restrictive behaviors. They have limited verbal and non-verbal communication abilities and minimal interest in social activities. Additionally, they experience considerable difficulty adapting to changes in routine and environment, necessitating high levels of support to navigate

daily life (S. J. Taylor & Brumby, 2020). This classification provides a framework for understanding the diverse presentations of ASD and tailoring support according to each individual's needs.

2.5. Autism and adulthood

According to the US Center for Disease Control (2018), 1 in 54 children have been diagnosed with ASD, with it being four times more common among boys than girls (Christensen et al., 2018; Maenner et al., 2023). This is reinforced by the "Report Of The National Autism Spectrum Disorder Surveillance System," which indicates that the prevalence of autism was approximately 1 in 66 children and youth (ages 5–17 years) in 2015 (2018). In Canada, approximately 50,000 autistic youth become adults each year (Bizier et al., 2016), and of those 50% share that they feel disconnected from employment or education opportunities after completing high school in the first two years (Bizier et al., 2016).

The growth of ASD prevalence has led to an increasing number of autistic adults seeking employment and entering the workforce. As about 50,000 high school students graduate annually, the population of transitional-age youth also rises. Hence, it is likely to see close to one million autistic youth enter adulthood in the coming decade, and history suggests that obstacles abound (Bizier et al., 2016; Shattuck et al., 2020).

Therefore, it is imperative to understand the goal and purpose of special education. The Canadian Center for Policy Alternatives report (2015) highlighted that many special education policies in Canada are outdated and should include current inclusive education practices (2015). In Canada, adults with disabilities have lower levels of education, higher rates of unemployment (62%), lower household incomes, and face challenges accessing affordable housing, health care, and transportation (Prince, 2004; Towle, 2015). In British Columbia, as per the Special Education Policy Manual of the Ministry of Education (2016) in schools is to enable students with special needs to have equal learning opportunities to pursue and accomplish the goals of their education programs and to prepare themselves for a meaningful life with potentially further education at post-secondary levels or obtaining lasting employment (2016).

While investigating and searching for literature for this proposed study, several systematic literature reviews were found on employment and ASD (Bennett & Dukes, 2013; D. Hendricks, 2010a; J. L. Taylor & Seltzer, 2011; L. Walsh et al., 2014; Wehman et al., 2012), along with several general disability employment reviews. Most of these studies and literature come from the UK and the US, and the labour market environment in the UK and US are different from Canada's. These markets not only differ based on the laws and rights that protect and/or support individuals with disabilities but also considering the approaches used to provide income insurance, and in the types of industries, types of jobs and education systems (Dudley et al., 2015). Therefore, there is a noticeable gap in Canadian research, posing an additional gap for this study.

In the United States, based on "The National Longitudinal Transition Study-2" (NLTS2) report on six years of post-high school outcomes of individuals with disabilities as they go through their early adult years, only 58% of these individuals are adults with autism who obtained employment (Sanford et al., 2011). Most adults see employment as an important part of life and a component that not only brings economic benefits, it also strengthens their social network and their sense of being a productive member of the society (Newman et al., 2011). Moreover, studies have linked employment to positive outcomes such as financial independence and improving self-esteem (Fabian, 1992; Lehman et al., 2002; Polak & Warner, 1996). As shown in Table-1, in the United States, young autistic adults received employment between the time they graduated from high school and their early twenties at a much lower rate than their peers with other forms of disabilities (Newman et al., 2011; Roux et al., 2015; Sanford et al., 2011).

Table 1. Paid employment of young adults by disability category.

	Autism	Traumatic brain injury	Multiple Disabilities	Deaf and Blindness	Learning Disability	Speech impairment	Orthopedic impairment	Other impairment
Employment status	Percent							
Percentage reported to have been:								
Employed at the time of the interview	37.2 (4.59)	51.6 (7.59)	39.2 (5.33)	30.1 (6.69)	67.3 (3.93)	63.9 (3.73)	35.0 (4.39)	64.4 (4.59)

NOTE: Standard errors are in parentheses. Findings are reported for young adults with disabilities out of high school up to 8 years.

Based on the 2017-2022 Canadian Survey on Disability (CSD) 1 in 4 Canadians aged 15 and over, about 8.0 million individuals had one or more disabilities (Government

of Canada, 2023), presenting a 5 percent increase compared with 2017 findings when 22% (6.2 million people) had one or more disabilities (Government of Canada, 2018).

According to the 2022 CSD report, out of all the individuals between the ages of 25 to 64 with disabilities, 62% are currently employed, in comparison, 78% of individuals without disabilities are currently employed (2023). Notably, the employment rate for individuals with disabilities aged 25 to 64 increased by 3% from 2017 to 2022. This resulted in a 5% reduction in the employment gap between individuals with and without disabilities (Figure 2). The results from the 2022 CSD report are consistent with the findings of the Labour Force Survey (Statistics Canada, 2023, p. 4).

Individuals with disabilities have consistently been employed at lower rates compared with those without disabilities, and this has been attributed to several factors, such as the recruitment process, unmet workplace accommodation needs, and discrimination (Statistics Canada, 2023, p. 1). In 2022, the employment rate for people with disabilities aged 16 to 64 was 65.1%, which was 15 percent lower than the 80.1% employment rate for people without disabilities (Government of Canada, 2023; Statistics Canada, 2023, p. 1). These rates were noted during a strong job market and a low unemployment rate whereas in the second quarter of 2022, employers were looking to fill nearly one million vacant positions, which was the highest number of job openings ever reported (Statistics Canada, 2022, p. 2).

The earlier report on the employment and income profile of Canadians with disabilities also presented that among those aged 25 to 64 years, persons with disabilities were less likely to be employed (59%) than those without disabilities (80%) (S. C. Government of Canada, 2018). Moreover, of individuals with disabilities aged 25 to 64 years who were not employed and not currently in school, two in five (39%) had the potential to work (2018).

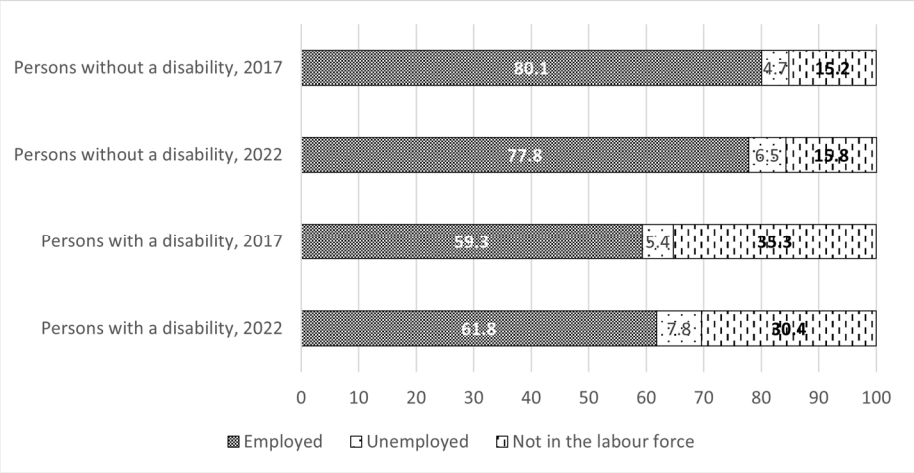

Figure 2. Labour force status for persons aged 25 to 64 years with and without a disability, 2017 and 2022.

2.6. Autism and transitioning

Transitioning from the high school environment to post-secondary or employment is indeed a difficult challenge for individuals with autism. Individuals with autism may struggle to adapt to their environment as quickly as those who are typically developed (Christensen et al., 2018; Huang & Wheeler, 2006, 2006; Maenner et al., 2023). Considering these characteristics and impairments that individuals with autism present in communication, social perception and cognition, and social skills (DSM5, 2013), proper support through coaching and intensive intervention is needed to avoid negative employment outcomes (Dudley et al., 2015; EARN, 2020; Lehman et al., 2002).

Of many transitional life stages for people with ASD, two have been identified as crucial and significantly important; transition from secondary school to college and from education to employment is increasing in Canada (Dipeolu et al., 2014; Hedley et al., 2018; D. R. Hendricks & Wehman, 2009). Each of these transition types presents unique challenges and difficulties for individuals with ASD. Such challenges usually present themselves due to the social competence and lack of social interaction skills in autistic individuals (Baric et al., 2017; Dipeolu et al., 2014; Roux et al., 2015; Sanford et al., 2011). The initial job interview is known to be the first and potentially the biggest hurdle that individuals with ASD face when they apply for job opportunities and plan to move from student life to adulthood (Gillies, 2012; D. Hendricks, 2010b; Sarrett, 2017a). Having difficulty understanding social cues or body language, failing to judge the amount

of information when answering questions, what tone of voice and level of formality to use, and the inability to recall past experiences are some of the challenges autistic adults face when being interviewed (Sarrett, 2017a). Social skills and behavioural characteristics are rated more frequently in interviews (Jaswal & Akhtar, 2019; Sarrett, 2017a; L. Walsh et al., 2014). In most cases, candidates are observed, assessed, and evaluated based on composure, response content, interaction with the interviewer(s), and even physical appearance (Barrick et al., 2009, 2012).

Even in circumstances where autistic individuals are successful in the interview stage and can obtain a job, adapt to the new environment, and complete day-to-day tasks, their performance and work experiences are often hindered by social communication and interaction challenges (D. Hendricks, 2010b). Besides the challenges posed by characteristics associated with autism, lack of proper accommodation in the workplace also poses additional obstacles to maintaining a job (Gillies, 2012; D. Hendricks, 2010b). As a result, autistic adults account for poor long-term employment outcomes even lower than employment outcomes for individuals with other disabilities such as intellectual dis/ability, psychiatric, and even traumatic brain injury (Baker-Ericzén et al., 2022; EARN, 2020; J. L. Taylor & Seltzer, 2011).

To improve the employment outcome for autistic individuals, two key components should be considered. One is the training and intervention process for the autistic employee, and the other is the training and orienting of the employer to plan and provide a safer and more inclusive workplace for autistic employees (Lindsay et al., 2021; Martin et al., 2023; Waisman-Nitzan et al., 2019, 2021). The need for an accessible and inclusive workplace and working environment that supports people with disabilities, including employees with ASD, has increased significantly, and government support for employers to plan and provide an inclusive workplace and accommodate employees with disabilities including those diagnosed with ASD (Government of Canada, 2019; Lindsay et al., 2021; Waisman-Nitzan et al., 2021)

2.6.1. Interviews – Important stage in transitioning

Many individuals with ASD have an excellent range of employment-related skills, such as attention to detail and technical and intellectual skills (Barnhill, 2007; Feinstein, 2018). However, social and communication challenges and difficulty with face-to-face

interactions often make it difficult for autistic adults to obtain or maintain meaningful employment, especially when participating in a face-to-face job interview (Lorenz et al., 2016; Sarrett, 2017a; Smith, Fleming, Wright, Losh, et al., 2015).

2.6.2. Skills for a successful job interview

Job interviews present a challenge not only for autistic adults but also for neurotypical individuals seeking to start or advance their careers. More than just a stage in the employment process, the job interview offers candidates the chance to align their education, experience, and skills with what employers are seeking (McNary, 2008).

As with other assessment and selection methods, interviews are tools designed to evaluate a candidate's ability to perform in a specific role (Huffcutt, 2011). Throughout the interview, applicants are asked a series of questions or given tasks aimed at eliciting responses directly related to the role and its required competencies (Huffcutt, 2011; Huffcutt et al., 2001).

Two primary factors influence the outcome of a job interview, both playing a critical role in the interviewee’s success or failure. While there is a common perception that responses to interview questions are the key determinant of success, empirical studies reveal that nonverbal behaviors also significantly impact outcomes (Huffcutt et al., 2001; Mehrabian, 1971).

In evaluating candidates, interviewers assess three domains: technical skills, often referred to as hard skills; impression or likability; and soft skills, including personality traits that correlate with job performance (Stanica et al., 2018; Vijayabanu et al., 2019). Together, these domains form a comprehensive profile of the candidate’s suitability for the role.

2.6.3. Job interview training for autistic applicants

Research indicates that proper training, preparation, and practice for job interviews can help autistic individuals overcome social challenges associated with the interview process. Developing strong interview skills appears essential for improving the employability of autistic individuals (Kumazaki et al., 2022; Lorenz et al., 2016; Smith et al., 2020; Smith, Jordan, et al., 2021).

Although supportive programs exist globally and in British Columbia for autistic students throughout the K-12 years (Autism BC, 2021; Ministry of Child and Family Development, 2021), many of these programs conclude when students finish secondary education, underscoring the need for continued support beyond high school.

In response, various public and private organizations have developed employment training programs to address the low employment rate among autistic individuals. Programs such as EmploymentWorks and Orbital Learning in Canada, the Marino Foundation and ACCEL in the United States, and Passwerk in Belgium offer specialized training designed to prepare autistic individuals for employment and facilitate community integration.

The Marino Foundation supports autistic people from childhood to adulthood through several programs, including career preparation and training (DMF, 2022). The ACCEL program provides education, behavioural, therapeutic, and vocational programs for individuals with special needs, including autistic people. The program aims to provide the necessary training and education for these individuals to start and maintain meaningful employment and independent life (ACCEL, 2018).

Concentrating on the needs of the technology sector since 2008, Passwerk focuses on identifying individuals with autism's unique qualities and providing them with the training required to establish a lasting and meaningful career in the technology sector as application and software testers (Passwerk, 2019).

In Canada, Autism Career Connection is an online program established in Ontario that provides employment training for autistic job seekers. It also provides education for employers to design inclusive recruitment and work environment. Built on Passwerk's curriculum, in Canada, Employment*Works* (A.B.) and Orbital Learning (B.C.) provide similar training programs for autistic adults to attain and maintain employment in the technology sector. While these programs offer training through different methods, and tools, one common theme is the focus on job interview training and preparation.

2.6.4. Tools for job interview training

The job interview training components in many of the programs previously mentioned rely on in-person coaching, training, and practice (ACCEL, 2018; Passwerk,

2019), while others incorporate technologies such as online videos, interactive applications, and virtual reality (HUMM et al., 2014).

Regardless of the delivery model, these training programs commonly utilize a "Modelling" approach. In this method, a model demonstrates a specific behavior or skill for learners to observe and emulate (Harris, 1983). Instructors teach the desired skill by demonstrating each step and explaining the process. Although straightforward, this approach is widely recognized and applied across various fields for training and therapeutic purposes (Harris, 1983; Hestenes, 1997).

2.7. Approaches in teaching and training autistic learners

Social Learning Theory posits that human behavior is primarily acquired through observation, imitation, and modeling of others (Bandura, 1977). Intervention strategies and teaching methodologies for autistic adults include Applied Behavior Analysis (ABA), Assistive Technology, Social Cognition Training, and Community-Based Interventions (Bishop-Fitzpatrick et al., 2013; Rutter & Taylor, 2002).

Both Bandura's Social Learning Theory and Skinner's Behaviorism provide valuable frameworks for designing effective learning interventions for autistic learners. Bandura's theory emphasizes observational learning, where individuals acquire skills by watching and imitating others (Bandura, 1977, 1986). In contrast, Behaviorism, as proposed by Skinner, focuses on shaping behavior through reinforcement and punishment (Skinner, 1985). Social Learning Theory is particularly useful for autistic learners who often display strong visual processing abilities and can benefit from visually structured instruction that minimizes distractions (Corbett & Abdullah, 2005), although they may struggle in complex social environments. Video modeling, a technique based on Social Learning Theory, has proven effective for teaching skills to autistic children by providing consistent, repetitive visual examples without the demands of real-time social interaction (Buggey, 2009; Buggey et al., 2011; Corbett & Abdullah, 2005).

Additionally, Skinner's Behaviorist approach is well-supported in autism literature, demonstrating that behaviors in autistic children can be modified through reinforcement, facilitating new skill acquisition and reducing maladaptive behaviors (Baron-Cohen, 1989; Koegel et al., 2010; Lovaas et al., 1979). Both theories underscore the importance

of structured, consistent, and individualized learning methods, making them relevant for designing educational interventions tailored to autistic learners.

2.7.1. Modeling

A widely used instructional method is "modelling," where an individual demonstrates a behavior or skill for learners to observe and emulate (Harris, 1983). In this approach, instructors teach students how to perform a particular skill by showing the steps while explaining each one. Although modelling may appear straightforward, it has been extensively applied across various fields, including training and therapy (Harris, 1983; Hestenes, 1997; Spector et al., 2014). Modelling plays a crucial role in both behavioral and social learning theories. From a behavioral perspective, modelling acts as a discriminative stimulus, where the demonstrated behavior becomes a cue within a structured paradigm (Alberto, 1999; Alberto & Troutman, 1986). Social Learning Theory, in contrast, suggests that modelling and imitation, even without reinforcement, can sometimes be more effective than techniques using immediate rewards (Dawson & Adams, 1984). The effectiveness of modelling, however, may depend on factors such as the model’s perceived prestige and similarity to the observer (Bandura, 1977).

In the context of autistic individuals, behaviorism is applied through systematic instructional methods focusing on observable and measurable behaviors (A. Anderson & Carr, 2021; Gitimoghaddam et al., 2022). Techniques like Applied Behavior Analysis (ABA) are particularly effective within this framework, using methods such as prompt delivery, shaping, and fading to teach targeted behaviors in a structured way (Hixson et al., 2008). These strategies are tailored to each learner’s unique needs, promoting engagement, skill generalization, and retention, and thereby supporting a personalized learning experience. By emphasizing reinforcement and consequences and employing naturalistic approaches like incidental teaching and self-management techniques, behaviorism provides clear, consistent, and data-driven methods to build competencies and foster independence in autistic learners (Iovannone et al., 2003).

Alongside coaching and scaffolding, modelling is one of three core methods in apprenticeship learning, and it has garnered attention in learning science and instructional research (Fischer, 2018). Modelling enables the expert to externalize their problem-solving and thought processes, allowing learners to gain insight into the steps

involved in executing a task (Fischer, 2018; Harris, 1983; Hestenes, 1997). Pedagogically, modelling is a well-established technique that allows instructors to demonstrate the process of achieving a goal simply by performing it (Harris, 1983).

2.7.2. Video modelling

Technological advancements, particularly in media, have given rise to video modelling (VM), an instructional method where target behaviors are recorded and played back step-by-step for learners to observe and imitate (Apple et al., 2005; Buggey & Hoomes, 2011; Corbett & Abdullah, 2005; Kourassanis et al., 2015; McCoy & Hermansen, 2007). Rooted in Social Learning Theory, which emphasizes learning through observing, imitating, and modelling behaviors, video modelling has proven especially effective in teaching autistic learners by leveraging their strengths in visual processing (Bandura, 1977, 1986). Through repetitive, clear demonstrations of desired behaviors, VM helps autistic individuals acquire and generalize social, academic, and functional skills across contexts (Bellini & Akullian, 2007; Buggey, 2009; Corbett, 2003).

Video modelling is supported by specialized equipment, including a video recorder to capture the instructional behavior and a display device to play back the footage. Widely adopted in training and educating autistic individuals, VM facilitates skill acquisition in areas such as social communication and job training through targeted, behavior-focused demonstrations (Bellini & Akullian, 2007; Corbett & Abdullah, 2005; Kourassanis et al., 2015). VM comprises various forms, including basic video modelling, video self-modelling (VSM), point-of-view video modelling (POVVM), and video prompting (VPM) (Buggey, 2009; Collet-Klingenberg, 2008; McCoy & Hermansen, 2007).

Basic Video Modelling: In this form, a model—often a peer, instructor, or other third party—performs the target behavior, which is recorded and later shown to the learner. The video may be edited to remove errors or prompts, presenting a clean, focused example for the learner to follow (Ayres et al., 2017; LaCava, 2008).

Video Self-Modelling (VSM): VSM is used when learners have prior knowledge of the target behavior. The learner performs the behavior while being recorded, often following preparatory steps such as scripting and role-playing. The video may be edited to remove any errors or pauses, providing a polished example of the learner's successful

behavior for self-observation (Bellini & Akullian, 2007; Buggey, 2009; Buggey & Hoomes, 2011; LaCava, 2008).

Point-of-View Video Modelling (POVVM): POVVM involves recording the target behavior from the learner's perspective, with the instructor holding the camera at eye level to capture the environment as the learner would see it. This approach, shown to be effective for teaching play skills, actions, and interactions, allows learners to experience the task from a first-person viewpoint, enhancing their ability to replicate the behavior (Chen et al., 2016; Cihak et al., 2016; Hine & Wolery, 2006; Tetreault & Lerman, 2010).

Video Prompting (VPM): In this method, the target behavior is broken down into steps, each recorded separately with pauses to allow the learner to attempt each step before proceeding. Video prompting is highly customizable, as it may use pre-recorded videos edited to fit this step-by-step format, providing a structured and controlled pace for the learner (R. Burke et al., 2013; Law et al., 2018; E. Walsh et al., 2017).

Video modelling, with its ability to provide structured, visually clear demonstrations, is well-suited to autistic learners, whose visual strengths and need for consistency benefit from this approach. Through VM, learners not only enhance their attention and retention but also receive vicarious reinforcement, which increases the likelihood of successfully imitating the behavior (Bandura, 1977, 1986; Rutherford & Rogers, 2003).

2.7.3. Self-Modeling

Self-modelling is a learning and intervention technique where individuals observe themselves performing desired behaviors via video recordings (Buggey, 1993, 2009). This approach capitalizes on the tendency of individuals to replicate behaviors when they see themselves successfully executing them. Self-modelling is grounded in social learning and behavioral theories, which emphasize the role of modelling in learning processes (Alberto, 1999; Alberto & Troutman, 1986).

In self-modelling, individuals use their own image as the model, based on the premise that people are more likely to relate to themselves than to others. Bandura (1986) noted that model-observer similarity is optimized when individuals model themselves. Physiological evidence supports this, showing greater arousal levels when

individuals view their own image compared to observing peers (Fuller & Manning, 1973). Self-modelling thus provides precise and unbiased feedback, ensuring all observed behaviors are personally relevant (Hosford, 1981).

Self-observation, a related technique, involves viewing unedited video feedback, showing both positive and negative aspects of one's behavior. This method, applied in fields like counseling and social skills training, has been linked to improvements in self-acceptance, marital social skills, realistic self-assessment, and reduced reliance on denial as a coping mechanism (Boyd & Sisney, 1967; Fuller & Manning, 1973). A study by Fireman and Kose (2002) demonstrated the efficacy of self-observation, with children who viewed their own performances showing notable gains in problem-solving skills over those who watched adult models or practiced the task.

Video Self-Modelling (VSM) is a specific application of self-modelling that utilizes video technology to allow individuals to observe themselves engaging in desired behaviors. Advances in video editing have made VSM more accessible and user-friendly, enhancing its use in research and practice (Buggey & Ogle, 2012). VSM has been employed across various disciplines to teach skills such as motor and social abilities, communication, self-monitoring, functional skills, vocational skills, athletic performance, and emotional regulation (Dowrick, 1999; Schaeffer et al., 2016).

Studies indicate that self-modelling is highly effective in facilitating behavior change. For example, children who watched their own problem-solving performances scored significantly higher than those observing adult models or practicing the task (Fireman & Kose, 2002). By harnessing the natural tendency of individuals to emulate behaviors they see themselves performing successfully, self-modelling, particularly through VSM, emerges as a powerful tool for behavior change. Its effectiveness is further enhanced when used in combination with other therapeutic interventions (Buggey & Ogle, 2012; Dowrick, 1999; Hosford, 1981; Schaeffer et al., 2016).

2.7.4. Immersive learning environments

Immersive learning environments, harnessing the unique capabilities of VR technology, offer substantial benefits in enhancing educational experiences by fostering a sense of presence and engagement that traditional methods often lack. These environments enable learners to interact meaningfully with content, facilitating increased

motivation and engagement through realistic and interactive settings (Coban et al., 2022; Pellas et al., 2020). For instance, Dede's (2009) *River City* multiuser virtual environment demonstrated that actional and symbolic immersion allowed students to engage deeply, cultivating sophisticated problem-finding skills within a simulated 19th-century city.

These environments also provide multiple perspectives, essential for understanding complex topics. Switching between exocentric (outside) and egocentric (inside) frames of reference enables students to grasp both concrete and abstract insights, combining the benefits of each perspective to promote a more comprehensive understanding of the subject matter (Bekele & Champion, 2019; Coban et al., 2022; Dede, 2009).

Immersive VR further supports the transfer of classroom knowledge to real-world applications, a critical component in STEM education where practical experience reinforces theoretical knowledge. Research indicates that immersive VR environments can enhance learning outcomes by providing a high degree of realism, which aids in retention and application of knowledge (Pellas et al., 2020). VR simulations allow students to engage in hands-on activities that might be otherwise too dangerous, costly, or impractical, offering risk-free experiences in fields such as engineering and medicine where practical skills are vital (Bekele & Champion, 2019; Coban et al., 2022; Narciso et al., 2021).

For learners with special needs, particularly autistic learners, VR can create predictable and controlled settings, reducing the anxiety associated with real-world unpredictability. These controlled environments allow autistic learners to engage with content in a stable, focused manner, helping to minimize distractions (Coban et al., 2022; Ledford et al., 2023; Smith et al., 2020). VR environments can also be customized to reduce sensory overload—a common challenge for autistic individuals—making learning more accessible and effective by tailoring the experience to meet their unique needs (A. Anderson, 2019; Coban et al., 2022; Smith et al., 2020).

2.8. Autism and Virtual reality

Advancements in video modelling technology, particularly for autistic individuals, have greatly expanded the customization and effectiveness of this intervention strategy,

allowing for tailored approaches that better meet diverse learner needs (R. Burke et al., 2013; Chen et al., 2016; Sigafoos, 2007). While VR environments, such as VREIT used in this study, excel in fostering engagement and supporting video modelling, this design case study centers on participants' perceptions of engagement and their experiences within the VREIT environment. Specifically, it investigates how VREIT's features enhance learners' perceptions of this virtual learning tool.

The primary goal of this study is to assess whether the constructed VR environment effectively supports engagement among autistic participants. This initial evaluation is essential, laying the groundwork for future studies to explore the overall efficacy of these methods in educational interventions.

2.8.1. Using VR for Autistic Learners

The rapid advancement of 3D and VR technology offers promising opportunities for job interview training tailored to autistic individuals, who often show a strong interest in interacting with virtual characters and environments, as seen in their preference for video games (Bozgeyikli et al., 2018; Mazurek et al., 2015). The gamified aspects of VR—structured rules, clear goals, progressive challenges, reward systems, and a low-risk environment—enhance its appeal, providing positive reinforcement while reducing anxiety (Mazurek et al., 2015; Shackelford et al., 2019).

Studies demonstrate VR's effectiveness for skills training and video modelling, particularly for autistic learners. VR has been used to teach social skills (Fitzgerald et al., 2018), provide job interview training (Krupa et al., 2016; Smith et al., 2020), and support various other training domains, including transition programs and vocational skills (Kandalaft et al., 2013; Ward & Esposito, 2019). Research specifically on VR-based job interview training reveals significant improvements in autistic individuals' performance and self-confidence, with VR offering a controlled, safe space for practice (Smith et al., 2014, 2022; Smith, Jordan, et al., 2021).

These findings have meaningful implications, as a positive link between self-confidence and interview success is well-documented. Confidence boosts performance (Tay et al., 2006), while anxiety can hinder it (Feiler & Powell, 2016; McCarthy & Goffin, 2004). By providing a structured environment for practicing interview skills, VR supports

autistic individuals in building confidence and reducing anxiety, ultimately enhancing their interview outcomes and employment prospects.

2.8.2. Research Opportunities

While studies have explored the educational potential of VR across diverse settings, notable gaps remain, particularly in longitudinal research, subject diversity, and the use of real-time 3D immersive VR with human interaction.

Most existing studies focus on short-term interventions and assess outcomes immediately following the intervention (Narciso et al., 2021; Pellas et al., 2020). This approach restricts our understanding of VR's long-term impact on learning retention and outcomes, as little evidence addresses sustained educational effects over time.

Research has also been concentrated within specific fields, primarily science, engineering, and, more recently, special education, especially in training autistic learners (A. Anderson, 2019; Michalski et al., 2021; Narciso et al., 2021). This narrow focus limits the generalizability of findings to other subjects, including interdisciplinary fields like mathematics and technology within K-12 education.

Additionally, there is limited research on real-time 3D immersive VR environments that involve real individuals interacting instead of virtual avatars. Though studies have examined various VR devices and applications, including head-mounted displays (HMDs) and mobile VR, few provide real-time, immersive experiences through direct human interaction. Current research often emphasizes technical aspects and short-term educational outcomes without investigating long-term engagement or real-time interactions between learners and instructors in VR settings (A. Anderson, 2019; HUMM et al., 2014; Smith et al., 2014, 2020).

Moreover, most studies rely on experimental or quasi-experimental methodologies, with a lack of mixed-method approaches that could offer deeper insights into VR's educational impact (Narciso et al., 2021; Pellas et al., 2020). Research has predominantly emphasized quantitative measures of learning gains, with limited exploration of qualitative factors such as emotional states, user satisfaction, and engagement levels (Michalski et al., 2021; Pellas et al., 2020).

2.9. Summary of Literature Review

This literature review examined virtual reality (VR) as a tool for coaching and modeling, particularly for autistic individuals. VR provides an immersive, controlled platform that can minimize distractions and focus attention on specific tasks, which is especially beneficial for autistic learners who may experience sensory overload in traditional settings (DeBoth & Reynolds, 2017; Moldoveanu et al., 2017). Studies support VR's efficacy in delivering lessons and training, making it an appropriate medium for video modeling methodologies (Fitzgerald et al., 2018; J. Lee et al., 2019).

The game-like elements in VR—structured rules, progressive challenges, mastery opportunities, achievements, and rewards—enhance its appeal, aligning well with the preferences of autistic individuals who often engage well with virtual environments. These gamified elements make learning more motivating and enjoyable, thus boosting engagement in training contexts (Mazurek et al., 2015).

Literature underscores the effectiveness of modeling as a teaching and coaching method. Traditional modeling, where instructors demonstrate behaviors for learners to observe and replicate, has long been applied across various fields. Technological advances have refined this technique into video modeling, which is particularly effective for autistic learners, enabling repeated viewing and practice of recorded demonstrations to improve retention and comprehension of target behaviors (Bellini & Akullian, 2007; Buggey & Hoomes, 2011).

This study’s evaluation of VREIT as a training tool emphasizes the importance of observing and interpreting participants' experiences, alongside iterative refinement based on feedback. This design aligns with principles of design-based research (DBR), enabling continuous adaptation and improvement. The VREIT platform incorporates three primary features:

1. **Video Modeling**: Allows learners to record and view videos as visual tools for reinforcing skills and behaviors.

2. **Real-World Feedback**: Provides immersive experiences with immediate feedback, enabling users to apply what they learn in real-world-like situations.

3. **Game-Like**: Includes interactive elements to boost motivation, enhancing the engagement and enjoyment of the learning process.

By integrating these components, VREIT effectively supports learning objectives while allowing for continuous refinement based on user feedback.

The next chapter will explore the design and development of the VREIT platform, beginning with a review of design principles specific to autistic users. This foundation aids in understanding the unique needs and preferences of this population, which informed VREIT’s design. The chapter will detail the iterative design process, explaining how research on interactive application design shaped the VREIT platform's user interface (UI) and user experience (UX). By incorporating real-world feedback and adhering to best practices, VREIT was developed to create a supportive, immersive, and gamified environment for practicing job interview skills in real-time with a coach. This section connects theoretical foundations to the practical steps taken in VREIT's development, illustrating how theory and practice converge in creating effective educational technology interventions.

Chapter 3. Methodology

This dissertation employs a design case study methodology to explore the development and implementation of the VREIT platform, assessing the engagement and experiences of two autistic participants in live, peer-to-peer job interview training sessions.

The study's ontological perspective is constructivist, positing that reality is shaped by individual perceptions and interpretations. This view is reflected in the focus on capturing the unique experiences and perspectives of participants interacting with VREIT and their understanding of job interviews. Constructivism also informs the study's epistemological approach, emphasizing the importance of gathering insights through participants' personal experiences to understand the phenomenon. Qualitative methods, such as interviews and observations, were used to gather this data.

The present research is a qualitative case study within a design-based research (DBR) framework, well-suited to an in-depth exploration of user experience within a use-case context. DBR employs iterative cycles of design, implementation, analysis, and refinement, applied here to develop and optimize VREIT. The "case" in this research is defined by the application of VREIT for job interview training with two autistic adult learners.

This approach was selected to provide a comprehensive understanding of VREIT's engagement and enjoyment levels during job interview training for autistic individuals. The case study method enabled the collection of rich, subjective data through interviews and observations, highlighting participants' experiences and perceptions. The DBR framework facilitated iterative refinement of VREIT based on participant feedback, ensuring the intervention remained relevant and effective. This approach aligns with the constructivist foundation of the study, which values the role of individual experiences and interpretations in informing and enhancing the intervention.

3.1. The study

This design case study began with the development of the VREIT application, intended to offer a real-time, immersive learning experience for educators and learners.

VREIT incorporates life-like full-body avatars that reflect the users' real-time facial expressions, aiming to create a realistic interaction between teacher and learner. Considering the specific needs of autistic individuals, the application's design adhered to principles tailored for this group. Following its development, the study observed how VREIT influenced engagement and learning experiences for two autistic participants undergoing job interview training. This constructivist approach relied on interpreting participants' experiences through pre- and post-interviews and observations during VREIT-based training sessions.

Introduction

Exploration of immersive technologies suggests that VR has the potential to transcend traditional learning environments, offering highly engaging and transformative experiences. However, current VR applications often fall short in facilitating genuine, real-time immersive interaction for educational purposes, revealing a need for platforms that bridge this gap in interactivity and engagement.

Using a design case study methodology. The present research examines the affordances and challenges of VREIT as an educational technology, specifically its impact on pedagogical approaches, learner engagement, and knowledge construction. This approach draws on insights from over fifteen years of post-secondary teaching experience, including working with cohorts of 20 to 25 students, many of whom presented unique challenges in classroom settings due to autism. Observations within these learning environments have contributed to a deeper understanding of the diverse needs and learning preferences of autistic individuals.

A qualitative case study approach was selected for this research to allow an in-depth exploration of individual experiences, providing rich, detailed insights into each autistic participant's learning process. This approach effectively captures the nuances and subtleties of the learning experience that might be overlooked by quantitative methods, especially in a population where learning styles and challenges are highly individualized.

The diversity in learning experiences highlights the complexity of educational engagement and the necessity for pedagogical strategies that address a wide range of learning preferences and abilities (Fischer, 2018; Spector et al., 2014; Tessmer &

Wedman, 1995). This principle extends to all learners, including those with autism (Judy et al., 2012; Leaf, 2017). Research consistently shows that learners bring unique skills, challenges, and personal histories into educational settings, shaping how they engage with content and absorb new information (Y. Wang et al., 2008). Such variability underscores the importance of an adaptable, inclusive approach to education that accommodates the distinct needs of learners, particularly autistic individuals, whose unique strengths and challenges necessitate tailored educational (Hew & Cheung, 2014; Y. Wang et al., 2008).

This understanding challenges the feasibility of statistically comparing learning experiences for autistic individuals due to the diversity and individuality inherent in their learning processes, favoring an approach that respects and acknowledges these differences.

The qualitative case study approach supports this by providing a structured research design for examining contextual factors relevant to understanding the “why” and “how” of phenomena within specific cases (Ayton, 2023). It enables an in-depth exploration of programs, events, activities, or individuals through multiple data sources such as interviews, observations, and documents (Maggin et al., 2018; Priya, 2021; Stake, 1995). Applying this framework to autistic adults using the VREIT platform for job interview training yields valuable insights into how VREIT can enhance job interview outcomes and inform future platform development.

3.2. Methodological Approach

This study adopted a qualitative design case study methodology to examine the VREIT platform’s effectiveness in job interview training for autistic adults. The primary data collection methods included observations and interviews, which allowed for an in-depth exploration of the participants’ unique learning experiences and perceptions. Given the focus on non-statistical, subjective data, a qualitative approach was well-suited for capturing detailed insights beyond what quantitative methods could provide (Sechrest & Sidani, 1995; Smeyers, 2008; Yilmaz, 2013). Qualitative research enables a nuanced understanding of phenomena within natural settings, using open-ended, flexible methods to capture participants' individual perspectives (Creswell & Poth, 2016; Yilmaz, 2013).

The qualitative case study approach allowed for a focused examination of each participant's experience without comparing or generalizing findings. The case study methodology, widely used for its capacity to reveal complex issues within their real-life contexts, provided an ideal framework for understanding VREIT's impact on learner engagement and interaction (Crowe et al., 2011; Rashid et al., 2019). Influential theorists like Stake and Yin offer differing perspectives on case study research; Stake's approach focuses on understanding a single case's complexity, aligning with constructivist principles, while Yin's approach emphasizes objective data and generalizability (Yazan, 2015; Yin, 2009).

In parallel, the study incorporated Design-Based Research (DBR), a methodology that emphasizes iterative design and testing in real-world contexts. DBR is particularly effective for refining educational interventions, as it allows for iterative cycles of design, enactment, and analysis, enabling real-time adjustments based on participant feedback (Easterday et al., 2014; F. Wang & Hannafin, 2005). This iterative approach was essential for continuously improving VREIT based on user experience, ensuring the platform's relevance and efficacy for autistic users (Barab & Squire, 2004). Through multiple data sources—observations, interviews, and participant feedback—the study triangulated findings to enhance the intervention's validity and provide a comprehensive understanding of VREIT's potential impact on job interview readiness (T. Anderson & Shattuck, 2012; Dede, 2005).

The choice of a design case study methodology reflects the understanding that each autistic individual's learning journey is unique. Quantitative methods focused on statistical generalizations would have been insufficient to capture the complex, individual experiences that this study aimed to understand. Instead, a qualitative case study approach inspired by Stake's constructivist perspective was adopted, emphasizing the exploration of individual cases within their natural contexts. This approach supported the collection of rich, subjective data through observations and interviews, providing valuable insights into participants' engagement and learning experiences.

The iterative design and development of VREIT were also aligned with DBR principles, which promote a cyclical process of design, enactment, analysis, and redesign. This approach allowed for continuous improvement and adaptability based on real-world feedback, ensuring the platform met the unique needs of the participants. By

using DBR, the study refined the VREIT platform throughout, making it increasingly responsive to participant requirements.

In summary, the integration of qualitative case study methodology with DBR provided a comprehensive framework to investigate VREIT's potential in supporting autistic individuals' job interview skills. This approach enabled the capture of nuanced learning experiences, facilitated iterative refinement, and advanced understanding of how VR can enhance inclusivity and accessibility in educational and employment training contexts.

3.2.1. Investigation and data collection

In this design case study, data was gathered from two autistic participants: an autistic male animator working at an animation studio with a diploma in 3D Modeling, and an autistic female student enrolled in an animation diploma program at a Metro Vancouver university. Both participants engaged individually and were unaware of each other's participation.

The investigation began with initial interviews for each participant to understand their perceptions and experiences regarding job interviews and interview training. These interviews were audio-recorded for later analysis.

Following the initial interviews, both participants underwent job interview training using VREIT. Each session included a mock interview within VREIT, followed by feedback and discussion. To establish a baseline, participants first engaged in a non-VR, face-to-face mock interview before a brief orientation to the VREIT platform, after which training continued within the VR environment. The mock interviews were tailored for junior-level roles in the animation industry, aligning with each participant's background, with questions sourced from various job search platforms (Appendix D). Observations during each session captured details on participants' interactions, reactions, interest, and engagement with the live avatar and the VREIT environment.

Subsequent to the VREIT sessions, each participant took part in a realistic mock job interview conducted by an animation industry expert, allowing for observation of their job interview performance and skills post-training.

Finally, participants were interviewed again to discuss their engagement and experience using VREIT as a learning environment for job interviews. These interviews were also audio-recorded. The data from these interviews and observations formed the foundation for the analysis and findings presented in Chapter 5.

3.2.2. Research question

Previous research on job interview training for autistic individuals has primarily utilized virtual reality environments based on pre-recorded video clips with scripted content (Smith et al., 2022; Smith, Fleming, Wright, Roberts, et al., 2015; Smith, Jordan, et al., 2021; Ward & Esposito, 2019). In contrast, this study employed Unreal Engine to develop VREIT, a real-time, interactive VR environment, to explore how VR can support autistic individuals in job interviews and their professional lives. The primary research question guiding this design case study was:

"How can VREIT's design features enhance engagement and perceived learning experience for autistic users in job interview training?"

3.3. Context

In this portion of the dissertation, a description of autistic learners and their challenges during transitions between life stages is provided, along with an examination of the relationship to autistic learners.

3.3.1. Positionality

Teaching autistic students across various college programs has profoundly shaped my professional journey and personal growth, underscoring the importance of patience, adaptability, and recognizing each student’s unique strengths and challenges. This experience has solidified my belief in the need for individualized teaching strategies tailored to the diverse needs within the autism spectrum. Committed to understanding and meeting these varied needs, I continually seek to learn and innovate in my teaching approach.

Engaging with autistic learners has been a journey of empathy and understanding, teaching me the critical value of active listening. Witnessing their

achievements when provided with suitable support has strengthened my dedication to inclusive educational practices. This experience has not only enriched my role as an educator but has also deepened my commitment to fostering a society that fully values and includes autistic individuals.

3.3.2. Research context

Understanding the unique journey of autistic learners as they transition between life stages is crucial for developing effective support systems. These individuals often face distinct challenges that can impact their educational and social development (Baker-Ericzén et al., 2018; Leaf, 2017). The transition from adolescence to adulthood, for example, is a critical period where autistic learners must navigate changes in educational settings, social expectations, and personal independence (Baker-Ericzén et al., 2022; Dipeolu et al., 2014; Gillies, 2012) Educators, caregivers, and policymakers must recognize the specific needs and obstacles faced by autistic learners during these transitions.

One of the primary challenges is the shift in educational environments and the expectations associated with these changes (Dipeolu et al., 2014; Sanford et al., 2011). As autistic learners move from a structured school system into higher education or the workforce, they encounter new social norms and learning formats. This can be particularly daunting for those relying on routine and predictability to manage their daily lives. Additionally, the decrease in formal support systems as they age out of school-based services leaves a gap that must be addressed to ensure a smooth transition (Sanford et al., 2011; Smith, Sherwood, et al., 2021).

Social integration and developing independent living skills are also significant areas of concern as autistic learners struggle with social cues and communication, making it difficult to form relationships and navigate social settings (Lindsay et al., 2021; McKnight-Lizotte, 2018). This can lead to feelings of isolation and anxiety as they attempt to integrate into new communities (Leaf, 2017). Furthermore, the acquisition of life skills necessary for independent living, such as managing finances, household tasks, and personal care, requires tailored support (K. et al., 2011; Leaf, 2017).

Addressing these challenges requires a multifaceted approach that includes personalized education plans, transition programs that focus on life skills and social

integration, and ongoing support from a network of educators, therapists, and community organizations (Hedley et al., 2017; Johnson et al., 2020).

Chapter 4. VREIT – an Educational Technology

VR with its capacity for real-time immersive experiences, presents a significant opportunity for enhancing educational practices (Campos et al., 2022; Coban et al., 2022). However, to maximize the pedagogical efficacy of VR applications, careful consideration of both User Experience (UX) and User Interface (UI) design is paramount.

From a user experience (UX) standpoint, it is imperative to prioritize intuitive navigation and controls to reduce cognitive load and facilitate the seamless engagement of learners with educational content. Emphasizing user comfort by addressing virtual reality (VR) sickness and integrating accessibility features is essential to foster inclusivity in educational experiences (Bailenson et al., 2008; LaViola, 2000; Stephanidis, 2001). Personalized learning pathways, facilitated by adaptable difficulty levels and individualized feedback mechanisms, cater to diverse learning preferences and optimize individual progress (Parong & Mayer, 2018).

UI design in VR necessitates a spatial approach, where interface elements are seamlessly integrated within the virtual environment, maintaining a sense of immersion while providing clear visual cues for user interaction. A minimalist design philosophy, emphasizing essential information and avoiding visual clutter, is crucial for effective knowledge transfer (Tullis & Albert, 2013). Diegetic UI, which embeds interface elements within the virtual world narrative, further enhances user engagement and comprehension (All et al., 2021; De Gloria & Veltkamp, 2016).

Ultimately, the success of VR in education hinges on creating meaningful interactions that actively involve learners in the educational process. Clear learning objectives, coupled with engaging content that leverages the unique affordances of VR, contribute to a compelling and effective learning experience (Merchant et al., 2014). Incorporating social interaction features, such as shared virtual spaces and collaborative tools, further enriches the learning environment (Hew & Cheung, 2010, 2014; Liubchak et al., 2022). By meticulously addressing these UX/UI design considerations, VR applications can transcend the limitations of traditional educational approaches and unlock new frontiers in pedagogical innovation.

4.1. Design for users' accessibility

To maximize the educational benefits of VR for learners, accessibility must be a core design principle, that includes careful consideration of UX/UI elements such as intuitive navigation, personalized learning pathways, and clear visual hierarchies within the virtual environment (Bekele & Champion, 2019; Tullis & Albert, 2013). It is particularly crucial to create inclusive VR experiences for autistic individuals, who often exhibit heightened sensitivity to sensory stimuli like color contrast, brightness, and certain visual movements (Barahona Corrêa & van der Gaag, 2017; Feinstein, 2018). Over-stimulation from such factors can lead to sensory overload, hindering engagement and learning. Therefore, VR applications designed for accessibility features for neurodiverse learners must prioritize a calming and adaptable sensory experience.

4.1.1. Color

When designing digital applications with accessibility in mind, careful consideration of colour usage is paramount due to the unique sensory processing characteristics associated with neurodiverse learners, including ASD (Barahona Corrêa & van der Gaag, 2017; Bozgeyikli, 2016). Studies indicate that neurodiverse learners have preferences or aversions to certain colors, which can significantly impact their engagement and comfort with digital applications (Dörner et al., 2016; Rusakova, 2021).

Accessible design practices include using the contrast between the font and background to improve readability and employing soft, natural, and mild colours to create a calming visual environment. Additionally, reducing the brightness of colours and opting for solid colour backgrounds can help prevent sensory overload (Jones, 2021; Pun, 2016).

Conversely, designers should avoid using bright colours, as they can be overwhelming and distracting. Extreme colour contrasts should also be avoided to prevent visual discomfort. Furthermore, using multi-coloured icons is discouraged, as it can complicate the visual interface and hinder user interaction (Chung & Son, 2020; Gaines et al., 2016; Jones, 2021). These guidelines aim to create a more accessible and user-friendly experience for all users, including neurodiverse learners.

4.1.2. Typography

Neurodiverse learners may encounter difficulties processing written information presented in serif fonts. Therefore, they may benefit from reading information presented in sans-serif fonts. To enhance their reading abilities, it is advisable to use sans-serif fonts when providing written content to learners (Dogusoy et al., 2016; Fabri & Andrews, 2016; Marcus, 2016; Omar & Bidin, 2015).

Ensuring that text boxes are prominent and presenting text in a single-column format can further aid in readability. Plain English for written content, labels and call-to-actions, can significantly improve understanding and engagement (Gaines et al., 2016; Mostafa, 2021; Pun, 2016).

Designers should avoid overlapping transparent images with text, which can create visual confusion and hinder readability. Furthermore, complex language should be avoided to prevent misunderstandings and reduce cognitive overload, ensuring that the content remains accessible (Britto & Pizzolato, 2016; Patti, 2023).

4.1.3. Visuals and graphics

The significance of incorporating images and visual graphics into user interface design, especially for autistic users, cannot be overstressed. Visual aids, such as animated instructions, have been shown to enhance the comprehension and task completion rates among all users, significantly (Omar & Bidin, 2015). This is particularly relevant in the context of designing interfaces and instructional content for the neurodiverse population, who process information differently than neurotypical individuals and respond favourably to visual aids (Marcus, 2016).

By leveraging the strengths of visual processing commonly associated with autism, designers can create more accessible, intuitive, and supportive digital environments (Hadadi, 2018; Mazurek et al., 2015; Shane et al., 2012). Incorporating images and visual graphics, especially animations, into user interfaces designed for neurodiverse individuals can significantly improve their interaction with technology. This approach not only caters to these users' unique needs but also contributes to a more inclusive design philosophy that benefits a broader range of users by accommodating diverse learning preferences and processing styles. In designing and developing the

VREIT, visual aids and icons were used to complement the text in all interactions between the application and the autistic participant.

4.1.4. Interactions

Research findings demonstrate that the use of animated instructions significantly enhances task completion success rates, with individuals achieving a 100% success rate when utilizing animated guides (Promann et al., 2016; Spinillo, 2016; Yoshii & Nakajima, 2016). This starkly contrasts the success rates observed with alternative instructional methods, including pictographs, verbal instructions, and written directions (Dogusoy et al., 2016). This contrast underscores the effectiveness of animated visuals in conveying information more clearly and effectively to users (Spinillo, 2016; Yoshii & Nakajima, 2016). Moreover, the preference for animated instructions is further evidenced by the lack of repetition requests from users when engaging with animated content. This suggests that animated visuals enhance immediate task performance and reduce the need for additional support or clarification, fostering greater independence and confidence in users (Promann et al., 2016; Spinillo, 2016; Yoshii & Nakajima, 2016).

4.1.5. Navigation and pages

Designing navigation requires a nuanced understanding of users' unique needs and preferences. Neurodiverse individuals often experience challenges with sensory processing, social communication, and information processing, which can affect their interaction with digital interfaces (Christensen et al., 2018; Maenner et al., 2023; Thrower et al., 2020b). To create an effective navigation design for these users, it's essential to prioritize simplicity, consistency, and predictability in the layout and functionality of the interface (Promann et al., 2016; Qin et al., 2016).

The incorporation of symbols, coordinated colors, or unique landmarks has been observed to enhance navigation and facilitate efficient spatial orientation among neurodiverse individuals (Mostafa, 2008).Thus, implementing clear navigation strategies can significantly benefit autistic users and alleviate their spatial navigation challenges.

4.1.6. Designing intervention for autistic learners

Theory of mind (ToM) refers to the ability to attribute mental states—such as beliefs, intents, desires, emotions, and knowledge—to oneself and others and to understand that others that other people have stheir own thoughts, beliefs, and feelings that may be different from one's own. It is a crucial skill for social interaction, as it allows individuals to interpret the behaviour of others and to predict how they might act in different situations (Strickland et al., 2013). In the context of autistic learners, challenges with ToM are often observed, impacting their social interactions and communication (Frith & Happé, 1994). Autistic learners' difficulty with ToM, can impact their ability to understand social cues, engage in reciprocal conversations, and build relationships with others. They may also have difficulty understanding the perspectives of others, which can lead to misunderstandings and conflict (Ozonoff, Pennington, et al., 1991; Ozonoff & McEvoy, 1994; Strickland et al., 2013).

Despite the challenges that autistic learners may face with ToM, there is evidence that they can improve their ToM skills with explicit instruction and practice. VR can be a valuable tool for providing autistic learners with opportunities to practice ToM skills in a safe and controlled environment (Glaser et al., 2023; Lorenzo et al., 2023; Strickland et al., 2013).

In this study, the theory of mind is relevant because it can impact the ability of autistic learners to benefit from VR interventions such as VREIT. For instance, if an autistic learner is using VR to practice social skills, they may need explicit instruction on how to interpret the behaviour of the virtual characters (Barahona Corrêa & van der Gaag, 2017; Strickland et al., 2013). They may also need help understanding the perspectives of the virtual characters and how their own behaviour might be perceived by others (Lorenzo et al., 2023).

Three primary types of VRs are used in educational settings for autistic learners: desktop VR, immersive VR, and spherical video-based virtual reality (SVVR) (Glaser et al., 2023; Lorenzo et al., 2023). Desktop VR is the most used type in studies with autistic learners. It is also typically the least expensive and most straightforward to set up. Immersive VR offers a more engaging and realistic experience than desktop VR but can be more expensive and complex to set up. SVVR uses 360-degree video footage to

create an immersive environment. It is relatively easy to develop and is compatible with a wide range of devices, making it a more affordable option for educational settings. Each type of VR has its advantages and disadvantages, and the best type of VR for an autistic learner will depend on their individual needs and the specific goals of the intervention (Glaser et al., 2023; Lorenzo et al., 2023; Strickland et al., 2013).

In designing VR for autistic learners, there are several important considerations to keep in mind. While there are three main types identified in recent literature, Desktop, Immersive and SVVR, the type of VR most appropriate for individual learners should be identified (Glaser et al., 2023; Lorenzo et al., 2023). The objectives of the VR intervention are also important factors that determine the kind of VR platform and the design behind the VR application. Social skills and emotions are the most common VR intervention objectives for autistic learners. Other objectives may include attention, communication skills, and motor skills (Lorenzo et al., 2023).

The activities included in the intervention should be considered when designing a VR environment for autistic learners. Activities that target emotions should be designed to help autistic learners identify, understand, and express emotions in a socially appropriate manner (Lorenzo et al., 2023; Schmidt et al., 2024). Non-social activities can help autistic learners develop skills in areas such as attention, communication, and motor skills (HUMM et al., 2014; Lorenzo et al., 2023; Moon et al., 2023).

4.1.7. Sensory

Designing VR environments requires careful consideration of sensory factors to enhance learning experiences and accommodate individual needs. Autistic individuals especially often exhibit unique sensory processing patterns, which can significantly influence their interaction with VR environments.

One critical aspect is the preference for controlled and predictable settings, which VR can provide by allowing users to manage stimuli and engage in safe, yet challenging tasks (Newbutt et al., 2020). This control over the environment helps mitigate sensory overload and anxiety, common challenges for autistic individuals (Schmidt et al., 2019, 2024). VR environments should, therefore be customizable to adjust the complexity and intensity of sensory inputs, such as visual and auditory stimuli, to match the learner's comfort level (Bozgeyikli, 2016).

The integration of multiple sensory modalities is another important consideration. VR can offer interactive 3D simulations that incorporate visual and auditory elements, which can aid in the processing and integration of information (Schmidt et al., 2024). This multimodal approach can enhance germane processing, making learning more meaningful for autistic learners (Lorenzo et al., 2023; Moon et al., 2023; Newbutt et al., 2020).

Moreover, the design should account for the sensory preferences and potential sensitivities of autistic individuals. For instance, environments should avoid sudden or intense sensory inputs that could cause discomfort or distraction (Lorenzo et al., 2016). Instead, VR should provide a sensory experience that aligns with the learner's strengths, such as visual thinking patterns, to facilitate engagement and learning (Newbutt et al., 2016). Designing VR environments for autistic learners involves creating controlled, predictable, and customizable settings that cater to individual sensory preferences and needs. By integrating multiple sensory modalities and considering sensory sensitivities, VR can become a powerful tool for enhancing learning experiences especially for autistic individuals (Lorenzo et al., 2023; Moon et al., 2023; Schmidt et al., 2024).

4.1.8. User journey

Understanding the user journey is pivotal for creating intuitive and user-friendly interfaces when designing and developing a digital application. The user journey encompasses all user interactions with an application, from initial discovery to regular usage (Gürvardar et al., 2016). Designers must consider factors such as user goals, challenges, and the overall flow of interactions to ensure a seamless experience. This involves meticulous planning and testing to identify and address potential pain points within the application. Studies have shown that factors such as font type and layout can significantly impact user engagement and comprehension (Gürvardar et al., 2016; Rusakova, 2021). For instance, readability and the ease of locating information can affect the speed and accuracy with which users complete tasks, thereby influencing their overall journey within the application (Dogusoy et al., 2016).

To design effective digital applications, it is essential to employ a user-centred design approach, incorporating feedback-informed iterative design and usability testing to refine the user journey continually. Eye-tracking studies and other research methods

can provide insights into user behaviour, helping designers to optimize text presentation and navigational elements for enhanced readability and user engagement (Dogusoy et al., 2016; Endmann & Keßner, 2016; J. H. Lee et al., 2015). Understanding the environmental and psychological factors that influence user behaviour can improve digital application design (Augustin & Coleman, 2012; Hewett, 2005).

4.1.9. Personalization for accommodation

Personalization plays a critical role in designing for autistic users as it allows for the accommodation of the unique preferences and needs that can vary widely among individuals on the autism spectrum (Dörner et al., 2016; Hulusic & Pistoljevic, 2016). Tailoring user experiences to meet these specific requirements not only enhances accessibility but also ensures a more engaging and effective interaction with technology (Dörner et al., 2016; Hulusic & Pistoljevic, 2016; Shabihi & Taghiyareh, 2017). Personalization for accommodation can include adjustments in visual design, such as font type and size, color schemes, and layout, as well as in functionality, like customizable navigation or the ability to control sensory stimuli (Wouters, 2016). This approach is crucial for creating accessible designs for autistic individuals (Fabri & Andrews, 2016).

Due to differences in sensory levels, autistic users have a diverse range of likes and dislikes (Christensen et al., 2018; Maenner et al., 2023; Thrower et al., 2020b). For this reason, it's crucial to allow them personalization options to accommodate their preferences (Endmann & Keßner, 2016; Gaines et al., 2016). The successful user experience for autistic individuals heavily relies on personalization and accommodation as a crucial component that may include size and types of fonts, line spacing, brightness, and colors (Britto & Pizzolato, 2016; Fabri & Andrews, 2016; Pavlov, 2014).

Table 2. Guidelines and principles of design for autistic users (Appendix A)

UI/UX Element Category	Do	Don't
Colours	Use contrast between font and background. Use soft, natural, and mild colours. Reduce the brightness of colours. Use solid colour for background.	Use bright colours. Use extreme colour contrast. Use many-colored icons.
Typography	Use plain sans-serif font for readability. Make sure the text box is standout.	Overlap transparent images and text. Use complex language.

	Present text in a single column. Use plain English to increase readability	
Visuals and Graphics	Use simple graphics instead of abstract images. Keep consistent design patterns. Use Alt text. Use text along with pictures/graphics	Use background images. Overlap transparent images and text. Having elements that “stand out” too much.
Interactions	Design for simplicity and fewer elements Have one toolbar only. Use clear and large buttons with icons and text. Use clear CTAs. Give short instructions of use at every step. Default to sound off.	Consist of cluttered interface. Buttons with icons only Having unexpected pop-ups. Having default auto-play videos.
Navigation and Pages	Strive for simple and clear navigation. Indicate on each page clearly where the user is. Support navigation with mouse or keyboard. Pages should load fast. Use visual indicators for time-consuming actions. Have a help button.	Use complex menus. Horizontal scrolling. Use pop-up elements and distractions.
User Journey	Allow time for users to finish the process Use precise content and simplify the text. Build simple and consistent layouts. Use simple sentences and bullets. Make logging in as easy as possible. Provide broader accessibility support (Autistic users often use captions on videos or text-to-speech for accessibility)	Use timer/countdown. Implement animated elements Use complex language. Use figures of speech, idioms, or jargon. Use large walls of text.

4.2. Design and development of VREIT

Following the preliminary design investigation and general UI/UX design principles, priority was given to autistic users and their preferences and sensitivities. Additionally, emphasis was placed on addressing their needs for personalization and control over the environment (Bozgeyikli, 2016; Mazurek et al., 2015) in designing VREIT. Hence, while using VREIT, the participants could customize elements such as light brightness, colour contrast, and sound. They can also select the virtual location and appearance of their coach's avatar from a provided selection during training.

4.2.1. Design of VREIT

In designing VREIT, UX design principles were followed, prioritizing intuitive navigation, personalization, and accessibility. These elements are crucial for enhancing user experience, especially for autistic users (Endmann & Keßner, 2016; J. H. Lee et al., 2015). The platform allows users to customize elements such as light brightness, colour contrast, and sound, catering to individual preferences and sensitivities. This personalization ensures that users can adjust the environment to their comfort, reducing cognitive load and enhancing engagement (Fabri & Andrews, 2016). The video example of VREIT at the end of the chapter provides an example of user workflow and process from launching the program to creating a session and interacting with the coach's avatar.

A minimalist design approach was followed, using soft, natural colours and sans-serif fonts to improve readability and reduce visual fatigue. Moreover, icons and visual cues were designed to aid navigation, making the interface intuitive and user-friendly, that also contributes to improved user experience. Consistent design patterns across the application further enhance usability by allowing users to apply learned interactions throughout the platform (Bekele & Champion, 2019; Britto & Pizzolato, 2016).

As an educational technology platform, VREIT is designed to provide a real-time, immersive and interactive learning experience. For this specific study, VREIT provides the learning experience by simulating real-life job interview scenarios for the two participants. This environment enables users to practice and refine their interviewing skills in a controlled, realistic setting. Life-like avatars and real-time facial expression mirroring facilitate genuine interaction, helping users better prepare for real-world interviews. By integrating social interaction features, live coaches, and personalized learning, VREIT supports diverse learning preferences and optimizes individual progress, ultimately aiming to improve job interview outcomes for autistic individuals.

The main idea behind creating VREIT was to facilitate job interview training centred around providing coaching and training through immersive, interactive environments that simulate real-life interview scenarios. This approach allows autistic users to practice and hone their interviewing skills in a controlled, comfortable, safe, and yet realistic setting. When creating the user interface (UI) for VREIT, findings from

design research were considered. Several key criteria were incorporated to ensure an optimal user experience, particularly for autistic users.

Contrast and colour selection: The design places a strong emphasis on the contrast between the font and the background. This is achieved by using soft, natural, and mild colors that are easy on the eyes and reduce visual fatigue. The color palette has been carefully chosen to ensure that the text is easily readable against the background, thereby improving the overall legibility and accessibility of the application.

Typography: Plain sans-serif fonts are known for their readability and clean lines. In designing VREIT, these fonts are presented in standout text boxes to draw attention to important information and enhance the overall user experience. The lack of decorative flourishes in sans-serif fonts contributes to a clean and uncluttered visual aesthetic.

Figure 3. VREIT (previously JIPVRP) SplashScreen and Main Menu snapshots.

Icons and Visual Cues: Icons were incorporated for buttons and other call-to-action elements to enhance the user interface. These visual cues are intuitive and universally recognizable, aiding in navigation and usability (A. Anderson, 2019; De Gloria & Veltkamp, 2016; Dörner et al., 2016). They provide a visual shorthand that speeds up the process of understanding the interface, making the application more user-friendly.

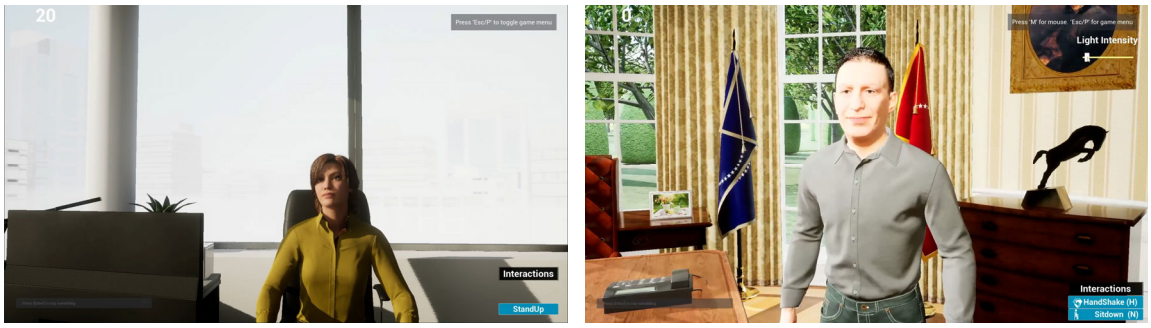

Figure 4. VREIT environment interaction UI

Consistent Design Pattern: Consistency in the design of the VREIT application is emphasized through a coherent design pattern across all sections and pages, utilizing simple graphics and layouts. This consistency enhances the application's usability, allowing users to apply knowledge gained in one area to others, making it easier to understand and navigate.

Figure 5. Flow of the menus in VREIT.

User Interface (UI) Controls for Autistic Users: The application includes UI controls that enable users to adjust the UI environment according to their needs and preferences. These controls offer options for changing contrast, brightness, and font size. This feature acknowledges the diverse needs of the user base and ensures that the application is accessible and usable for all, promoting inclusivity in design.

Figure 6. Light intensity control UI.

The VREIT application was designed with principles of accessibility, usability, and inclusivity in mind. Each design decision focused on the needs of users, especially autistic learners, to make the VREIT learning environment functional and user-friendly. This approach aligns with the overarching goal of creating an immersive and interactive VR environment to facilitate training and coaching sessions for the two autistic participants in the context of job interview training.

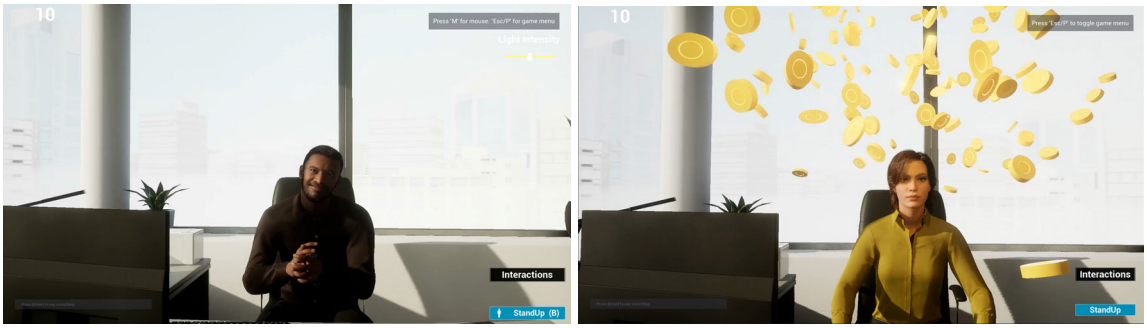

Figure 7. Score and Reward feedback system.

4.2.2. Development

Considering job interview training for autistic people, most existing platforms rely heavily on scripted and pre-rendered videos and text prompts and no live interaction

between an actual coach and the learner (S. L. Burke et al., 2018, 2021; Smith et al., 2014, 2022; Stanica et al., 2018) Recognizing the limitations of this approach, for the purpose of this study a fully 3D virtual reality environment was created to facilitate live interaction between the human coach and autistic participants. This represents a significant departure from previous methods and provides a more dynamic and responsive training experience.

Game Engine: To design and develop this immersive virtual reality environment, Unreal Engine 5.2, developed and published by Epic Games, was utilized.[5] This powerful game engine enables the creation of a realistic and engaging virtual space where users can interact in real time.

Realistic Avatars: The latest technology from Epic Games, the Metahuman Creator, allows for the creation of photorealistic avatars. This tool enables highly realistic and detailed human avatars, enhancing the immersive experience of the virtual reality environment.

Facial Expression and Animation: While Unreal Engine already provided the Livelink tool for capturing and recording facial animation, a live-streaming connection was specially developed between the Livelink tool and Metahuman avatars to allow live streaming of head movement and facial expression in real-time, adding another layer of realism to the virtual interactions.

Voice Communication: Recognizing the importance of clear and immediate feedback during training sessions with VREIT, a real-time voice communication feature was developed and incorporated. This option allows the coach and the learner to interact and talk as if they were in the same room, despite being in a virtual environment. Utilizing Unreal Engine's communication tools, a dedicated voice communication channel was created for clear live voice interaction, ensuring minimal latency and a smooth, effective training experience.

Network Connectivity: regardless of the location of trainer and learner, to use VREIT, a network connection (wireless or wired) is required to establish and run virtual reality

[5] An American video game and software developer and publisher established in 1991 which is famous for developing and providing the Unreal Game Engine for developers, learners, and hobbyists along with well-known games such as Unreal Tournament and Fortnite.

sessions. To ensure smooth connectivity between the trainer and the autistic learner, the Epic Online Services (EOS) subsystem was utilized. An easy method was developed to start a session, facilitating a seamless connection between the two user ends and eliminating the need for a specialized network setup.

4.2.3. Features

The development of the VREIT application incorporated several innovative features to enhance the training and coaching experience for autistic learners.

True Facial Expression in Run-Time: One of the key features implemented in VREIT is the ability to display true facial expressions in real-time (lip sync, eye movement, cheeks and mouth, facial wrinkles). This feature allows for a more authentic and engaging interaction between the coach and the learner. It provides the autistic learner with valuable non-verbal cues crucial in understanding and responding appropriately during job interviews (S. L. Burke et al., 2018; Smith et al., 2014; Smith, Sherwood, et al., 2021).

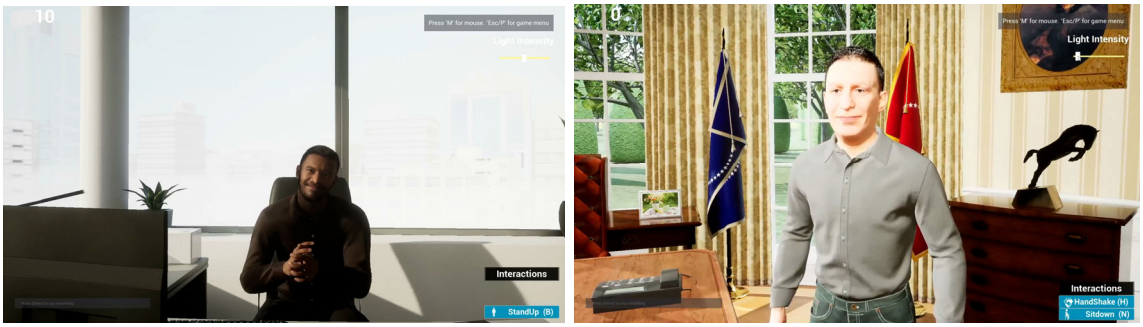

Figure 8. real-time facial expression streaming.

Customizable Interface: Within the user interface of VREIT, UI controls were placed to allow autistic learners to adjust the UI environment according to their comfort and preferences. This feature acknowledges the diverse sensory needs of autistic individuals and ensures that the application is accessible and comfortable (De Gloria & Veltkamp, 2016; Heflin & Hess, 2007; Iovannone et al., 2003).

Choice of Avatar: The application allows the learner to choose the avatar representing the coach. This feature provides a sense of control and familiarity to the autistic learner, which can reduce anxiety and enhance the learning experience (Politis et al., 2017; Walker, 2015).

Choice of Virtual Environment: VREIT allows the learner to choose the virtual environment for the sessions. The choice of environment can make the training more engaging and relatable, whether it is a typical office, a futuristic organization, a spaceship, or even the Oval Office. This feature can help autistic learners to familiarize themselves with various workplace environments, thereby reducing anxiety and improving their performance in actual job interviews (Ahmed et al., 2020a).

Choice in Mode of Interaction: Recognizing the diverse technological preferences and accessibility needs of users, VREIT supports both VR headset-based interaction and traditional screen-based interaction. Users with VR headsets can experience a heightened sense of immersion and presence in the virtual environment, while those who prefer or require screen-based interaction can still benefit from the platform's interactive features and realistic simulations (Newbutt et al., 2020).

Furthermore, for screen-based interaction, VREIT offers users the flexibility to choose their preferred mode of interaction, catering to individual comfort and learning preferences. When inside VREIT, users can opt for a first-person perspective, immersing themselves fully into the virtual environment and experiencing the interview scenario from the interviewee's perspective. Alternatively, users can choose a third-person perspective to observe the interaction between the two avatars, the trainer and the trainee. This may create a sense of detachment and help reduce anxiety for those who find first-person immersion overwhelming (Gallagher, 2005; Pira et al., 2023).

These choices for modes of interaction ensure that VREIT remains accessible to a wide range of users, regardless of their technological access or comfort levels with virtual environment VR technology.

Choice in Mode of Navigating Virtual Environment: VREIT offers users multiple ways to navigate the virtual environment, catering to different preferences and interaction modes. When using VREIT with a VR headset, users can physically move within their real-world space to navigate the virtual environment, mirroring natural movement and interaction (G. C. Burdea & Coiffet, 2024; Newbutt et al., 2020).

Alternatively, whether using VR goggles or screens, users can choose to navigate VREIT environment using a keyboard and mouse, which provides a more traditional and potentially less disorienting control method, particularly for those who may

be new to VR or prefer a more structured approach. This choice in navigation options allows users to tailor their experience to their comfort levels and preferences, ensuring accessibility and ease of use for a wide range of individuals (Bozgeyikli et al., 2018; Michalski et al., 2021; Newbutt et al., 2020).

To further enhance user interaction and provide a more immersive experience, VREIT allows users to engage with certain 3D props within the virtual environment. For instance, users can interact with their chair by moving it to a desired spot and sitting in it, replicating a natural action that might occur in a real-world interview scenario. This feature promotes a sense of presence and realism, allowing users to practice interview skills in a more engaging and authentic setting (Ahmed et al., 2020b; slater et al., 2024).

Choice of Light Intensity: The VREIT also allows for adjusting the light intensity in the virtual environment. This feature caters to the sensory sensitivities of autistic individuals, allowing them to create a comfortable and conducive learning environment (De Gloria & Veltkamp, 2016; Heflin & Hess, 2007; Iovannone et al., 2003).

Live Voice Communication: A live voice communication feature was implemented to enhance the realism of the virtual environment, allowing for immediate, dynamic feedback during training sessions. This real-time interaction further enhances the learning experience and allows for immediate correction and reinforcement benefiting autistic learner (Iovannone et al., 2003; Leaf, 2017; Venkatesh et al., 2012).

4.2.4. Testing and deployment

Before deploying the VREIT application with participants, ensuring its functionality and robustness was essential. The testing and deployment process, conducted in iterative cycles lasting four to five weeks, played a vital role in establishing the platform's reliability and potential effectiveness in the study.

The initial testing phase focused on a comprehensive evaluation of the platform’s workflow. Five testers were recruited through LinkedIn to independently navigate the application, moving from accessing the main menu to starting, engaging in, and concluding sessions. This rigorous workflow testing aimed to identify any potential bottlenecks or usability issues that could impact the user experience.

Following workflow testing, these testers assessed each of VREIT's features, including live streaming of facial animations, interface customization, avatar and location selection, light adjustment, and live voice chat. Each feature was tested individually and in combination with others to ensure seamless integration and optimal functionality.

After each testing phase, identified bugs were addressed, followed by retesting to confirm the fixes. This iterative process of testing, debugging, and retesting was instrumental in refining the platform's stability and enhancing its performance. The development of VREIT was completed in September 2024, marking a significant milestone in this research journey. Based on feedback, VREIT met the required standards for functionality and user-friendliness, making it ready for research use.

VREIT is a standalone Windows application, designed to run 'out of the box' without the need for a separate installation, thereby simplifying deployment and enhancing accessibility. A short, narrated video linked below provides an overview of the VREIT user workflow from the learner's perspective. This video, based on the earliest version of VREIT, serves as a visual supplement to the descriptions and analyses presented in this dissertation, showcasing the platform's functionalities, user interface, and real-world applications.

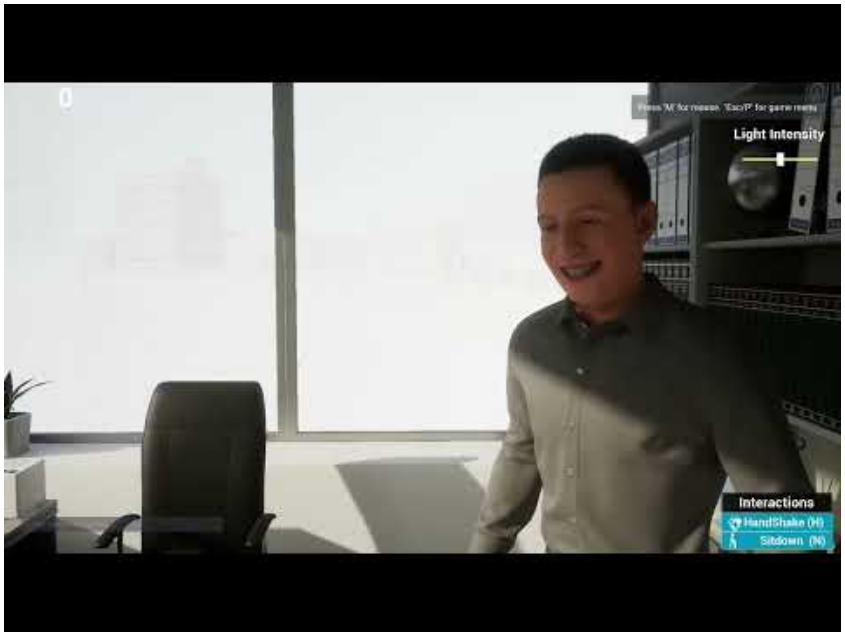

Figure 9. **Ramin Shadmehr (2024, July 14). VREIT User workflow. https://youtu.be/zyf9ebBA-wk**

Chapter 5. Implementation and Evaluation

5.1. Methods

5.1.1. Recruitment and participants' description

This study provides insight into the practicality of VREIT for autistic adults, which could lead to further studies on larger sample sizes. In this design case study, one female and one male participant were observed using VREIT for learning and practicing job interviews. They were also interviewed to share their experience using the platform.

5.1.2. Participants

When investigating a learning intervention for autistic individuals, including both male and female participants is essential. Research indicates that autism spectrum disorder (ASD) often presents differently across genders, with autistic females frequently exhibiting less noticeable signs than males (Halladay et al., 2015; Lai et al., 2015). From an ethical perspective, ensuring equal participation opportunities across genders supports generalizability and enhances the external validity of the study, enabling broader application of results (Cook & Campbell, 2002; Mastroianni et al., 1994). Including both genders also aids in understanding potential gender-specific responses to the intervention, which could inform the development of tailored strategies for learning support among autistic individuals (Dean et al., 2017). This approach allows for a more comprehensive understanding of how virtual reality-based video modeling affects individuals across the gender spectrum.

This study aimed to explore autistic participants' perceptions of job interviews and training in a real-time VR environment featuring a human coach. Participants were selected based on current or prior experience with job interview training, along with actual interview experiences. The inclusion criteria required participants to be diagnosed with autism, aged 20 to 34 (Statistics Canada, 2017), and either students or graduates of post-secondary programs from public or private institutions. All participants needed to possess basic computer literacy and be comfortable with virtual environments, which was essential given the study's focus on virtual reality-based learning.

Recruiting the participants:

Between 2010 and 2019, teaching in a 3D modeling and technical arts program at a public post-secondary institution provided a unique opportunity to discuss aspirations with students, particularly a Ph.D. goal focused on developing training methodologies for autistic adults. This topic struck a chord with many students, especially those who voluntarily disclosed their autism status through the college's Disability Resource Center. Their enthusiastic support and desire to participate in future studies provided early encouragement for this research. Over time, these students maintained contact, offering continued interest and encouraging further communication when research began. By 2023, these students had graduated, and after discussing the study's objectives and significance, one alum expressed interest in participating.

Additional participants were recruited through university connections, with a colleague introducing a daughter interested in the research. Recruitment adhered to the university's Ethical Review Board guidelines, as well as the British Columbia Freedom of Information and Privacy Act (2014) and Canadian Anti-Spam Legislation (2014). Each recruitment email contained an informed consent form, ensuring participants clearly understood the study's scope, role expectations, and rights as contributors.

Both participants in the study were autistic adults, a group often considered vulnerable due to challenges in navigating social complexities (Christensen et al., 2018; Maenner et al., 2023). Yet, research indicates that autistic adults often approach decision-making with deliberate and reasoned consideration, less affected by certain biases, such as the sunk cost fallacy, than their neurotypical peers (Hartman & Hartman, 2024; Lindsay et al., 2021). High-functioning autistic adults, specifically, are typically capable of making well-informed decisions about research participation, provided the information is accessible and tailored to meet their needs (Lindsay et al., 2021).

Participant 1, John, a 33-year-old Senior Modeler/Texture Artist, brought eight years of experience in the film and animation industry, having graduated from a one-year 3D modeling and animation program at a public college in British Columbia. John's current role in an animation studio added relevance to the study by offering insights into the challenges autistic individuals encounter in job interviews. His firsthand accounts helped to ground the study's findings in real-world applications, ensuring alignment with actual industry expectations.

Participant 2, Jane, a 20-year-old student in her second year of a 2D animation diploma program at a public university in British Columbia, provided a timely perspective, being on the cusp of transitioning from education to employment. As an autistic woman in a creative industry that increasingly values diversity and inclusion, her insights shed light on how job interview training could be tailored to meet the unique needs of autistic individuals. Including her perspective, she addressed a significant research gap, providing a deeper understanding of how autism manifests across genders and enhancing the inclusivity of the study.

Jane's participation also underscored broader societal efforts to increase diversity and inclusion within educational and professional settings. Her involvement enriched the study, emphasizing the importance of creating accessible solutions for a diverse user base. This inclusive approach not only enhanced the study's quality and relevance but also supported the development of technology that meets the needs of a wide range of users, reinforcing the value of inclusivity in educational research.

Ethical considerations:

Simon Fraser University follows the Tri-Council Policy Statement (TCPS 2) of 2014 regarding Ethical Conduct for Research Involving Humans. The university's Research Ethics Board approves research proposals that include recruitment strategies, data gathering methods and tools, confidentiality maintenance methods for participants, voluntary participation, potential distress, or harm to participants, as well as the ways in which the research data may be used in reports, presentations, and other forms of dissemination. The research proposal, processes, and reporting comply with university policies aligning with TCPS 2. The ethics approval statement is included in Appendix E of this dissertation document.

Informed Consent, participation and right to withdraw:

The informed consent document (provided in Appendix B) is a crucial document that outlines the purpose of the research, what is expected of the participants, how their data will be used, and their rights during and after participation. This document also provides participants with contact information for the principal researcher, supervisors, and university personnel, who can be contacted in case of questions or complaints in a confidential manner. Participants were informed in writing in the informed consent

document as well as in person before the interview that they could choose to skip any question that they did not wish to answer. Participation in this study was completely voluntary, and participants were informed that they had the option to quit the interview or withdraw their participation at any time during or after the interview without facing any negative consequences.

Personal and professional ethics:

During this study, a strict ethical framework was adhered to, guiding the research and writing processes in alignment with the Research Ethics Board and TCPS2. Emphasizing integrity, transparency, and accountability in all academic endeavors was crucial. A commitment was made to conduct the work with the utmost honesty, avoiding any form of plagiarism or misrepresentation of data. All sources and references that informed the research were diligently cited.

Furthermore, there is a deep commitment to fairness, emphasizing balanced presentation of all findings and arguments without bias or favoritism towards any viewpoint. Understanding the impact research can have on the broader community is essential, and efforts are made to ensure that the work contributes positively to the field of study. Additionally, all actions are taken to respect the confidentiality and privacy of participants in the research. In accordance with ethical research practices, all necessary consents have been obtained, and steps are implemented to protect individuals' identities and personal information.

5.1.3. Procedures and apparatus

This study aimed to learn about the participants' experience using VREIT as a platform to receive training and improve job interview skills. To accomplish this goal, participants went through the following steps:

- Engaged in an initial, in-person interview to share perceptions of job interviews and training (see Appendix C).John completed nine VREIT sessions, and Jane completed seven.
- Approximately two-thirds of these sessions were conducted in person, with the remainder held online:

    - For John, in-person sessions took place at his apartment using his computer, while the researcher used a laptop. Online sessions were also held in his apartment.
    - For Jane, in-person sessions were held at her school office, where she used the office computer, and the researcher used a laptop. Jane attended online sessions from home. Participants received all necessary technology and equipment to facilitate VREIT interaction.
- Throughout each VREIT session, the researcher observed participants, noting their interactions with the environment and trainer's avatar.
- After completing VREIT sessions, each participant took part in a final, non-VREIT mock interview conducted on Zoom and audio-recorded.
- Following this mock interview, each participant was interviewed separately to revisit their perceptions of job interviews and training, with additional questions focused on their VREIT experience (see Appendix C).

5.1.4. Data analysis

This qualitative case study employed thematic analysis to achieve a detailed understanding of each participant's unique experiences and perceptions without direct comparisons, as such comparisons were not feasible. Thematic analysis facilitated the identification, analysis, and reporting of patterns (themes) within the data, enabling an individualized exploration of the participants' experiences and perceptions (Boling, 2021; Herrington & Oliver, 2000). Additionally, narrative analysis complemented this approach, particularly with the use of pre- and post-intervention interviews, as it emphasizes how participants construct meaning through their shared stories (Boling, 2021; Herrington & Oliver, 2000; Tennyson et al., 1992).

5.1.5. Observation

During the observation of the VREIT sessions for each participant, notes were taken to capture highlights and noticeable elements in each session. The approach focused on logging qualitative aspects of the participants' engagement, interactions, and perception of experience during the job interview training in the VREIT. Attention was paid to their interaction, behaviours, engagement, verbal and non-verbal responses to questions. These observations provided a rich qualitative and subjective dataset,

offering insights into the participants' perceptions of experience experiences, challenges, and successes throughout the training sessions within the VREIT environment.

A coding table (Table 2) was developed to streamline the observation process and make the analysis more efficient post-observations, based on the Mock Interview Rating System (Sherwood & Smith, 2023) and several other studies on virtual interview training for autistic individuals (Bozgeyikli et al., 2018; S. L. Burke et al., 2018, 2021; Smith et al., 2017, 2023). In this table, expected interactions and behaviour are categorized to facilitate the observation of participants' engagement and perceived experience, allowing for easier referencing of specific moments or patterns during the data analysis phase. It was important to note any anomalies or unexpected occurrences, as these could indicate significant factors influencing participants' interactions with the VREIT that might not be immediately apparent. The existing literature reviewed on interview training for autistic adults suggests that each category in Table 2 aims to define what interactions and behaviours should be noted and assessed.

Engagement level: In the context of job interviews and employment training programs. this refers to the degree to which participants are actively involved and responsive during the interview process. Higher levels are characterized by participants being fully engaged, consistently conversational, and providing detailed and applicable responses (Baker-Ericzén et al., 2022; Dudley et al., 2015; Flower et al., 2019; Sherwood & Smith, 2023). Conversely, lower levels are marked by disengagement, lack of conversational behaviour, and short, repetitive, or uninformative responses (Dudley et al., 2015). For instance, one can assess engagement on a scale where higher scores indicate a higher level of engagement, reflecting behaviours like maintaining focus and responding appropriately to questions (Sherwood & Smith, 2023).

Confidence level: In the context of job interviews, particularly for autistic individuals, confidence is a multifaceted construct that encompasses verbal and nonverbal indicators of comfort and self-assurance throughout the interview process. High confidence is characterized by a relaxed demeanour, minimal fidgeting, clear thought, complete answers, and frequently offering examples to support responses (Baker-Ericzén et al., 2018, 2022; Lynas, 2014). Conversely, low confidence is marked by signs of anxiety, such as constant fidgeting, frequent loss of train of thought, and incomplete answers that require follow-up clarification (Sherwood & Smith, 2023; Smith et al., 2023). The

assessment of confidence is crucial, as it directly impacts the likelihood of being hired, with coders evaluating this trait using a seven-point Likert scale during mock interviews (Smith, Sherwood, et al., 2021).

Conversation framing (positive / Negative): Framing conversation involves structuring dialogue in a way that enhances understanding and engagement. This technique is particularly useful in educational and training contexts, where clear communication is essential for effective learning (Baker-Ericzén et al., 2018, 2022; Sherwood & Smith, 2023). Positive framing in conversation involves presenting information in a way that highlights the beneficial aspects and lessons learned from past experiences (Sherwood & Smith, 2023). This approach emphasizes flexibility, adaptability, and a positive mindset. As defined in the Autism Mock Interview Scoring Manual (2023) sharing multiple examples of being adaptable and reframing prior experiences in a positive light can significantly enhance one's perceived positivity. Negative framing involves focusing on the adverse aspects of past experiences, highlighting inflexibility, and presenting situations in a negative manner (Sherwood & Smith, 2023).

Professionalism: A manner in which individuals conduct themselves in a work environment, reflecting respect, politeness, and a focus on work-related topics constitutes professional behaviour (Baker-Ericzén et al., 2022; Sherwood & Smith, 2023). High levels of professionalism is characterized by consistently providing specific work-related responses, maintaining politeness throughout interactions, avoiding inappropriate topics, and disclosing personal information in a productive manner (Baker-Ericzén et al., 2018, 2022; Sherwood & Smith, 2023). Professionalism is crucial in the employability of autistic individuals as it helps them navigate social expectations and workplace norms, thereby enhancing their employability and integration into the workforce (Spoor et al., 2021). The ability to exhibit professional behaviour can significantly impact the perceptions of non-autistic employees and supervisors, influencing their willingness to provide support and accommodations (Spoor et al., 2021).

Level of interest: According to the Mock Interview Scoring Manual (2023), level of interest in a job interview context is primarily assessed by evaluating the participant's enthusiasm and engagement with the position being discussed. Higher scores in this category reflect participants who ask several thoughtful questions, reflect on job duties,

and consider how their personal strengths can be applied to these duties (Baker-Ericzén et al., 2018; Capo, 2001; Sherwood & Smith, 2023). Alternatively, a lack of enthusiasm, minimal or irrelevant questions, and a disregard for follow-up details lead to lower scores based on the interview scoring manual (Sherwood & Smith, 2023).

Honesty and transparency: In various contexts, particularly in professional settings, honesty and transparency are critical attributes, where honesty refers to the quality of being truthful, sincere, and free from deceit or fraud (Capo, 2001; Sherwood & Smith, 2023). It involves presenting oneself as trustworthy, providing clear, consistent, and well-articulated answers, and adhering to ethical practices, such as reporting theft and following policies (Sherwood & Smith, 2023). Transparency, on the other hand, involves openness and clarity in communication, ensuring that all relevant information is disclosed in an appropriate and productive manner, avoiding the discussion of inappropriate topics, and maintaining a professional demeanor (EARN, 2020; Sherwood & Smith, 2023). These qualities are essential for fostering trust and integrity in interpersonal and professional relationships.

Dependable and trustworthiness: Dependability refers to the quality of being reliable and consistent in fulfilling one's duties and responsibilities. It involves being punctual, staying on task, prioritizing work, and demonstrating a strong work ethic through specific examples of efficiency and self-motivation (Baker-Ericzén et al., 2018, 2022; Sherwood & Smith, 2023). Another quality is trustworthiness which includes being honest and ethical, presenting oneself as believable with clear, consistent, and well-articulated answers. It includes making statements about ethical work practices with examples, not providing contradictory answers, and adhering to rules (Sherwood & Smith, 2023).

Interest in collaboration and working with others: Collaborative behaviour and working as part of a team is the ability of an individual to effectively engage and cooperate with colleagues, supervisors, and clients to achieve common goals (Baker-Ericzén et al., 2018; Hedley et al., 2017; Sherwood & Smith, 2023). Based on the mock interview scoring manual (2023), this skill is assessed by evaluating whether the participant demonstrates ease in working within a team setting, takes direction well, and maintains positive interactions with others. High scores in this area are given to individuals who provide convincing examples of teamwork, conflict resolution, and flexibility in their interactions. Additionally, the ability to work well with others is crucial for

functional outcomes, as it involves understanding social cues, perspective-taking, and social communication, which are essential for successful vocational integration (Baker-Ericzén et al., 2022; Sherwood & Smith, 2023).

Sharing of skills, strengths, and weaknesses: When it comes to job interviews, sharing details on the ability to be successful in the role is an essential skill for all job interviewees, including those with ASD. Sharing skills, strengths, and weaknesses is the ability of a participant to effectively communicate their competencies, positive attributes, and areas for improvement during an interview (Sherwood & Smith, 2023). This involves providing multiple examples of their strengths and skills, detailing how these have been applied in various settings such as work, school, or home, explicitly stating career goals, and discussing their strengths in action and how they have overcome past limitations, handled stress, and demonstrated resilience (Baker-Ericzén et al., 2022; Sherwood & Smith, 2023).

Sharing past experiences: In the context of job interview skills development, sharing past experiences refers to the ability of a participant to effectively communicate their previous responsibilities and experiences in a manner that is relevant to the job they are applying for (Baker-Ericzén et al., 2022; Sherwood & Smith, 2023). This involves providing multiple examples of past experiences with a positive frame, detailing previous responsibilities at home, work, or school, and discussing interactions with previous teachers or supervisors in detail. Participants who excel in this area are able to draw clear connections between their past experiences and how these experiences will inform their work in the prospective job, thereby demonstrating their suitability for the role (Baker-Ericzén et al., 2022; Sherwood & Smith, 2023).

Sharing beyond known characteristic limitations: Interviewees' ability to effectively communicate their personal growth and resilience by discussing past challenges and how they have been overcome is an essential skill for a successful job interview. This involves providing multiple examples of handling difficult situations, managing stress, and demonstrating perseverance (Sherwood & Smith, 2023). Participants who excel in this area share specific instances where they have worked on personal improvements and successfully navigated stressful or challenging circumstances, thereby showcasing their adaptability and problem-solving skills (Sherwood & Smith, 2023). This skill is crucial as it highlights the individual's capacity to learn from past experiences and apply

those lessons to future job roles, making them more attractive to potential employers (Baker-Ericzén et al., 2022; Sherwood & Smith, 2023).

In this study, it was crucial to use the criteria provided in the Mock Interview Scoring Manual (2023) to evaluate participants' interview skills as these criteria offered a structured and standardized approach to assessment. The criteria in this manual were used in several previous publications that studied job interview training approaches for autistic individuals (Smith et al., 2014, 2017, 2020; Smith, Fleming, Wright, Losh, et al., 2015; Smith, Sherwood, et al., 2021). Moreover, the psychometric properties analysis of this scoring scale (2023) indicates it may have utility as a reliable and valid method for assessing the job interview skills of autistic individuals in a transition stage (Smith et al., 2023). By employing the criteria provided in this scoring manual, each participant's engagement and interaction were observed and evaluated consistently across various dimensions such as confidence, professionalism, and the ability to share past experiences and strengths. This consistency is vital for maintaining the reliability and validity of the research findings, as it minimizes subjective biases that could arise from different raters interpreting performance in varied ways. Having these criteria in the observation table allowed for noting specific interactions and engagements critical in learning for the participants, providing a more streamlined approach to comparing observation of participants across sessions.

Table 3. Categories of notables in observations

Observable Interaction and Behaviour	Observation notes and comments
Participant engagement level	
Confidence level	
Conversation framing (positive / Negative)	
Professionalism	
Level of interest	
Honesty and transparency	
Dependable and trustworthiness	
Interest in collaboration and working with others	
Sharing (skills, strengths, and weaknesses)	
Sharing past experiences	
Sharing beyond known characteristic limitations	
Others / Anomalies	

5.1.6. Interview recordings & transcripts

An interview protocol was developed to capture and analyze participants' perceptions of job interviews and job interview training, utilized before and after VREIT training sessions (Appendix C). In this research, audio recordings from interviews with participants played a pivotal role in the data analysis process. The interviews provided firsthand insights and experiences that were central to the study. To ensure a thorough analysis, each session was recorded to capture any nuances and inflections in the participants' voices, which often convey as much meaning as their words.

For transcription, Microsoft Word's Dictate feature was utilized to convert audio recordings into written text efficiently and accurately. The tool's design, which deletes audio files immediately after transcription and refrains from any third-party sharing (Microsoft, 2024), ensured participant privacy and data security. By converting the audio into searchable text, the transcriptions facilitated systematic coding, making it easier to identify themes, patterns, and key concepts within the interview data.

These transcriptions became a cornerstone of the data analysis, serving as a primary resource from which detailed insights were drawn. Through examining participants' responses, the analysis unpacked their perceptions, building a nuanced understanding based on their lived experiences. Integrating audio recordings and textual data, the study gained a comprehensive perspective on participants' engagement with job interview training, rooted in authentic, qualitative evidence.

5.1.7. Data collection and analysis

A comprehensive data analysis approach was undertaken to assess VREIT's impact on the engagement of two autistic participants and their perceived experience using VREIT for job interview training. This approach focuses on capturing the subtleties of their interactions within the technology and any changes in their perceptions of experience and engagement.

Baseline Perceptions: Initial (pre-VREIT) interviews were conducted to establish each participant's baseline perception of their interview experience and skills. Following the VREIT sessions, post-interviews were held to identify any shifts in participants' views regarding VREIT as a tool for learning and practice. Through this

simulated environment, participants could engage in realistic interview scenarios to develop and refine their skills.

Comparative Analysis: By analyzing pre- and post-interview data, the study captured participants' feedback on VREIT as a learning tool, noting any self-reported changes in engagement, comfort, and sense of control during interview training. This comparative approach highlighted shifts in confidence and perceived skill level, contributing valuable insights into VREIT's role in enhancing learning and engagement in job interview preparation.

VREIT Observations: For data analysis, the Observation Behaviour Table (Appendix G) and session notes provided an organized foundation, with each comment and observation already coded and categorized. This structured approach enabled the quick identification of progress, regressions, trends, and patterns across sessions for each participant. Observational notes captured participants' behaviors, interactions, verbal and non-verbal responses, and engagement with both the virtual trainer and environment, which were pivotal in pinpointing moments of advancement or challenges. These observations provided rich context to understand each participant's learning progression and the effectiveness of VREIT in job interview training, focusing on aspects like body language, eye contact, response times, and instances of frustration.

Interview and Observational Data Triangulation: To deepen the analysis, interview data was triangulated with observational notes, allowing for cross-validation between participants' self-reported experiences and observed behaviors. This triangulation facilitated a holistic narrative of each participant's journey with VR training, from initial interactions to final reflections. By aligning self-reported engagement and experience with observed behaviors, the study enhanced the reliability of findings.

This qualitative analysis approach prioritized participants' engagement and experiences with VREIT, combining interviews, observational notes, and triangulation to derive meaningful insights into the platform's impact on job interview skills training. Additionally, the development of the interview protocol and observation table provides a replicable framework for future research, potentially enabling broader-scale studies.

5.2. Disclosure of funding

The development of the VREIT application was entirely self-funded, with no external financial support obtained. The development process took eight months, followed by an additional four months dedicated to conducting research. To expedite VREIT's creation, an expert from India was hired, with the cost of their services personally covered. Additionally, all expenses for essential plugins and add-on tools required to enhance the platform's functionality were self-financed.

5.3. Findings

This chapter presents findings on the use of VREIT for job interview training tailored to autistic adults, focusing on how engagement with the platform affects their perceptions of job interviews and related training. The results are drawn from data collected through pre- and post-VREIT interviews, as well as observational notes recorded during VREIT sessions, following the methodology outlined in the previous chapter. The implications of these findings are then analyzed in relation to existing literature and the broader field, highlighting VREIT's potential contribution to enhancing job readiness and learning experiences for autistic individuals.

5.3.1. Experience of Participant A

John, a 33-year-old Senior Modeler/Texture Artist at a globally recognized film studio, has eight years of experience in the film and animation industry. He completed a one-year 3D modelling and animation program at a public college in British Columbia at 24, following an earlier brief enrollment in a nursing program, which he left due to a lack of interest. After completing his animation program, John pursued additional job interview skills coaching, further supporting his professional development. As a former student in one of my classes in 2013, John has demonstrated a continued commitment to refining his skills and advancing in his field.

Interview findings Pre and post-VREIT

John's journey through the job interview process, as captured in both pre- and post-VREIT training discussions, reveals a nuanced evolution in his perception and confidence regarding job interviews. In his initial interview, John conveyed a mix of

emotions, from the anxieties of preparation to self-critique after less successful experiences. He shared, "Doing the interviews were nerve-racking, constantly making sure I look right...Do I smell OK? Do I have the right clothes on? Am I overdressed? Am I underdressed, that sort of thing." This anxiety was underscored by John's extensive experience with approximately "10-15" interviews, which he described as "decent," attributing his foundational skills to a program his parents enrolled him in, designed to support job interview skills for those with disabilities. Despite his experience, John acknowledged a desire to improve his communication abilities, recounting moments of regret over specific responses and a heightened self-awareness of his own shortcomings. He remarked, "Constantly thinking to myself, how do I say this? Am I going to say this correctly or am I going to say [it] in the way that the interviewer is going to think I am just some sort of creep?"

John's reflections on his interview history were particularly insightful, detailing both successful and less favorable outcomes. He highlighted a notably positive experience with a globally recognized animation studio where he felt at ease and could convey his adaptability, a key factor in his hiring. He recalled, "It went extremely well. The interviewer was very comfortable with me. He was very impressed about my abilities to adapt to different styles." In contrast, he remembered another interview with a similar studio where his overthinking became a hindrance: "You go into a studio to have an interview, and the person interviewing you is in sweatpants and a messy T-shirt, and you kind of think, am I overdressed? Are they going to think I'm just some creep?" These introspective reflections reveal John's capacity to analyze and critique his performance, identifying external and internal influences on his interview outcomes.

Post-VREIT training, John's reflections displayed a pronounced increase in confidence and positive outlook. When asked if he would perform better in future interviews, he responded with certainty: "100%." He rated his confidence after VREIT sessions at "very confident, 9.5 out of 10," attributing this newfound assurance to his training experience. John's ability to assess his past experiences and recognize areas of growth, combined with the practical, immersive application offered by VREIT, underscores a comprehensive improvement in his interview preparedness.

In his post-training reflections, John's insights on specific interviews remained consistent with his initial views, affirming a stable perspective on his past. However, the

notable increase in confidence signified a positively transformed outlook for future interviews. He emphasized the role VREIT played in this change, noting, “I find it can be a very useful, but a very important tool for people like me.” John articulated the unique comfort VREIT provided: “People like me know certain things make us uncomfortable. Being at home and just using a VR headset and knowing that it is OK, this is just an avatar we are looking at. We can relax. We can be ourselves. We do not have to worry about eye contact or having Tourette's or something. We can feel like we are talking to a normal person. So, we can understand better.”

John’s progression from initial anxieties and self-critique to enhanced confidence demonstrates the value of targeted, immersive interview training platforms like VREIT. This evolution suggests that such tools can be instrumental in bolstering self-efficacy and job interview performance, providing a supportive, adaptable environment that aligns with the needs of individuals seeking to build confidence in professional settings.

VREIT sessions observation

John's journey throughout the VREIT job interview training sessions showed notable growth across multiple areas of interaction and behavior, indicating a sustained commitment to improving his interview skills and a deeper engagement with the process.

Engagement Level: John demonstrated a steady improvement in engagement over the sessions. Initially, he showed basic interest in the VR environment and its functions, actively participating but with a somewhat tentative involvement. As sessions progressed, especially by session seven, his engagement increased markedly. Comments like, "Shows a high level of engagement this session" highlighted his evolving comfort and attention to the interview content, reflecting a more profound connection to the material and a dedication to refining his performance. By sessions nine and ten, John's engagement had become a nuanced commitment, where his participation reflected both enthusiasm and a solid grasp of interview strategies. His growing focus and ability to sustain interest over multiple sessions demonstrated his adaptability within a professional setting, underscoring how VREIT effectively fostered an engaging, safe space for practice.

Confidence Level: John’s confidence saw a significant upward trajectory over the course of his training. Initially, his responses were hesitant, with a lower-than-typical

assertiveness. As he continued through the sessions, especially around session five, there was a marked improvement: "The way John articulates answers...shows a significant improvement in self-assurance compared to initial sessions." By sessions seven and eight, his self-confidence became more robust, allowing him to respond with clarity and conviction, further supported by constructive feedback from VREIT. This progression from cautious articulation to confidently presented answers highlights the impact of immersive, feedback-driven VR training in helping John achieve a comprehensive enhancement of his interview skills.

Framing Conversation: John's ability to frame his responses positively also showed notable progress. Initially, his responses were neutral or focused on challenges, missing opportunities to highlight his strengths. However, by session five, John had adopted a more optimistic approach, framing challenges as growth opportunities. This positive framing developed further by the final sessions, where he adeptly emphasized his strengths and framed areas for improvement constructively. His refined conversational framing not only made his responses more engaging but also demonstrated an awareness of how positivity impacts the listener, a valuable skill in both interview and professional contexts.

Professionalism: John's professionalism was evident from the start but improved steadily through the sessions. Initially, his demeanor was polished, but by session five, there was a marked growth in how he presented himself within the virtual setting, covering attire, conversation tone, and overall presence. His professionalism evolved to include transparency, dependability, and an openness in sharing experiences. By session ten, his growth in professionalism was well-established, evident in his more articulate, honest responses, which were underscored by consistency and ethical conduct. His ability to embody professionalism by the end of the sessions reflects a mature understanding of interview norms and conduct standards, adding to his appeal as a dependable candidate.

Interest Level: John demonstrated a consistently high level of interest in the interview process, reflecting both curiosity about the mock roles and a commitment to understanding their specifics. Early in the sessions, this interest manifested through questions about the position and company background, signifying a proactive engagement with the mock interview. His sustained interest, evidenced by insightful

inquiries and a keen enthusiasm through the later sessions, indicated his willingness to contribute meaningfully to prospective roles. The consistency in his interest level suggests that John is not only committed to securing a position but also invested in learning and growth opportunities within it.

Honesty and Transparency: John's approach to honesty and transparency was a consistent strength across all sessions. From the outset, he demonstrated a willingness to admit mistakes and openly discuss areas of improvement. His transparency added to his credibility, and this openness about his achievements and challenges gave his answers authenticity. His growth in this area is reflected in his final sessions, where his balanced, honest responses underscored his reliability. His transparency and ethical stance emerged as defining qualities, laying a foundation of integrity crucial for professional trust.

Dependability and Trustworthiness: John consistently emphasized his dependability and work ethic throughout the sessions. His ability to provide examples of reliability, discuss responsibilities, and demonstrate a commitment to ethics reinforced his professional image. As sessions progressed, his responses about teamwork and dependability became more reflective and nuanced, underpinned by a commitment to ethical practices. This steady emphasis on reliability contributed to a robust profile of a trustworthy, dependable candidate, aligning with qualities highly valued in professional environments.

Interest in Collaboration: Initially, John’s interest in collaboration was moderate, with few examples provided. By session five, his understanding of teamwork’s value had evolved, demonstrating a stronger appreciation for collaboration in achieving goals and addressing challenges. In the final sessions, John spoke convincingly about his teamwork experiences, articulating a balanced view on collaboration's role in professional success. His growth in this area illustrates a developed perspective on teamwork, positioning him as a candidate prepared to work effectively within a team.

Skill Sharing: John’s growth in articulating his skills, strengths, and weaknesses was substantial. Early on, he was somewhat reserved in discussing his abilities, but by session five, he became more detailed in sharing his skill set, providing relevant examples that showcased his strengths and areas for improvement. His capacity to draw

on past experiences to illustrate his skills became increasingly refined, with later sessions showing a marked improvement in articulating relevant examples and linking past achievements to prospective job roles. This evolution in skill-sharing indicates a thoughtful, self-aware approach to professional development.

Sharing Past Experiences and Overcoming Challenges: John's ability to share past experiences and discuss his limitations improved significantly over the sessions. Initially, he provided brief anecdotes, but as he progressed, his responses grew in specificity and relevance, offering a clearer view of his background and achievements. This shift to sharing detailed experiences reflects an enhanced self-awareness and comfort in discussing limitations and challenges constructively, highlighting resilience and adaptability.

In summary, John's journey through VREIT interview training demonstrated notable growth in engagement, confidence, professionalism, and positive framing. The progression across these areas underscores the transformative impact of immersive VR training, enabling John to build on his natural abilities and overcome challenges in a supportive setting. The enhancements in his interview readiness, reflected in greater confidence, polished professionalism, and effective communication, highlight VREIT's role as a valuable tool for preparing candidates for the job market.

5.3.2. Experience of Participant B

Jane, a 20-year-old female student diagnosed with level 1 autism at age five, is currently in her second year of a 2D animation diploma program at a public university in British Columbia. With a strong talent for drawing and animation, she aspires to work as an animator in the entertainment industry. Her academic performance is average in elective courses but ranks in the top ten for digital arts courses, underscoring her strength and passion in the field of animation. As a future female animator on the autism spectrum, Jane brought a valuable perspective to this study, representing both the creative aspirations and unique experiences of autistic individuals in the arts.

Interview findings Pre and post-VREIT

Jane's journey through the VREIT job interview training program demonstrates a notable progression in self-confidence and interview readiness, evolving from initial uncertainty to a more self-assured and reflective stance.

In the pre-interview, Jane reflected on her limited job interview experience, which largely consisted of entry-level positions unrelated to her field in 2D animation. Her first job, a store clerk position, came through a familial connection and did not involve a formal interview process. She recounted, “I just spoke to the manager, and I was like, my mom works here, and could you maybe get me a job? And he was like, OK, just come here next week for training.” This lack of traditional interview exposure may have left her feeling less equipped for future interviews. Jane described her primary source of interview-related anxiety as simply “getting there in the first place,” noting that after this, she found it “pretty comfy because, you are just talking to someone.”

Jane also mentioned a prior experience in a job interview training program for individuals on the autism spectrum, which introduced her to mock interviews and essential etiquette. This experience showed her proactive approach to job preparation. “The program was all about what to do in an interview and being polite and stuff. Another important thing is to be sure to dress properly,” she recalled, indicating her awareness of the need to cultivate effective interview skills.

Following her sessions in the VREIT environment, Jane’s post-interview reflections highlighted a newfound appreciation for the virtual training experience. Describing it as “like playing a video game,” she stated, “I sort of feel this environment is a bit safer and more comfortable; I can manage, adjust, and modify it to what I like to learn and practice for job interviews.” This sentiment underscores the appeal of virtual, gamified interview preparation for individuals on the spectrum, as it allows for a customizable, comfortable, and controlled learning environment.

Jane’s increased self-awareness was evident in her post-training reflections on areas for personal improvement. Acknowledging the importance of preparation, she noted, “I know I should prep more so I don’t end up telling myself stuff like, ‘oh damn, I should have said this or asked that.’” This level of self-reflection represents a shift from

her initial, less critical view of her own interview performances, showing growth in her ability to self-assess constructively.

Throughout her engagement with VREIT, Jane's enhanced self-confidence and understanding of the interview process became apparent. This evolution emphasizes the benefits of targeted, immersive training programs, particularly for autistic individuals navigating job interviews. Jane's experience in the VREIT environment, which she described as "a pretty good model, like how a video game would look like," clearly resonated with her. She expressed a particular fondness for the virtual "white painted office," noting, "I really liked that. That was fun," underscoring her positive response to the program's design and adaptability.

VREIT sessions observation

Jane's journey through VREIT job interview training, spanning sessions 1 to 8, highlights her significant development across key areas, reflecting a deepening engagement, increased confidence, and growth in professional self-awareness. Her progress in these sessions emphasizes her adaptability and commitment to enhancing her interview skills.

Participant Engagement Level: Initially, Jane's engagement appeared minimal, showing detachment and limited enthusiasm: "Somewhat detached and did not actively participate in the conversation. Responses were brief and lacked depth, perhaps low interest in the interview process." However, as sessions progressed, Jane's engagement levels increased notably. By sessions 3 and 4, her participation was more dynamic; she asked relevant questions and responded with enthusiasm, indicating a deeper interest: "She maintained eye contact with the avatar, nodded in acknowledgment, and responded promptly to questions."

In later sessions, particularly sessions 6 and 7, her engagement was highly pronounced, culminating in the final session with increased attentiveness and active responsiveness. This transformation, from initial reserve to active involvement, suggests that Jane adapted well to the VREIT environment, progressively enhancing her engagement with the material and the mock interviews. This improvement is critical as it directly impacts her appeal as a candidate, demonstrating her readiness to actively engage in professional settings.

Confidence Level: Jane's confidence saw a steady and consistent rise across the VREIT sessions. In the early sessions, her responses were tentative, marked by low voice and minimal eye contact: "She appeared nervous and unsure of herself, often hesitating before answering. Her voice was low, and she avoided eye contact." However, by session 4, her confidence had visibly increased; she responded more fluidly and maintained eye contact with the coach's avatar, indicating a growing sense of ease in the interview setting.

By session 7, her confidence was noticeably elevated. She responded to questions assertively, demonstrated strong eye contact, and spoke with conviction, showing comfort with the process. The final session underscored her growth as she answered questions with clarity and steadiness, reflecting her increased self-assurance: "There's a noticeable increase in how Jane presents herself. Her answers were assured, and she maintained a steady, confident voice."

Framing Conversation: Jane's progress in framing her responses evolved markedly throughout the sessions. Initially, her approach to answering questions focused more on challenges without effectively showcasing her strengths. In session 1, Jane showed a general awareness of challenges, but her responses lacked the framing needed to highlight positive takeaways: "She shared some challenges she had overcome but did not explore these deeply or connect them to how they prepared her for future roles."

By session 5, Jane had made strides in framing her responses with a more solution-oriented perspective, focusing on strengths and growth rather than obstacles: "She focused on solutions and her ability to overcome challenges." By session 8, she demonstrated a refined approach to framing her experiences, emphasizing positive outcomes and growth: "She adeptly highlighted strengths and learning opportunities, framing past experiences as preparation for future roles."

Professionalism: Jane displayed consistent professionalism across her sessions, progressively enhancing her conduct, language, and presentation. Initially, while her attire and respect toward the interviewer were appropriate, her manner of expression had room for more formality. By session 4, Jane's professionalism was marked by improved attire, formal language, and a balanced approach between formality

and approachability: “maintained a professional demeanour, with appropriate attire and respectful, courteous language.”

In later sessions, her professionalism was notably polished. She demonstrated respect, thoughtful responses, and well-structured answers that reinforced her professional suitability for interview settings: “Exhibited professionalism in her attire, manner of speaking, and respect toward the interviewer. Her responses were thoughtful and well-structured.”

Level of Interest: Despite knowing the interviews were mock, Jane’s level of interest in the hypothetical position grew consistently. Initially, her interest seemed passive, but by session 4, her curiosity about job specifics was evident. This trend continued into session 6, where she showed genuine enthusiasm by asking insightful questions about the job role: “Showed a genuine interest in the position by asking insightful questions about job duties and expressing enthusiasm for the role.”

By the final session, her interest had evolved into active curiosity, and she inquired about job responsibilities with a proactive approach: “Interest in the position was clear. She asked specific questions about job duties and expressed enthusiasm about how her skills could contribute to the team.”

Honesty and Transparency: In her early sessions, Jane's responses were genuine but lacked detail, which initially made it challenging to assess her full transparency. By session 4, however, her openness improved, as she shared experiences candidly and without embellishment: “She provided concrete examples to support her claims, which lent credibility to her statements.”

In later sessions, particularly session 8, her transparency reached a high point. She discussed personal challenges and areas for improvement with forthrightness, enhancing her credibility: “She was honest and transparent in her responses, providing clear examples and openly discussing areas for improvement.”

Dependability and Trustworthiness: Jane’s reliability and trustworthiness were consistent strengths that grew more pronounced across the sessions. In earlier sessions, her examples of reliability were brief but suggestive of her commitment. By session 4, she reinforced her trustworthiness through specific instances, emphasizing

her integrity and commitment to ethical standards: “She made a strong case for herself as she shared examples that highlighted her reliability and commitment to ethical standards.”

By session 8, Jane’s dependability and trustworthiness were clearly articulated through her commitment to ethical practices and her consistent reliability in past roles: “Examples of past responsibilities and her commitment to ethical practices underscored her dependability.”

Interest in Collaboration and Working with Others: In initial sessions, Jane’s collaborative abilities were mentioned but lacked depth. By session 4, her teamwork skills were more evident as she described past collaborative experiences, emphasizing her role and contributions: “She spoke highly of her experiences in team settings, emphasizing her role in achieving shared goals.”

In later sessions, her collaborative spirit was further refined, with Jane sharing examples that demonstrated her adaptability and appreciation for teamwork, aligning her skills with team-oriented environments: “She shared several instances that highlighted her ability to work well in a team, discussing her role in achieving shared goals.”

Sharing: From early sessions, Jane displayed a growing ability to discuss her skills, strengths, and weaknesses with specificity. Initially, she mentioned strengths but lacked examples. By session 4, her responses had become more articulate, with concrete examples that showcased her skills: “She was articulate in discussing her strengths, providing specific instances where she applied them.”

By the final sessions, Jane confidently discussed her skills, linking them to the job role and expressing areas for growth with clarity. Her openness about weaknesses and her desire for personal growth reflected her maturity: “She expressed herself clearly, provided examples of how she has applied her skills in professional settings, and demonstrated a high level of self-awareness.”

Throughout her VREIT sessions, Jane’s ability to share past experiences and continue conversations evolved significantly. Early on, she tended to use short answers, but by sessions 4 to 6, she expanded on responses and framed challenges as learning opportunities. By session 8, she discussed her limitations candidly, framing them

positively and contributing to a comprehensive narrative of growth: “Discussed past limitations with a focus on growth, sharing how overcoming challenges led to personal and professional development.”

In summary, Jane’s journey through the VREIT program illustrates her significant growth in engagement, confidence, and professional maturity. Her development across these sessions highlights her adaptability, self-awareness, and readiness to approach job interviews with a strong, strategic mindset, positioning her well for future opportunities in her field.

5.3.3. Synthesis of the findings

This study investigated how the VREIT platform influences autistic adults' perceptions of job interviews, utilizing triangulation of multiple data sources to ensure a comprehensive understanding of VREIT’s effects. Triangulation involved analyzing qualitative data from participant interviews and observational data from VREIT sessions, allowing for validation and enhancement of findings. This process offered a robust understanding of participants’ evolving perceptions of job interviews and how VREIT influenced these perceptions through targeted training.

Interview Insights: Pre- and post-VREIT interviews revealed self-reported changes in participants' perceptions of job interviews. Both John and Jane noted improvements in confidence, comfort, and a clearer understanding of the interview process after completing their VREIT training. They highlighted the immersive virtual environment and interaction with the live trainer’s avatar as effective practice for real-world interviews. These self-reports were crucial in capturing the participants’ personal reflections on their growth and preparedness.

Observational Data: Observational data from the VREIT sessions offered an external perspective on each participant's behavioural changes over time. Tracking Jane and John across multiple sessions highlighted notable improvements in engagement, professionalism, and their ability to articulate responses more confidently and effectively. Both participants displayed increasing engagement and self-assurance, corroborating their self-reported growth in these areas. Observations provided a steady, session-by-session view of how VREIT influenced specific competencies, adding depth to the participants' self-assessments.

Triangulation and Data Contrasts: The triangulation of interview and observational data revealed complementary insights while also uncovering contrasts. While interviews provided insight into participants' perceived improvements, observations offered a more detailed view of gradual progression. For example, while John confidently reported a 100% improvement in interview skills post-VREIT, the observational data captured a more nuanced development, noting specific areas where growth continued to evolve. This contrast between self-perception and observed performance underscored the value of combining multiple data sources for a balanced analysis.

Triangulating these data sources enriched the overall findings by reinforcing credibility through consistency across types of data, while also identifying areas where participants' perceptions only partially captured their full development, as seen through the observational lens. This approach added depth to the understanding of VREIT's transformative potential, providing a comprehensive view of its impact on interview preparedness for autistic adults.

Triangulating interview and observations - John

Interview Data: Before beginning the job interview training with VREIT, John's pre-training interview captured a range of emotions tied to his past job interview experiences, including anxiety and self-critique. He described his past performance as "decent" but acknowledged areas for improvement, specifically in his communication skills. After completing the VREIT sessions, John's confidence showed a substantial increase, and he expressed a much more positive outlook on future interviews, stating with confidence that he would perform "100% better."

Observational Data: Throughout the VREIT sessions, John's engagement levels and commitment to developing his interview skills were observed to steadily improve. By session 10, he was fully engaged, showing a focused effort on personal growth and interview skills enhancement. Notable behavioral changes included increased articulation, consistent eye contact, and more relevant, detailed responses, indicating a growing comfort and confidence in his abilities.

Alignment and Contrast: Both the interview and observational data align in showing John's progression in confidence and self-awareness. His recognition of past

interview limitations in the interview data is mirrored by observed improvements in his articulation and engagement during VREIT sessions. However, while the interview data reflects John's perception of increased confidence, the observational data provides a more comprehensive view, revealing specific behavioral shifts and detailing the progression of his engagement. This contrast underscores the depth added by observational insights, capturing a fuller, more nuanced view of John's development through VREIT.

Triangulating interview and observations – Jane

Interview Data: In her pre-VREIT interview, Jane described her past interview experiences as tentative and lacking detail, suggesting lower levels of confidence and preparation. Given her status as a recent graduate from a diploma program, her limited exposure to formal job interviews was understandable. Post-VREIT, Jane highlighted practical benefits gained from the training, noting that VREIT helped her prepare for real-life interviews. She also offered feedback on VREIT's design to enhance usability for autistic users and acknowledged areas for further growth, specifically around preparation and response development.

Observational Data: Throughout sessions 1 to 8, Jane demonstrated substantial improvements in both engagement and confidence. Her initial involvement was minimal, but she gradually became more engaged and responsive as the sessions progressed. By the final sessions, her responses were assertive, and her posture and voice reflected newfound confidence. These shifts indicated that VREIT was positively influencing her comfort and skill in interview settings.

Alignment and Contrast: Both the interview and observational data confirm Jane's progress in confidence and engagement. Her self-reported advancements in interview readiness were corroborated by observed increases in her ability to articulate responses and engage actively during sessions. However, observational data offered deeper insight into her behavioral shifts, such as enhanced body language, eye contact, and improved response quality—details that her interview responses did not fully capture. This contrast highlights the added depth of observational analysis, providing a clearer picture of Jane's developmental journey with VREIT.

5.3.4. Summary of findings

This design case study employed a robust qualitative approach, using both interviews and observations to explore the impacts of the VREIT application on participants' perceptions of job interviews and their preparation for these settings. By triangulating data from these sources, the study provided a well-rounded understanding of the participants' engagement and perceived experiences within VREIT, enriching the overall findings and revealing deeper insights into its transformative potential.

In pre-VREIT interviews, participants expressed a range of emotions about past interview experiences, including anxiety, self-critique, and uncertainty. Following VREIT sessions, both John and Jane demonstrated a substantial boost in confidence and an optimistic outlook toward future interviews. They recognized the practical benefits of VREIT in preparing for real-life scenarios, citing improvements in skills and readiness. Observational data during the sessions corroborated these self-reports, highlighting notable improvements in engagement, confidence, communication skills, and professionalism, as well as in honesty and transparency in interactions.

These findings also informed the iterative design process for VREIT, revealing how specific design elements impacted user engagement, confidence, and perceived learning. Feedback from John and Jane about the VR environment and avatar interactions, alongside the observational insights into how they navigated the platform, highlighted areas for refinement. This iterative approach not only strengthened the usability and accessibility of VREIT but also enhanced its potential to meet the unique needs of autistic individuals more effectively in job interview settings.

The results align with existing literature on the social competence and interaction challenges that autistic individuals often encounter in transitional stages, such as job interviews. This study contributes to the broader academic discourse by demonstrating the potential of VR-based training, specifically VREIT, in enhancing job interview skills for autistic individuals. The progress observed in both John and Jane underscores the effectiveness of targeted, immersive training programs in supporting autistic adults through critical transitions.

To expand the insights gained, future research could explore VREIT’s use with non-autistic participants. Comparing and contrasting feedback between autistic and non-

autistic users could yield valuable information on the platform’s universal design strengths and areas needing further customization. Such a study would enable a deeper understanding of VREIT’s impact across different user profiles, potentially leading to adjustments that enhance its effectiveness for diverse populations.

Ultimately, this design case study highlights VREIT's effectiveness in cultivating job interview competencies in autistic adults, with both participants exhibiting growth in confidence, engagement, and articulation of skills. By triangulating interviews and observations, the study offers a comprehensive view of their development, affirming existing literature while offering new insights into VR's role in addressing challenges faced by autistic individuals. This research underscores the potential of VR-based programs to support autistic adults in critical transitions, such as job interviews, by fostering social and professional competencies and refining the platform through iterative design.

Chapter 6. Discussion

A respectful approach to autism and autistic learners centers on understanding the diverse experiences across the autism spectrum. Research underscores that each autistic individual brings unique strengths and needs, which calls for flexible, tailored teaching strategies to maximize each learner's potential (Christensen et al., 2018; Maenner et al., 2023; Talantseva et al., 2023; Thrower et al., 2020b). This approach emphasizes that no single method fits all; what proves effective for one student may differ greatly for another.

Building a supportive learning environment fosters remarkable progress, reinforcing the value of inclusive educational practices that appreciate the contributions of autistic individuals. Adopting a personalized approach—attuned to each learner's strengths and challenges—demonstrates the potential within every student. This perspective fosters empathy, deeper understanding, and an appreciation for listening to the voices of autistic learners and their families. Such an approach, shaped by commitment to respect, inclusion, and empowerment, contributes to a more inclusive and understanding society.

6.1. Design of VREIT

The VREIT application was designed to bridge traditional learning environments with the immersive, interactive potential of virtual reality (VR), offering a platform tailored specifically for the unique needs of autistic users. Grounded in a design-based research (DBR) approach, VREIT's development involved iterative cycles of design, testing, and refinement, allowing for ongoing adaptation based on real-world feedback. This approach ensured the platform was not only technically robust but also sensitive to UI and UX principles that prioritize user comfort and engagement, such as muted colors, visual simplicity, and customization options.

The potential of VREIT and similar VR applications as educational tools is considerable. VREIT combines gamified, immersive elements with real-time, life-like avatar interactions, enhancing authenticity and providing a safe space for learners to practice complex skills like job interview techniques. The platform's ability to mirror real-time facial expressions adds to its realistic training potential, supporting autistic

individuals in developing job interview skills in a controlled, adaptable environment that can be tailored to reduce sensory overload.

The development process presented technical challenges, from live streaming of facial animations to ensuring seamless interface customization, all of which required careful troubleshooting and improvement cycles as part of the DBR framework. This iterative process was essential in refining both the platform's performance and the user experience, ensuring that the application could support smooth, consistent training sessions.

Looking ahead, VREIT's scalability and adaptability offer promising opportunities. Its standalone nature simplifies deployment across educational settings, and the DBR approach allows for continuous enhancement based on diverse user needs. With potential applications beyond job interview training, VREIT is positioned as a versatile educational technology, ready to support various skill-building and learning scenarios for a broad range of users.

6.2. VR to support autistic learners

The VREIT application was developed in this design case study to address the gap in real-time VR tools that offer immersive learning experiences between learners and educators through life-like avatars. Implemented in job interview training for autistic learners, VREIT served as a real-time VR tool to examine its role as a supportive resource in learning, exploring its influence on participants' engagement and perceived experience. VR's potential in autism education is noteworthy, as it provides a controlled and immersive environment for skill development—essential for autistic individuals who benefit from predictable settings (Schmidt et al., 2024). The use of VR in autism education has shown particular promise for improving social skills and emotional recognition, as these environments enable the simulation of social interactions, allowing autistic students to practice and enhance social competencies without real-world pressures (Ahmad Lawan et al., 2023; Narciso et al., 2021).

VR's capacity to offer customizable and immersive experiences uniquely addresses the sensory and communication challenges many autistic individuals face (Passig et al., 2016; Smith et al., 2017). VR can meet the visual learning preferences of

autistic students, providing a tailored educational experience that aligns with their specific needs (Newbutt et al., 2020; Schmidt et al., 2019; Smith et al., 2020). However, while the advantages of VR in autism education are substantial, variations in acceptance and effectiveness must be acknowledged, as some users may experience side effects like dizziness or anxiety, potentially affecting their acceptance of VR as a learning tool (Newbutt et al., 2020). Considering these individual differences is essential when implementing VR interventions to ensure accessibility and comfort.

The implementation of VREIT with two participants demonstrated VR's potential as an educational tool, particularly in providing autistic learners with a safe and controlled space for skill-building and development. The findings from VREIT use suggest that VR can play a valuable role in education for autistic individuals. Continued research is necessary to understand VR's unique strengths and limitations in autism education and to ensure these technologies can effectively support the diverse needs of autistic learners.

The insights gathered during the development and testing of VREIT were deeply informed by a comprehensive review of the literature during PhD research preparation, which included studies on ASD prevalence, characteristics, VR in autism education, and application design for autistic users. This literature review identified both direct and indirect connections between the findings and existing studies, highlighting where the results support established theories and where they provide new insights or challenge current knowledge. This analysis not only situates the VREIT findings within broader academic discourse but also clarifies its contribution to understanding the unique challenges and opportunities of job interview training for autistic individuals. Comparative analysis underscores the relevance of VR-based interventions, highlighting both their promise and the areas requiring further exploration. This grounding in literature ensures that the findings are contextualized and provides a foundation for future studies that aim to expand our understanding of VR applications in autism education.

6.2.1. Presence of challenges in adulthood and transitioning between life stages

The findings from this study align with existing literature on the critical challenges faced by autistic individuals when transitioning between life stages, particularly adulthood. This transition requires substantial support and preparation, with difficulties

emerging around navigating necessary steps, such as interviewing for jobs or post-secondary programs, adapting to new environments, meeting specific demands, and managing the perceptions of others.

During pre-interviews, both John and Jane shared aspects of their challenges and anxieties related to job interviews, reflecting broader transitional difficulties often encountered by autistic individuals. John highlighted his concerns with making a favorable impression, including his anxieties around wearing suitable attire and maintaining eye contact. Jane expressed nervousness over the logistical elements of attending interviews, such as traveling to unfamiliar locations and meeting new people. These challenges echo findings from previous research indicating that transitions are often marked by increased anxiety and specific hurdles for autistic individuals (Dipeolu et al., 2014; Hedley et al., 2018; D. R. Hendricks & Wehman, 2009).

This study's findings reinforce the view that these challenges stem, in part, from social competency gaps and limited interaction skills, which can make tasks like job interviews particularly daunting. For many autistic individuals, the job interview represents the first and possibly most substantial barrier to employment, aligning with existing research that emphasizes the social demands of interviews as a critical hurdle (Gillies, 2012; D. Hendricks, 2010a; Sarrett, 2017a).

The findings support the need for targeted support mechanisms, such as VREIT, to aid autistic individuals in navigating these transitional challenges, particularly by addressing the specific social and practical skills that are often required in job interviews and other key transition points.

6.2.2. The interview - an obstacle to obtaining employment

During both the pre- and post-VREIT interviews, participants John and Jane shared their unique challenges related to job interviews, revealing insights into their individual struggles and experiences. Observations during non-VREIT interviews confirmed their accounts, highlighting the consistency in the difficulties they face.

John described his job interview experiences as "nerve-wracking," emphasizing the anxiety and self-doubt he encounters both before and during interviews. He highlighted the pressure of ensuring he appears "right," questioning even minor details

such as his clothing and scent. Specific challenges like maintaining an appropriate level of eye contact and vocal tone added to his stress, often resulting in feelings of being overwhelmed or freezing up during the interview. John's recollection of an unsuccessful interview with a well-known local animation studio illustrates these challenges: he felt he unknowingly conveyed disinterest, which he believed negatively impacted the outcome.

Similarly, Jane expressed anxiety, especially regarding the initial stages of an interview, such as traveling to the interview location and facing the interviewer for the first time. She also noted that despite her practice and preparation, the challenges of face-to-face interactions remain daunting and serve as a barrier to employment. Her concerns align with studies on autism spectrum disorder (ASD), which describe ASD as a developmental difference that impacts social interest, communication, and response to new social situations, often resulting in repetitive and anxious behaviors during such interactions (Bertrand et al., 2001; Christensen et al., 2018).

These individual accounts mirror findings in the literature, which indicate that autistic individuals, even when possessing the necessary technical and intellectual skills, often face heightened challenges in job interviews due to the social and communicative demands these settings entail (Barnhill, 2007; Feinstein, 2018). Existing studies emphasize that alongside technical skills, autistic individuals must focus on communication, interaction, and nonverbal behaviors—areas often challenging due to the social characteristics associated with autism (Huffcutt et al., 2001; Lorenz et al., 2016; Sarrett, 2017b; Smith, Fleming, Wright, Roberts, et al., 2015).

The emotional and psychological toll of job interviews was a recurring theme for both participants. John focused on the technical aspects of communication, while Jane highlighted her need for better preparation and the support she received through a tailored training program. Their experiences underscore the complexities of job interviews for autistic individuals, reflecting the personal and developmental challenges they navigate and the importance of addressing these needs within job preparation programs (S. L. Burke et al., 2021; Feiler & Powell, 2016; McCarthy & Goffin, 2004; McNary, 2008). These insights offer valuable contributions to the growing understanding of the interview process from an autistic perspective, highlighting the importance of targeted support to bridge these specific challenges.

6.2.3. Benefits of modeling and specialized training

In their interviews, both John and Jane highlighted the benefits of individualized training programs in preparing for job interviews, particularly considering the unique challenges they face as individuals on the autism spectrum. Such training provides them with essential support, helping them build the skills needed to perform well in interviews and increase their opportunities for industry employment.

John discussed his early training program, which emphasized interview fundamentals like eye contact and presentation, which he completed shortly after high school. This training was instrumental in helping him manage interview-related anxiety, which he described as a tendency to "clam up" under stress. Similarly, Jane noted that her specialized training, which included mock interviews and video modeling, helped her understand how to dress and conduct herself appropriately during interviews. She felt that these courses, specifically tailored to autistic individuals, were crucial in preparing her for the social dynamics of the interview process. Research has similarly emphasized the effectiveness of individualized training and modeling in helping autistic individuals overcome social challenges associated with job interviews, thus improving interview skills and employability (Kumazaki et al., 2019; Lorenz et al., 2016; Smith et al., 2020; Smith, Jordan, et al., 2021).

Both participants reported that such training programs were instrumental in reducing anxiety, boosting confidence, and making them feel more prepared for the interview experience. They valued the structured practice and preparation, noting that these programs equipped them with strategies to manage interview pressures. Through the use of mock interviews and video modeling, they were able to visualize and rehearse the interview process, making it less intimidating and more accessible. Research supports the effectiveness of these methods, showing that modeling and video modeling allow trainers to demonstrate key skills, which autistic individuals can then practice and refine through repetition and feedback, ultimately aiding in the development of desired interview behaviors (Buggey, 2009; Buggey & Hoomes, 2011; Collet-Klingenberg, 2008; McCoy & Hermansen, 2007).

The findings reinforce the value of individualized training for autistic individuals, emphasizing its role in developing practical job interview skills that can ease the transition into the workplace.

6.2.4. Enhancement of engagement and confidence

In the pre-VREIT interviews, both Jane and John conveyed a lack of confidence when preparing for or participating in job interviews, describing feelings of nervousness and anxiety. Observations from early VREIT sessions aligned with these initial sentiments, as both participants appeared disengaged and lacked confidence during interactions.

However, in the post-VREIT interviews, significant changes were observed. John rated his confidence at 9.5 out of 10, a substantial increase from his initial self-assessment of 6 to 7. He even stated he felt “100%” confident going into an interview, attributing this improvement to his experience with VREIT. Jane echoed this sentiment, noting that the mock interviews and training sessions within VREIT effectively familiarized her with the interview process and reduced her anxiety about interacting with new people and unfamiliar environments. These responses align with research indicating that individualized training, especially those involving visual aids and VR, substantially boosts confidence and engagement among autistic learners (Bozgeyikli et al., 2018; R. Burke et al., 2013; S. L. Burke et al., 2018; Smith, Fleming, Wright, Roberts, et al., 2015).

The findings also revealed that having control over the environment and avatar within VREIT helped both participants feel more comfortable and secure, further enhancing their confidence and reducing anxieties associated with unfamiliar social settings. Both participants expressed that the training sessions allowed them to practice responses and receive structured guidance on presenting themselves effectively in interviews, reinforcing the importance of targeted training to build confidence in job-seeking individuals with disabilities. This observation supports existing research, which has documented the positive impact of specialized training programs on self-assurance and job-readiness among individuals on the autism spectrum (Bishop-Fitzpatrick et al., 2013; Fitzgerald et al., 2018; Rega et al., 2018).

Notably, the final observational sessions demonstrated an increase in both confidence and engagement in John and Jane, as they interacted more fluidly and actively. Such findings reflect the body of literature underscoring how well-structured, individualized training can address the social challenges faced by autistic individuals, helping them build confidence and become more engaged during the interview process (Kumazaki et al., 2019; Lorenz et al., 2016; Smith et al., 2020; Smith, Jordan, et al., 2021).

Chapter 7. Conclusion

The insights gathered in this study highlight the significant potential of using VR applications like VREIT to enhance job interview training and skill development for autistic individuals. The immersive, gamified environment of VREIT not only improves engagement but also addresses sensory sensitivities and allows users to interact in a controlled, supportive setting. This design case study demonstrated how VR's unique features—such as immersive interaction, real-time feedback, and customizable sensory settings—can benefit autistic users by minimizing sensory distractions, creating a predictable environment, and providing an avenue for repeated practice, which ultimately boosts confidence and preparedness (G. Burdea, 2003; Zheng et al., 1998).

The gamified elements of VREIT, including achievements, level progression, and reward systems, further enhance motivation and engagement among users, making the learning process enjoyable and meaningful (Mazurek et al., 2015; Olson, 2010). For autistic individuals, who may encounter heightened stress and sensory overload in unfamiliar or unpredictable scenarios, VR offers a platform where job interview skills can be practiced safely, with tailored pacing and customizable sensory elements such as brightness, contrast, and sound (Dörner et al., 2016; Hulusic & Pistoljevic, 2016). This personalization fosters an inclusive learning environment by supporting individual needs and sensitivities.

The implications of VREIT and similar VR applications extend well beyond job interview training for autistic users. Individuals with social anxiety, attention deficits, or other neurodiverse conditions also stand to benefit from VR's structured and adaptive environment. VR's capacity to simulate real-life scenarios while allowing users to control their environment can be invaluable for building essential social and professional skills in a way that supports gradual learning and exposure (All et al., 2021; Hayes et al., 2015). This study reinforces the idea that VR platforms like VREIT could be further adapted and scaled to support various user populations facing learning challenges.

In future research, examining the comparative effectiveness of VREIT across diverse user groups could provide deeper insights into VR's broader educational applications. Comparative studies involving neurotypical and neurodiverse individuals, for example, could illuminate differences in feedback, engagement, and skill retention.

This cross-population analysis would enrich our understanding of how VR platforms can best be designed to meet a wide range of learning needs, ultimately informing the iterative improvement of VREIT and similar tools.

In conclusion, VREIT exemplifies the transformative potential of VR in education, offering a personalized, immersive, and supportive learning environment for autistic individuals and others with unique learning challenges. The findings underscore how VR-based applications, through game-like and real-time interactivity, can empower diverse learners to develop skills that are vital for real-world success, thereby advancing the capabilities and inclusivity of educational technology in ways that meet the needs of a diverse user base (Kumazaki et al., 2019; Smith, Jordan, et al., 2021).

7.1. Summary of key findings

In this study, VREIT, a VR platform designed as an interactive, real-time, unscripted, immersive learning environment, was employed to facilitate job interview skills training for autistic learners. Using a design case study approach, VREIT's impact on two autistic participants' engagement and experiential perceptions was explored through pre- and post-VREIT interviews and in-depth observations during the VREIT sessions. To ensure a comprehensive understanding of VREIT's influence, findings were triangulated across participant interviews and observational data, validating and enhancing insights by comparing varied data sources. This triangulation allowed for a robust understanding of the participants' perceptions and the impact of VREIT in job interview training.

Pre- and post-session interviews revealed significant self-reported changes in participants' perceptions of job interviews. For example, both John and Jane described a marked increase in confidence, comfort, and understanding of the job interview process post-VREIT. They emphasized that the VR environment and interactive experience with the avatar of a live trainer provided effective preparation for real interviews.

Observational data from VREIT sessions offered additional perspectives on participants' behavioral changes, showing clear improvements in competencies such as engagement, professionalism, and articulation of responses. Observations of John and

Jane during these sessions aligned with their self-reported increases in confidence, engagement, and comfort.

Some contrasts between interview data and observations added depth to the findings. For example, although John confidently estimated a "100% improvement" in his interview skills, observational data revealed a more gradual progression, capturing specific areas where growth continued alongside his newfound confidence. This contrast highlights the value of triangulating data to obtain a balanced and nuanced understanding of each participant's experience.

The triangulated data provided a holistic view of each participant's developmental journey. John's progress illustrated his transition from self-doubt to a confident interviewee, demonstrating personal and professional growth, while Jane's shift from tentative engagement to a proactive, self-assured participant underscored her readiness to tackle real-world interviews. These findings underscore VREIT's potential as an impactful tool for enhancing job interview skills among autistic individuals, supporting both observed behavioral improvements and self-perceived development.

7.2. Recommendations

This design case study aimed to evaluate the impact of the VREIT virtual reality application on autistic participants' perceptions of job interviews and their preparedness for job interview training. It specifically examined the benefits of a gamified, interactive, immersive, real-time VR environment, using VREIT as a potential tool for autistic individuals.

The literature reviewed highlighted existing applications of virtual reality in job interview training for autistic learners, generally involving video game-like simulations on a screen or pre-recorded video overlays within a 3D environment. With the advancement of VR headset technology, along with its increasing accessibility and affordability, a shift toward native VR environments could provide users a more engaging and immersive experience. Unlike traditional screen-based systems, VREIT was designed for use with VR headsets, allowing users to fully immerse themselves in a virtual interview environment while still offering a game-like format for screen-based use when VR headsets are not available.

The findings of this study present several promising outcomes, suggesting that VREIT holds potential as a solution for real-time immersive job interview training, benefitting both autistic learners and their coaches. The following recommendations are based on the insights gained from the study:

1. **Expand User Testing Beyond Autism Spectrum Populations**: Future research should explore the use of VREIT with neurotypical users and individuals with other learning differences. This broader application could provide comparative insights into the unique benefits of VR for diverse populations and further tailor VREIT's design to meet a range of learning and training needs.

2. **Enhance Customization and Personalization Features**: Given that individual preferences vary widely, especially among autistic individuals, the customization of sensory elements within VREIT (e.g., brightness, sound, color contrast) should be further developed to ensure a comfortable experience for each user. Tailoring these elements to individual sensitivities will increase usability and engagement.

3. **Develop VR Coaching and Feedback Mechanisms**: Integrate real-time coaching and personalized feedback features within VREIT to enhance the learning process. This could include AI-driven feedback on eye contact, tone, and response timing, helping users to reflect on their performance and make improvements before entering real-world interview settings.

4. **Increase Training Modules and Scenarios**: Expand the training scenarios within VREIT to cover a wider range of industries and interview formats, enabling users to practice specific interactions relevant to their career paths. This could include different role-play scenarios, group interviews, or technical evaluations that reflect real-world job market demands.

5. **Evaluate Longitudinal Outcomes and Real-World Transferability**: Conduct longitudinal studies to assess how skills practiced in VREIT translate to real-world interviews over time. By following participants through subsequent interviews and employment settings, researchers could gain a clearer picture of the platform's long-term impact on employment outcomes.

6. **Incorporate Feedback from Trainers and Employment Specialists**: Engage job coaches, trainers, and employment specialists in the development and iterative improvement of VREIT. Their expertise can guide adjustments to the platform's training modules and provide insights on how to best support users in transferring VR-based practice to actual interviews.

7. **Enhance Accessibility and Technical Support**: Ensure that VREIT's design remains accessible to users of varying technical abilities by providing comprehensive guides, easy navigation, and robust technical support. Simplifying onboarding will help VREIT reach a broader audience, including those who may be less familiar with VR technology.

The promising outcomes from this study indicate VREIT's potential as a conceptual solution for job interview training within an immersive VR environment. These recommendations underscore the platform's versatility, highlighting future adaptations to broaden its applicability and optimize it as an impactful training tool for job readiness among autistic individuals and beyond.

7.2.1. Future Use Cases

This design case study primarily evaluated VREIT's potential impact on autistic participants' perceptions and preparedness for job interviews. Given the positive outcomes observed, future applications of VREIT span several areas that could benefit from its gamified, immersive, real-time VR environment.

Job Interview Skills: VREIT's VR environment provides a safe, controlled setting for users to repeatedly practice job interviews, crucial for mastering communication and building self-confidence. With lifelike avatars and real-time interactions, VREIT allows trainers to pose interview questions, offer guidance, and provide immediate feedback, helping learners improve specific areas through repetitive, scenario-based training. This aligns with studies indicating VR's effectiveness in preparing autistic individuals for competitive employment (Bozgeyikli et al., 2018; Smith, Fleming, Wright, Roberts, et al., 2015), suggesting VREIT could similarly boost confidence and preparedness for real-world job interviews.

Employer Training: VREIT could also serve as a training tool for employers, offering a unique perspective into the challenges autistic candidates face in job interviews, such as interpreting social cues and managing sensory sensitivities (Meister, 2021). By allowing employers to observe simulated interview scenarios, they can learn strategies for creating more supportive environments, such as providing concise instructions and offering response time, fostering inclusivity. This approach aligns with existing research emphasizing the need for empathy and understanding in recruitment processes to build a diverse, inclusive workplace (EARN, 2020).

Career Counselors: For career counselors and job coaches, VREIT offers a powerful tool for personalized training. Through the platform, autistic learners can practice various interview scenarios in a safe environment, while coaches provide real-time feedback. VREIT's screen-recording feature allows coaches to review sessions, offering tailored insights and strategies that align with learners' unique needs. Immediate feedback and personalized guidance help reinforce positive behaviors and address areas for improvement, contributing to the learner's confidence and preparedness.

Expansion to Other Groups: VREIT's applications extend beyond autism. Individuals with anxiety disorders, for instance, may find VREIT's controlled setting beneficial for building interview confidence through repeated practice, helping them manage anxiety. For career-changers, those re-entering the workforce, or non-native speakers, VREIT can offer skill-refreshing opportunities and cultural adaptation to current job market expectations. Non-native speakers and international students, often challenged by language and cultural differences, can gain familiarity with interview protocols and nuances, enhancing their communication confidence (Lev-Ari, 2015; Mahdi, 2022).

Remote Training: With the digital shift and rise of remote work, VREIT can serve as a valuable solution for remote interview training. By connecting trainers and learners through an internet-enabled VR environment, VREIT enables users to practice interview skills from their homes, receiving real-time feedback and support. VREIT can democratize access to essential job preparation resources, particularly for those facing geographic or logistical barriers, and aligns with trends in digital transformation and remote work, which emphasizes accessibility and flexibility (Beti et al., 2019; Grensing-Pophal, 2020).

The multi-faceted applications of VREIT demonstrate its adaptability as a VR-based tool for diverse training needs. By expanding its user base and refining its features, VREIT has the potential to become a vital resource for job interview preparation, inclusivity training, and remote learning, supporting learners and trainers across a range of challenges and contexts.

7.3. Limitations

This study primarily aimed to evaluate the design and development of the VREIT platform as a proof of concept for enhancing job interview preparedness for autistic individuals. While the innovative approach provides valuable insights, several limitations impact the robustness and generalizability of its findings.

The most significant limitation lies in the limited sample size (n=2), which restricts the ability to reach statistical conclusions and generalize outcomes to the broader autistic population. This small sample size reflects a narrow scope and may not capture the full spectrum of autistic individuals' experiences and challenges. Furthermore, the qualitative nature of this study, while offering in-depth individual insights, limits its applicability for making broad, generalizable conclusions.

Reliance on self-reported data and subjective interpretations presents another limitation. Metrics for success, such as self-reported confidence and perceived interview readiness, vary widely among individuals. The absence of a control group further complicates the attribution of observed improvements directly to the VREIT training. Moreover, the study lacks long-term follow-up, leaving questions about the sustained impact of the training on employment outcomes and job satisfaction unanswered. Longitudinal studies would be beneficial in assessing the long-term effectiveness of VR-based training for job interview preparedness among autistic individuals.

Potential biases in data interpretation are also noteworthy. With a single researcher conducting and coding the observations, subjective biases may have influenced findings. Although every effort was made to maintain objectivity, qualitative research’s inherent subjectivity means that multiple raters could interpret participant progress differently, affecting the study’s consistency.

Another limitation arises from the participants' backgrounds in the digital entertainment industry, which likely provided them with a familiarity with VR and interactive environments. This familiarity may have made navigating the VREIT environment easier for them than it would be for a general population or individuals with limited digital experience. Consequently, feedback on VREIT's usability and impact might not be as relevant for those with less computer literacy. Further testing with novice users is recommended to ensure feedback reflects a broader range of user experiences.

While this study offers insights into VREIT's potential for job interview training for autistic individuals, these limitations highlight the need for future studies with larger and more diverse participant populations and rigorous methodologies. Expanding on these findings will help validate VREIT's broader applicability and refine its effectiveness as a training tool for job readiness.

7.4. Final Reflections

Exploring the effectiveness of VREIT in job interview training for autistic adults has illuminated both its potential and its current limitations. The study's small sample size and reliance on self-reported data limit the generalizability of the findings, meaning the experiences shared here may not represent the broader population of autistic individuals. Additionally, the absence of a control group restricts our ability to directly attribute observed improvements solely to VREIT training, and the long-term effects on employment outcomes remain uncertain.

Future research could build upon these insights by incorporating a larger, more diverse sample to strengthen the generalizability of findings and establish a clearer attribution of outcomes through a control group. Integrating objective assessment tools, such as standardized interview performance scales, could provide measurable metrics that add rigor and reliability to evaluating job interview skills. Longitudinal studies that follow participants' career progress and job satisfaction post-VR training would also provide invaluable insights into VR's lasting impact on employment success.

Expanding VREIT's applications to a range of diverse groups—including individuals with anxiety, non-native speakers, and newcomers to the workforce—could broaden the platform's applicability and effectiveness. VREIT could also be adapted for

employer training, allowing recruiters to experience interviews from an autistic individual’s perspective, fostering empathy, and supporting more inclusive hiring practices. Further exploration into real-time feedback mechanisms could reveal how immediate, coach-driven cues impact interview performance and skill retention.

This study underscores VREIT's transformative potential as a gamified, immersive VR platform that prepares autistic individuals for job interviews by providing a safe, controlled environment for practicing essential skills. The platform's unique design allows users to engage in repeated, low-stress practice sessions with real-time feedback, effectively mimicking the dynamics of live interviews. While the study’s constraints, such as the small sample size, temper the conclusions, the findings suggest that VR-based training could make a significant difference in helping autistic individuals feel prepared and confident for interviews.

The successful development of VREIT represents a meaningful step forward in using technology to foster equitable employment opportunities. As VR technology continues to evolve, platforms like VREIT hold the potential for increasingly personalized and effective training environments that benefit not only autistic job seekers but also individuals with anxiety, non-native speakers, and other diverse populations. Extending VREIT to train employers in inclusive interviewing practices further opens possibilities for a more neurodiverse-friendly workforce.

This study contributes to the growing recognition of VR as a powerful tool in education and job training. By offering a structured, immersive experience tailored to the unique needs of autistic individuals, VREIT bridges the gap between learning and real-world application, empowering individuals and fostering greater inclusion in the workforce. The journey of VREIT is just beginning, with the potential to shape an inclusive, tech-driven future for diverse learners and job seekers alike.

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Appendix A. Design for Autistic Users

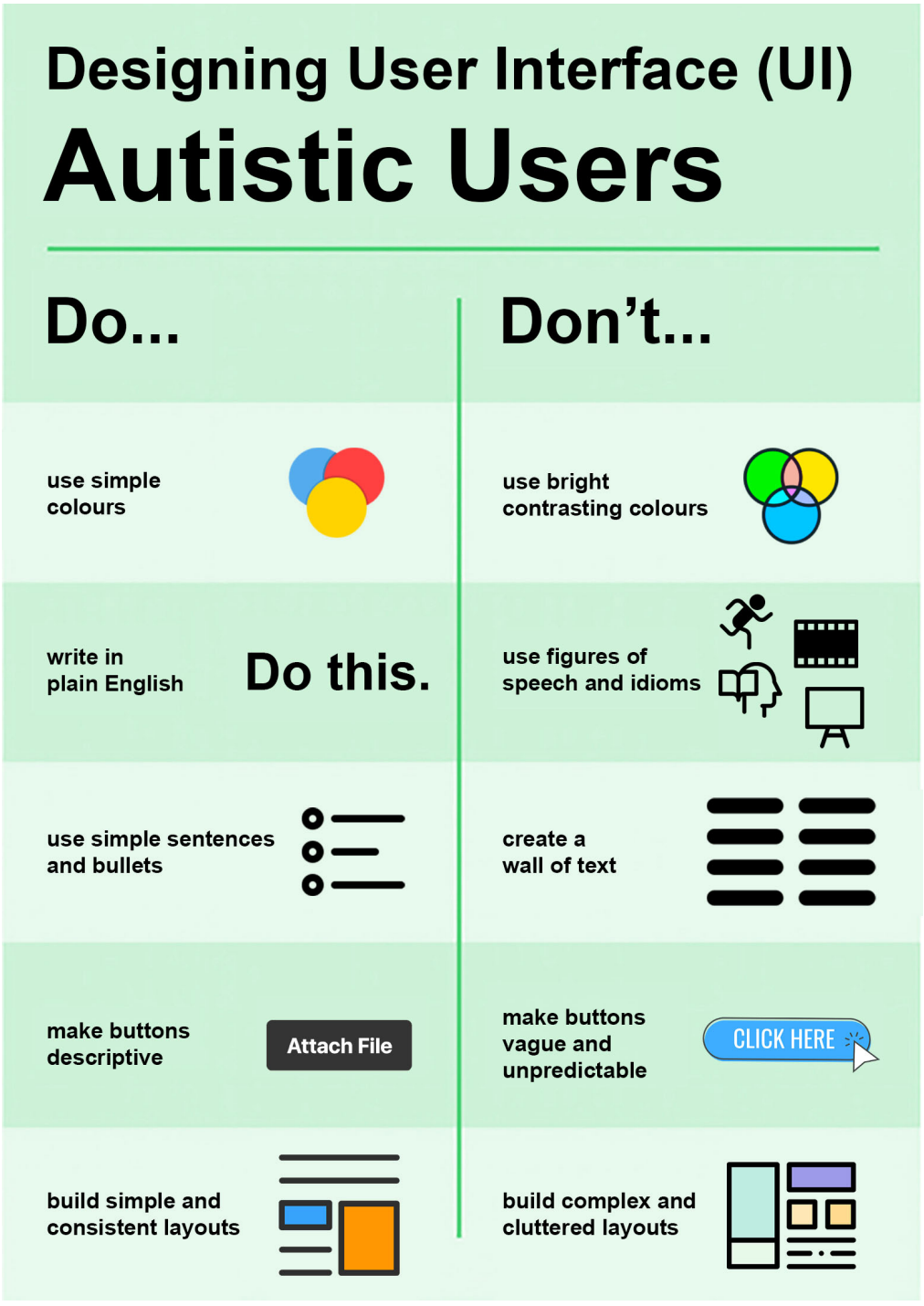

Figure 10. Designing for Autistic users

Appendix B. Informed Consent

Examination of Virtual Reality-Job Interview Skill Training (VR-JIT) for People with Autism Spectrum Disorder: A Pilot Study

Informed Consent Form

Introduction and Purpose of the Study:
Thank you for considering participating in the study about the VR-JIT experience in job interview skill training. Before you decide whether to participate, please take time to review the following information. If you have any questions or need additional information, please ask. If, after reviewing this information, you are still interested in participating, then we will go forward with the study and your participation.

I, Ramin Shadmehr, am conducting this study as part of my Ph.D. thesis research in Educational Technology & Learning Design at Simon Fraser University. Dr. Robert Williamson, Associate Professor of Education, is the faculty supervising my work in this program.

Description of the Research:
This study aims to learn about your experience using VR-JIT as a platform to receive training and improve job interview skills. To accomplish this goal:

- I will interview you before your session with the VR-JIT program. This is an in-person interview for 45-60 minutes. The interview will be audio recorded.
- You will have an initial job interview skills assessment session before VR-JIT training.
- For the first eight weeks, you will participate in a 90-minute session every two weeks.
- For the following six weeks, you will participate in a one-hour weekly session.
- You will receive all technology and equipment required to work with the VR-JIT application.
- During the VR-JIT sessions, I will observe you and take notes on how you interact with it. Additionally, the avatars' on-screen interactions will be recorded and stored confidentially on secure cloud-based storage through Simon Fraser University.
- I will interview you (in person and for up to 60 minutes) after completing the VR-JIT program. The interview will be audio recorded.
- Second job interview skills assessment session after the VR-JIT training.
- A proposed schedule for your participation is provided on the second page of this form, which could be adjusted to fit your needs.
- You can also view the dissemination plan for the findings of this study on the last page of this form.

Compensation:
You will be reimbursed for your time participating in this study ($20 CDN per hour). You may withdraw from the study at any time for any reason. If you wish to withdraw from this study at any time, contact me via email. If you withdraw from this study, all information related to you will be destroyed, and you will be allowed to keep your time reimbursement.

Potential Risks and Benefits:

Due to the nature of this study, there are no known risks to you while participating in the interview or VR-JIT sessions. Moreover, participants in this study may benefit from working with the VR-JIT application, as it could provide a better understanding and learning experience of job interview skills training via virtual reality.

Confidentiality:

Throughout this process, I ensure that your identity is protected. I will keep the audio recording in a secure, password-protected location (SFU Cloud drive) until the end of the research process and my thesis defense. I will transcribe the interview myself, and the resulting transcript will not include any information that could be traced back to you. I will maintain the data on the cloud drive (encrypted) for a total of 5 years. Only my supervisor and I have access to the data during this time. At the end of 5 years, I will delete the data.

I can be reached at xxx@sfu.ca or xxx-xxx-xxxx If you want to talk to the supervisor about this research, you can reach Dr. Robert Williamson at xxx@sfu.ca or xxx-xxx-xxxx. Feel free to contact either of us now or at any point in the future.

If you have any concerns about your rights as a research participant and/or your experiences while participating in this study, please get in touch with the Director, SFU Office of Research Ethics, at dore@sfu.ca or 778-782-6593.

Authorization:

By signing this consent form:

- You are not waiving any legal rights you may have in the event of research-related harm. You have the right to pursue legal recourse should you experience any harm from participating in this study.
- You agree to participate in this interview and to have the conversation audio-recorded.
- You understand that you are free to stop participating in this activity at any time.

Signature of Participant Date (YYYY/MM/DD)

Printed Name of Participant

Proposed participation schedule:

Date	Description	Length
June 5th, 2023	Initial Interview session	45-60 minutes
June 12th, 2023	Job interview skills assessment	45-60 minutes
June 19th, 2023	VR-JIT session 1	90 minutes
July 3rd, 2023	VR-JIT session 2	90 minutes
July 17th, 2023	VR-JIT session 3	90 minutes
July 31st, 2023	VR-JIT session 4	90 minutes

August 7th, 2023	VR-JIT session 5	60 minutes
August 14th, 2023	VR-JIT session 6	60 minutes
August 21ST, 2023	VR-JIT session 7	60 minutes
August 28TH, 2023	VR-JIT session 8	60 minutes
September 5th, 2023	VR-JIT session 9	60 minutes
September 12th, 2023	VR-JIT session 10	60 minutes
September 18th, 2023	Second and final Interview	45-60 minutes
September 25th, 2023	Second and final job interview skills assessment	45-60 minutes

*Note: the initial interview session is scheduled for October 14, 2023. The rest of the dates will be adjusted accordingly

Dissemination Plan for Ph.D. thesis research *(Examination of Virtual Reality-Job Interview Skill Training (VR-JIT) for People with Autism Spectrum Disorder: A Pilot Study)*

Upon completing this study, I will submit the finding of this research to my research committee for their review towards completion of my Ph.D. program. I will also share the research findings with the participants, including yourself.

After completing my program, I plan to submit the findings of this study as a research article to peer-reviewed academic journals in educational technology and training for autistic people. In addition, I will submit the results for presentation at academic conferences related to educational technology and training for autistic people, along with sharing the findings as a brief article on LinkedIn.

Appendix C. Interview Questions

Interview Guide (open-ended questions, the interviewer may ask follow-up questions based on the responses received) (Interview 1)

1. How many job interviews have you had?
2. Can you tell me about your job interview experience?
3. Tell me about the most and the least successful interview experience?
4. Have you participated in any training to develop job interview skills?
    a. If yes, will you please share your experiences and describe the training?
5. Please explain your level of confidence concerning your interview skills with regard to a future job prospect.
6. With regard to your interview skills, which parts of the interview process do you find most difficult?

The following questions will be asked after using the VR-JIT: (Interview 2)

1. Please describe your experience with the VR-JIT program.
2. If applicable, how would you compare training through VR-JIT with any previous job interview training?
3. In your opinion, what is the role of virtual reality as a platform to deliver training regarding interview skills?

Appendix D. Animation Industry Interview Questions

General Questions:

1. Walk us through the journey that led you to pursue a career in animation/video games/visual effects.

2. What are your top 3 strengths and weaknesses as a creative professional?

3. Describe a project you're particularly proud of and explain why it stands out.

4. How do you approach learning new software or techniques?

5. What are your preferred methods for staying updated with industry trends and advancements?

6. Share an instance where you received constructive feedback and how you incorporated it to improve your work.

7. How do you manage your time and prioritize tasks simultaneously when working on multiple projects?

8. Describe your ideal work environment and team dynamic.

9. What aspects of our company/studio culture resonate most with you?

10. Which artists, studios, or games have significantly influenced your work and why?

11. What are your salary expectations for this role?

13. What specific skills or areas of expertise are you eager to develop further?

14. How do you handle creative blocks or challenges during a project?

15. Do you have any questions for us about the company, team, or role?

These interview questions were adapted from several online job searching platforms.

Appendix E. Research Ethics Board Approval

SFU RESEARCH ETHICS

Minimal Risk Approval – Delegated

Study Number: 30001403
Study Title: An Examination of Virtual Reality-Based Video Modeling on the Enhancement of Interview Skills Training for People with Autism Spectrum Disorder: A Pilot Study

Approval Date: March 23, 2023
Expiration Date: March 23, 2024
Principal Investigator: Robert Williamson
SFU Position: Faculty
Faculty/Department: Education

Student Lead: Ramin Shadmehr
SFU Collaborator(s): N/A
Research Personnel: N/A
External Collaborator(s): N/A

Funder: N/A
Funding Title: N/A
Funding Number: N/A

Document(s) Approved in this Application:

- MIAS-marino interview assessment scale
- Informed Consent Letter V5 – Dated March 3, 2023
- Interview Questions_V4 – Dated March 3, 2023
- tcps2_core_certificate – Ramin Shadmehr – Dated March 14, 2023

The application for ethical review and the document(s) listed above have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human participants.

The approval for this Study expires on the **Expiration Date. An Annual Renewal must be completed every year prior to the Expiration Date. Failure to submit an Annual Renewal will lead to your study being suspended and potentially terminated.** The Board reviews and may amend decisions or subsequent amendments made independently by the authorized delegated reviewer at its regular monthly meeting.

This letter is your official ethics approval documentation for this project. Please keep this document for reference purposes.

This study has been approved by an authorized delegated reviewer.

Appendix F. Complete list of keywords

AUTISM: Prevalence, Characteristics, Levels and Subtypes

- Prevalence Autism
- Characteristics Of ASD
- ASD Behavioural Characteristics
- Functional Limitations Of ASD
- Social And Communication Impairments In ASD
- Autism And Speech Impairment
- Autistic Behavioural Patterns
- ASD Diagnostic Criteria
- Autism Levels and Subtypes

Autism In Adults

- Autism and Adulthood
- Prevalence of autism in people over 18 years of age
- Prevalence of autism in adults

Transitioning For Autistic People

- Autism and transitioning stages
- Autism and transitioning
- Employment for autistic individuals
- Transitioning to employment with autism

Modelling For Teaching and Learning

- Modelling Teaching and Learning Method
- Types Of Modelling Methods
- Effective modelling methods for autistic individuals
- Video Modelling and Autism

Virtual Reality as Assistive Technology

- Virtual Reality for autistic individuals
- Virtual reality for training
- Virtual reality for job interview training

Appendix G. Observation Behaviour Table

Observable Interaction and Behaviour	Observation notes and comments
Participant engagement level	
Confidence level	
Conversation framing (positive / Negative)	
Professionalism	
Level of interest	
Honesty and transparency	
Dependable and trustworthiness	
Interest in collaboration and working with others	
Sharing (skills, strengths, and weaknesses)	
Sharing past experiences	
Sharing beyond known characteristic limitations	
Others / Anomalies	