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Immersive Virtual Reality (VR) and Telehealth to Promote Engagement in Occupations for Rural Populations: Manual for Occupational Therapists

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Immersive Virtual Reality (VR) and Telehealth to Promote Engagement in Occupations for Rural Populations: Manual for Occupational Therapists

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Abstract

Telehealth has been used to alleviate the impact of occupational deprivation in rural communities (American Occupational Therapy Association [AOTA], 2018). There is continuing research on the development of telehealth in the occupational therapy profession. An emerging type of technology utilized in occupational therapy consists of using immersive VR interventions to increase client's performance skills (Karamians, Proffitt, Kline & Gauthier, 2019; Kwan, Park, Yoon & Park, 2012; Halton, 2008; Weiss Rand, Katz & Kizony, 2004). The combination of immersive VR and telehealth allows occupational therapy practitioners to interact, evaluate, and intervene with clients living in rural communities. The immersive VR system encourages engagement in occupations by rehabilitation of the client's performance skills and provides opportunities for the client and practitioner to work with one another to achieve tasks within the client's virtual context. Using telehealth and immersive VR allows the practitioner to engage with the client in both the virtual context and the client's natural context. Dunn, Brown and McGuigan (1994) and Turpin & Iwama (2011) explain that occupational performance cannot be fully understood outside of the natural context. A therapeutic manual has been developed which uses the Oculus Quest© immersive VR system, created by Facebook Technologies LLC. The Oculus Quest© interventions will be delivered using telehealth for clients living in rural communities. The manual provides occupational therapy practitioners with information needed to utilize immersive VR and telehealth during the therapy process in the client's natural environment. The manual is intended for the occupational therapy practitioners interested in adding immersive VR technology to their rural practice. Practical information and considerations for effective use of immersive VR technology are included in the manual.

Chapter I: Introduction

Immersive Virtual Reality (VR) is a type of technology delivered through telehealth, which provides clients with the opportunity to combine aspects of the virtual environment with their natural environment. The team discusses the utilization of technology to minimize occupational injustice in rural populations, the application of immersive VR using telehealth, and the relation of VR in occupational therapy practice. Rural populations face a variety of barriers for searching, finding, and implementing health services due to factors such as cost, time, and distance. Utilization of telehealth can help eliminate some barriers and enhance access to health services in rural or isolated populations.

The team developed and provided a product that will allow occupational therapy practitioners to learn and facilitate the use of immersive VR during the occupational therapy process. The product consists of a manual that allows practitioners with a new way of providing therapy services to the rural population and assists in educating on how to use the immersive VR system in combination with telehealth. In addition, this type of intervention will encourage and help increase the engagement during meaningful activities for the clients. Practitioners search and develop games and activities within the immersive VR system that match the personal values, interests and factors of each individual client. The manual provides example activities that practitioners may use if applicable to their clients.

Factors that influence the application of the team's product can include the increased use and production of new technology, as well as the changes in occupational therapy reimbursement for the utilization of telehealth. The use of technology is an emerging trend that is widely used within the practice of occupational therapy for evaluation, intervention, and discharge purposes and is a trend that will continue to grow and be utilized (Gagnon et al., 2006; Moffet & Eley,

2009). Technology devices such as the use of a computer and telehealth can give the occupational therapist and their client increased access to needed services.

The product will be guided by the Ecology of Human Performance (EHP) model and the Human Activity Assistive Technology (HAAT) model. The team's dynamic interaction between the EHP and HAAT model incorporates the various components of the person, context, and assistive technology device being utilized and how these components affect participation during meaningful occupations.

Chapter II will demonstrate the team's extensive literature review prior to the manual development. Key terms and concepts used during the literature review search for the product included rural populations/settings, technology/assistive technology, occupational therapy, and immerse virtual reality. Chapter III illustrates the team's entire process taken for the manual development. Chapter IV consists of a summary of the team's manual. The completed manual consists of the guiding models related to immersive VR and telehealth, step-by-step instructions relaying the step-up process, possible screenings/assessments utilized, along with potential games to distribute as interventions. Chapter V demonstrates an overall summary of the team's work along with recommendations and limitations determined by the team.

Chapter II: Literature Review

Occupational Injustice in Rural Populations

Due to the implementation of telehealth technology as a means to provide health services being relatively new, the utilization of telehealth still faces many barriers related to structural, organizational, and professional aspects of health services (Gagnon, Duplantie, Fortin, & Landry, 2006). Gagnon et al., (2006) clarified that existing barriers such as reimbursement, policies governing telecommunications, and the introduction of new technology challenges during the implementation of telecommunication in rural populations. The medical profession, for example physicians, represent one of the main groups of telehealth users, in which the introduction of this technology into their practice can be affected through these existing barriers (Gagnon et al., 2006).

Wilcock and Townsend (2009) report that occupational injustice is "the right of every individual to be able to meet basic needs and have equal opportunities and life chances to reach toward her or his potential but specific to the individual's engagement in diverse and meaningful occupation" (p 193). The American Occupational Therapy Association (AOTA) explained the emerging practice of technology and refined the role of occupational therapy practitioners in providing ethical and competent occupational therapy services using assistive technology (AT) (Goodrich & Garza, 2015). Reports concluded a higher number of barriers for rural patients seeking health services compared to the barriers of the health care providers giving health service in a rural community. Health care delivery can be technology-demanding, costly, and dependent on workforce skill, but largely in rural areas, long waiting time, irregular contact with therapists, and traveling long distances can be increased (Brems, Johnson, Warner & Roberts, 2009; Gardner, Bundy & Dew, 2016).

According to Brems, Johnson, Warner, and Roberts (2009), rural areas demonstrated to have more health care barriers compared to urban areas. These health care barriers included resource and service limitations, overlapping roles of health care services, training constraints, and provider travel. Resource and service limitations for availability of skilled services such as occupational therapy, physical therapy, diabetes management, and stroke care. Due to the lack of resources and services, there can be an increased drive time for individuals traveling to receive these services in urban areas. The use of telehealth can assist in bridging the gap between rural areas and the need for increased skilled health services.

Technology and Occupational Therapy

The use of technology in occupational therapy has grown in its 100 years of practice. Technology within occupational therapy practice is also known as assistive technology (AT). The Assistive Technology Act of 1998 (2004) as written in the Public Law 108-364 located on page 1710 defined an AT device as "any item, piece of equipment or product system whether acquired commercially off the shelf, modified, or customized that is used to increase, maintain, or improve functional capabilities of individuals with disabilities." Cason (2015) defined telehealth as a remote service of health care services using information and communication technologies, in which the provider and client/consumer are in different locations.

Occupational therapy practitioners use telehealth as a service delivery model (Cason, 2015; Cason, Hartmann, Jakobs & Richmond, 2013). Telehealth can substitute traditional in-person physician-to-patient encounters with home-based medical services (Singh et al., 2010). Cason et al., (2013) noted that occupational therapy practitioners use telehealth for evaluation, intervention, consultation, monitoring, and supervision during therapy sessions. Bondoc,

Goodrich, Gitlow and Smith (2016) described the use of AT to facilitate intervention in occupational therapy practice and the support of a client-centered approach. Bondoc et al., (2016) explained that occupational therapy practitioners design, fabricate, apply, modify, and provide training regarding AT as part of the intervention process. Through the occupational therapy process stated above, telehealth has the potential to increase health care services. Telehealth strengthens practitioner's ability to deliver services and permits change to the healthcare system as a whole (Gagnon et al., 2006). Home telehealth services within the U.S. Department of Veterans Affairs enabled 41,430 patients to live independently in their own homes (Darkins, 2014). Smith (2017) also offered evidence supporting the importance of AT and its role in the field of occupational therapy. Smith (2017) expressed that no single force has an impact on society related to the quality of life compared to technology.

Individuals with a variety of disabilities, illnesses, and physical or cognitive deficits have benefited from the use of newly developed virtual technology. Virtual reality (VR) has developed rapidly in the last couple years and it is one of the most promising and challenging technologies to master and utilize. The use of VR openly allows one or more people to interact with a virtual environment that simulates the client's real world (Liu et al., 2019; Gatica-Rojas & Méndez-Rebolledo, 2014). The American Occupation Therapy Association (2020) explained the Centers of Medicare and Medicaid Services clarified the approval for institutional settings, including home health agencies to bill telehealth services under Medicare Part B along with telehealth services in skilled nursing facilities (SNFs) billed under Medicare Part A. Allowing occupational therapy practitioners to bill for telehealth services increases the motivation for the

use of telehealth. Delivering the services via telehealth allows practitioners to reach clients who do not have easy access to healthcare services.

The literature above supports the use of technology such as telehealth within occupational therapy practice. The literature explained the ability for occupational therapy practitioners to deliver services through telehealth to increase client participation during meaningful occupations. An emerging technology in today's society is the use of immersive VR, which can be adapted to use in the occupational therapy practice. Immersive VR in the occupational therapy practice is described below.

Rural Populations and Telehealth

Singh et al., (2010) stated that in rural areas, there is a large population identified as experiencing hardships such as the lack of access to a variety of health care services. The hardships experienced support the critical influence of telehealth within the rural population. Gagnon et al. (2006) defended that telehealth can support the delivery of services in a timely fashion for remote or isolated populations, facilitate access, and save travel costs for both the patients and professionals. For these rural or isolated areas, telehealth is considered a tool that can exert a positive impact on several dimensions of health care service delivery (Gangon et al., 2006). For example, telehealth can have a positive impact on occupational therapy by allowing the patient to be surrounded by their least restrictive environment and obtaining a client-centered session based on client outcomes. According to Cason et al., (2013), occupational therapy outcomes aligned with telehealth includes facilitation of occupational performance, health and wellness, prevention, and overall quality of life and concluded that telehealth will be valued for its effectiveness and cost-efficiency.

Hinton, Sheffield, Sandars and Sofronoff (2017) aimed to treat and prevent severe behavioral, emotional and developmental problems in children and adolescents by improving the knowledge, skills and confidence of their parents. Hinton et al., (2017) developed the study to examine the efficiency of a telehealth intervention identified as Triple P Online-Disability (TPOL-D) for parents of children with a disability. The study consisted of 98 parents and caregivers of children aged 2-12 years-old diagnosed with a range of developmental, intellectual and physical disabilities. The results explained that the parents or caregivers who utilized the telehealth system had significantly increased confidence when managing their child's emotional and behavioral problems. Results showed participants who received the TPOL-D intervention had significant improvements within their parenting practices such as greater consistency, decreased coercive behaviors, increased positive encouragement, and improved parent-child relationship.

Likewise, Moffat and Eley (2009) performed a literature review that identified the benefits of telehealth for individuals living and working in rural areas of Australia. The authors discovered consumer benefits such as lower costs, reduced inconvenience while accessing specialist health care services, and improved access to services. Health care practitioners described benefits of enhanced local services, experiential learning, and collaboration skills (Moffat & Eley, 2009).

Gardner, Bundy and Dew (2016) performed a qualitative study to understand the perspectives of caregivers of a person with a disability living in rural New South Wales (NSW) on the use of information and communication technologies (ICT). Some barriers identified by the participants were long waiting time for therapy access; having irregular contact with therapists;

and traveling long distances for therapies. Gardner, Bundy and Dew (2016) found that participants believed ICT could overcome the barriers. The three themes developed based on the participants' perspectives. (1) building on previous experiences; (2) making ICT work; (3) potential for adding value. Each participant used technology and had access to the internet. Participants believed internet access was useful and essential. The participants perceived the benefits of using ICT to overcome the barriers of receiving occupational therapy services while living in rural areas. Gardner, Bundy and Dew (2016) provided limitations of a small sample size and participant residential areas allowing more internet access compared to remote areas. Gardner, Bundy and Dew (2016) concluded that based on the participant perspectives, ICT has the potential to increase occupational therapy access. Gardner, Bundy and Dew (2016) stated that occupational therapists could benefit from eliciting the experiences, knowledge and willingness of rural caregivers when delivering services via ICT.

Furthermore, Singh et al., (2010) performed a qualitative, longitudinal case study in which the purpose of the study was to examine the adoption of telehealth in rural public health districts and to explain how the innovation became sustainable. Semi-structured interviews were used which were transcribed and coded to develop the principal findings. Singh et al., (2010) discovered that extensive collaboration with a combination of technology advocacy and opportunistic exploitation can enable sustainable rural telehealth. Overall, telehealth innovations can reduce the resource differential between urban and rural areas by enhancing access to medical services for rural communities (Singh et al., 2010). In addition, "telehealth delivers services over distance to facilitate knowledge sharing and distribute complex diagnostic processes and medical decision making across health care" (Singh et al., 2010, p 986). Thus,

telehealth is becoming a strong alternative to health care for occupational therapy and other health care services.

Immersive VR

VR, augmented reality (AR), mixed reality (MR), and immersive VR are the four terms commonly used by individuals (Bockholt, 2017). Bockholt (2017) defined each term to help readers understand the similarities and differences between these terms. The generic term, VR, can range from technological devices such as head-mounted displays to mobile phone video games. AR is defined as virtual context utilized in the real world (Bockholt, 2017). An example of AR is the placement of an individual's bitmoji on a table using the Snap Chat app. MR is the combination of VR content and real-time film sequences. Bockholt (2017) further described MR as an individual being recorded while simultaneously using VR with the assistance of a green-screen technology.

Immersive VR is the use of VR to completely immerse the individual into an artificial world. To be able to completely immerse into an artificial world, VR relies on technologies such as 3D stereoscopic head tracker displays, hand/body tracking, and binaural sound as part of the whole VR system (Cipresso, Giglioli, Raya & Riva, 2018). The VR system is then split into two different parts including input and output devices. "The input devices are the ones that allow the user to communicate with the virtual environment" (Cipresso et al., 2018). In the VR Oculus Quest © system, the input devices include the joystick controllers, which controls, commands, and communicates with the VR environment. On the other hand, the output devices allow the gamer to hear and touch everything that happens in the virtual environment (Cipresso et al.,

2018). In the VR Oculus Quest© system, this would entail the headset to stimulate body senses for the virtual experience.

According to Cipresso et al., (2018), due to these technologies that make up the VR system, this can create an interactive, multisensory, viewer-centered, and 3D computer generated virtual environment for the gamer. Weiss, Rand, Katz and Kizony, (2004) stated that users interact with displayed images, move and manipulate virtual objects, and perform other actions that help immerse the user into a simulated environment which enhances the feeling of a virtual world. In order to improve the individual's functional abilities, the therapist will increase the difficulty by increasing or changing physical or verbal guidance of the individual's movements and actions, which will then modulate the level of difficulty within the task or activity (Sveistrup, 2014).

The literature described above supports the use of the utilization of immersive VR. Immersive VR has the ability to incorporate multiple senses such as vision, tactile, and proprioception to increase functional performance during engagement in meaningful tasks and occupations.

VR Utilization for Physical Diagnosis in Occupational Therapy

Virtual intervention during rehabilitation utilizing telehealth is able to provide a natural and real-life environment for the client (Halton, 2008). Virtual rehabilitation allows supported learning through understanding and memory preservation (Cipresso et al., 2018). Using VR for therapy for individuals in rural settings, the therapist has the ability to replace real stimuli, recreate experiences, and apply learning opportunities with a high amount of realism through this technology (Cipresso et al., 2018). This real-life environment and supported learning allows the

ability for an occupational therapist to utilize client-centered intervention in a least restrictive environment during occupational therapy practice. “VR can provide patients with safe access to interactive, true-to-life situations that would otherwise be inaccessible to them due to motor, cognitive, and psychological limitations” (Weiss, Bialik & Kizony, 2003, p 335).

Weiss et al., (2004) justified that VR has a number of qualities that make it highly suitable as an intervention tool, including the ability of active learning, the ability to objectively measure behavior in a challenging but safe place, and the freedom to individualize treatment during sessions. VR can also provide enjoyment of experiencing the real-world environment rather than be confined in the hospital setting (Nunnerley, Gupta, Snell & King, 2017).“VR will provide a unique medium where therapy can be provided within functional, purposeful and motivating context, and can be readily graded and documented” (Sveistrup, 2014, p 26). In addition, VR programs can simulate real-world activities, which clients are able to practice for an extended period of time due to the task or activity being considered more enjoyable by the individual compared to conventional programs (Pazzaglia et al., 2020). Halton (2008) stated a particular compliance obstacle for post-discharged clients when using home exercises and therapy programs, in which VR helps enjoyment and motivation to enhance compliance within occupational therapy interventions.

Ellington, Adams, White and Diamond (2015) developed a study to investigate the behavioral intention of post stroke patients to use a virtual system for practicing instrumental activities of daily living (IADL’s). The study consisted of 14 participants who were immersed into a virtual world-based system. The participants went through four sessions of participating in IADL’s, such as cooking and putting away groceries. Data was collected through a questionnaire

based on the Technology Acceptance Model. The results of the study determined four themes: use of the affected arm increased, virtual practice was enjoyable, technology was user-friendly, and the system reflected real-life activities (Ellington et al., 2015).

Additional evidence of the benefits of incorporating immersive VR into interventions to facilitate occupational performance and participation were provided by Kwon, Park, Yoon and Park (2012) using a double-blind randomized control trial with the purpose to examine the effects of conventional therapy combined with intensive VR program on upper extremity function and activities of daily living (ADL) with individuals in acute stage of a stroke compared to using conventional therapy alone. Kwon et al., (2012) used five games that required reaching and lifting motor skills. The VR training lasted 30 minutes per day for five days a week for a total of four weeks. CT consisted of routine physical and occupational therapy. The participants and therapists focused on gait training, balance, table-top activities, strengthening exercises of the upper limb, and ADL training. The experimental group had significant improvements related to the upper extremity functioning between the pre-test and post-test based on the findings of the Fugl-Meyer Assessment (FMA) and Manual Function Test (MFT). The experimental group had significantly higher measurements in the FMA compared to the controlled group. The experimental group had a significant difference in the pre- and post-tests for both groups. Kwon et al., (2012) explained one of the limitations as the small sample size which may be a factor of not seeing significant differences between the two-groups related to upper extremity ADL performance. Just et al., (2016) demonstrated that VR provides an opportunity to train and improve movements and skills through increased repetition when working with stroke clients.

The Oculus Quest © system increased physical involvement by recruiting more body segments in each movement compared to non-VR therapy.

Furthermore, a research study performed by Weiss, Bialik and Kizony (2003) focused on helping individuals with disabilities engage in occupations, such as leisure, through the use of telehealth and VR. They explain the ability to change the virtual environment easily by grading the task and being able to adapt the task to the clients' or patients' capabilities, which is one of the most important advantages of VR. In this case, the experience of the virtual environment would not improve body functions, but would enhance the individual's participation in the activity as a means to an end (Weiss, Bialik & Kizony, 2003). For example, the use of the VR game would not change the individual's body functions such as mental, sensory, or neuromuscular function, but will increase the individual's ability to participate in meaningful leisure activities and increase quality of life based on the individuals needs and mental or physical capabilities.

Lewis and Griffin (1998) discussed patients and clients suffering from motor disturbances can benefit from VR environments in many ways, including re-training of disturbed functions as a series of graded motor tasks of decreasing or increasing complexity. According to Lewis and Griffin (1998) patients and clients suffering from motor disturbances benefit from VR environments in many ways including re-training of disturbed functions is a series of graded motor tasks of decreasing or increasing complexity, and VR offers precise feedback in real-time to the therapist. The graded tasks and feedback enhance occupational therapy practitioners use of developing client-centered interventions during rural telehealth sessions.

More recent evidence supports the knowledge that the use of VR within the intervention process provides an enriched environment that promotes client factors and both cognitive and motor skills. Clients who utilize repetitive practice and task-specific training have shown to have increased motor and cognitive skills through the use of VR with telehealth (Pazzaglia et al., 2020). The use of VR in the occupational therapy practice acts as a source for integrating client factors and performance skills to foster functional performance in daily occupations.

An increased use of VR systems has also begun to be used as a tool in neuropsychological practice such as body neglect as a post-stroke symptom. Broeren et al., (2007) tested VR application for neglect assessment by comparing the virtual environment VR system while looking at performance and hand movements. The results showed that the participant's performance in the VR task indicated that the VR system is more informative for performance in search patterns, repeated pressure, ipsilesional start of search, and hand movements compared to more conventional tests such as pencil and paper tests (Broeren et al., 2007). Broeren et al., (2007) concluded that the VR system can provide a deeper analysis on detecting small variation in performance. Similarly, Corbetta, Imeri and Gatti (2015) performed a systematic review of meta-analysis of randomized control trials to determine if rehabilitation that incorporates virtual reality is more effective than standard rehabilitation for improving walking speed, balance and mobility after stroke. The systematic review consisted of 15 articles. Nine studies measured locomotor function using a 10-meter walk test, 6-minute walk test or gait velocity tests.

The participant' balance was assessed using the Berg Balance Scale in nine studies. Seven of the studies used the Timed Up and Go test to assess mobility. The seven studies

measuring walking speed, 65 participants utilized the VR rehabilitation replacing some of all of standard rehabilitation had significantly improved walking speeds. Of the five studies assessing balance using the Berg Balance Test, 67 participants received VR. These participants demonstrated significantly improved balance. Of the five studies measuring the participant's mobility, 53 received VR. The participants had significantly improved mobility as well. Corbetta, Imeri and Gatti (2015) determined that substituting some or all standard rehabilitation with VR provided higher benefits in walking speed, balance and mobility for individuals diagnosed with stroke.

Karamians, Proffitt, Kline and Gauthier (2019) performed a meta-analysis study in which the purpose was to determine the efficacy of VR-based and gaming-based interventions for the improvement of upper extremity function for individuals post-stroke. The studies within the meta-analysis utilized the Downs-Black credibility checklist with the rating score of greater than or equal to 18; and the outcome measures of the studies were the Wolf Motor Functioning Test, the Fugle-Meyer, or the Action Research Arm Test. Karamians et al., (2019) discovered an improvement produced by the use of VR and gaming interventions. The dose of the VR intervention and severity of the impairment did not have a significant influence on the outcomes. The treatment gains were significantly larger when using gaming interventions compared to visual feedback. The use of VR and gaming interventions showed significant treatment advantages compared to active control treatments. Karamians et al., (2019) concluded that the use of VR and gaming-based interventions for upper extremity rehabilitation post-stroke appears to be more effective than conventional methods.

Nunnerley, Gupta, Snell, and King (2017) worked to develop and test the feasibility of an immersive 3D (VR) wheelchair training tool for individuals who have sustained a spinal cord injury (SCI). The qualitative study consisted of using the Oculus Rift headset and a Dynamic Control wheelchair joystick to design a wheelchair training system. Participants of the study consisted of experienced wheelchair users with more than five years of experience and clinicians with more than two-year experience working in the rehabilitation of individuals with SCIs. Two researchers facilitated the focus groups and asked semi-structured questions related to the participants' perspectives using the Oculus Rift system. The wheelchair users and clinicians thought the program was realistic related to the experience of driving a powered wheelchair. Participants were able to identify applications for the use of VR wheelchair training for individuals who were newly diagnosed with SCI. Some of the wheelchair user participants explained how the use of the VR can help with the anxiety of being newly diagnosed (Nunnerley, Gupta, Snell, & King 2017). The evidence supports the use of the Oculus immersive VR as a tool for clients, and is relevant as the product described in the manual is a similar Oculus product, which is able to be used with telehealth technology.

According to Flores et al., (2018) the individuals with the SCI's completed a skills learning intervention in combination with Dialectical Behavioral Therapy mindfulness skill audio tracks. The study focused on outcome measures such as nervousness/anxiousness, depression, and feelings of emotional upset of the individual. The evidence displayed affirmation that the combination of virtual reality and mindfulness training helped reduce psychological issues of individuals with SCI's (Flores et al., 2018). Lack of mobility, sensory limitations,

mindfulness techniques, and boredom were major inhibiting factors with treatment for this population, but immersive VR can help individuals with different levels of SCI's.

In a second study from Araujo et al., (2019), VR-based interventions with individuals with an SCI were correlated with an increased motor function, decreased neuropathic pain, and increased balance and aerobic function. Of these searches, 721 titles in the databases utilized, VR was used both alone or paired with other therapies to increase therapeutic practice. Due to VR through the use of telehealth, the individual with an SCI can interact in meaningful tasks or activities to incorporate into their daily occupations at home and in the community setting.

Individuals with vestibular dysfunction can also be positively affected by the use of immersive or 3-dimensional VR rehabilitation using exercise and movement interventions. Yeh et al., (2014) discusses that individuals with this deficit may not perform activities of daily living, which can lead to a decreased quality of life and a further decline of vestibular function. But with simple and repeated eye movement, head motion, limb motion, and balance training, imbalance and dizziness can be exacerbated (Yeh et al., 2014). The results showed that balance and performance scores were significantly improved, which indicates the VR system intervention effectively promoted vestibular function and balance rehabilitation (Yeh et al., 2014).

VR Utilization for Psychosocial Diagnosis in Occupational Therapy

Additionally, according to Manera et al., (2016) cognitive-based training based on immersive VR has been an emerging area of focus for researchers in the field of dementia and mental condition injuries (MCI) and has been shown to be a promising tool of therapy and rehabilitation. "Successful applications have been developed for treatment of phobias, stress, anxiety, as well as for post-stroke rehabilitation and pain mitigation" (Manera et al., 2016, p 2).

The results demonstrated the participants with MCI reported high level of security, low discomfort, and low anxiety and fatigue during participation in intervention (Manera et al., 2016). The participants also reported preference for VR compared to a paper version of the task that was given during the study, even if the task was more difficult through VR (Manera et al., 2016). Comprehensively, the study showed that the VR system was able to improve adherence during cognitive training with individuals with conditions such as dementia or an MCI. Maggio et al., (2018) developed a study to determine the effects of a VR training system related to the cognitive and behavioral recovery in patients with Parkinson disease (PD). An experimental group who received semi-immersive VR while the control group received cognitive training only. The experimental group had significant improvements in their mild cognitive impairments along with their general cognition and visuospatial abilities. Maggio et al., (2018) determined that the use of VR improved motivation and participation.

Newer research demonstrates the ability for VR to help with pain management while treating burns. It was demonstrated that allowing the participant to be immersed in a virtual environment with three-dimensional vision and interaction through movement promoted distraction of the real senses (Scapin et al., 2017). According to Scapin et al., (2017) this specific real sense interaction is achieved using helmets, goggles, gloves, hand controls, and/or voice command to allow the patient to sense the virtual environment in real time. This study established that the use of VR during each case showed relevant effects in pain reduction and increased movement from the burned parts of the body. Furthermore, results showed the VR system emphasized entertainment, reduced time thinking about pain, and helped reduce stress while the participant created movements during wound management and dressing (Scapin et al.,

2017). This pain management intervention allows VR to help individuals with burns increase their movement and decrease pain while accomplishing wound care interventions within the participants home environment.

The utilization of immersive VR has demonstrated to have beneficial results for clients' cognitive and motor skills as well as their overall function. However, there are precautions to take into consideration as the immersive VR may not be applicable to all clients. The section below provides precautions occupational therapy practitioners should consider when determining if immersive VR is suitable for each of their clients.

Precautions

Some precautions for the use of the Oculus Quest© VR system can include individuals with oculomotor disturbances such as eyestrain, difficulty focusing, blurred vision, headache, or fatigue (Flynn et al., 2003). According to Lewis and Griffin (1998) precautions such as individuals with postural instability are less likely to be successful with immersive VR due to disorientation or other side effects. Aspects of disorientation can include dizziness with the eyes open or closed and vertigo (Flynn et al., 2003; Nunnerley, Gupta, Snell, and King 2017). The therapist must be cautious of the patient or client's past motion sickness history because individuals with this history are more susceptible to motion sickness while using the Oculus VR system during occupational therapy interventions (Lewis & Griffin, 1998).

Problems with disorientation, balance, and nausea following engagement in VR activities can happen, due to temporal and spatial distortions between the individual's motions of the body and the corresponding movements displayed from the Oculus VR system (Lewis & Griffin, 1998). Occupational therapists need to be aware of these side effects from VR because such

distortions have shown a decline in performance of tracking, manipulation, and reading tasks (Lewis & Griffin, 1998). This will affect the overall strength of the VR system as an intervention as it could impede client safety and result in decreased performance and compromised learning.

Usability of VR in Occupational Therapy

Researchers have studied the usability of the immerse VR system, which can include presence, user inputs, display quality, simulation fidelity, and overall system usability (Flynn et al., 2003). Based on some of these factors, this can support or hinder the intervention process for an individual. Seo et al., (2016) stated that overall, VR games need to demonstrate the potential for providing motivational, challenging, interesting, easy-to-use, and an easy to understand process to help engage individuals with stroke or other physical deficits during intervention.

Motivation was a major factor for making VR programs successful during therapy. When patients were able to feel that their experience was unexciting, they began to lose interest or retract from the program and lead to decreased motivation (Howard, 2017; Brayanton et al., 2006). This decreased motivation can lead to less effort during the task or activity that results in smaller improvements in rehabilitation outcomes or no outcomes at all (Howard, 2017; Betker, Desai, Nett, Kapadia & Szturm, 2007). Patients have found that interactions with a VR environment was fun and interesting through the use of novelty of immersive displays, such as head gear and surrounded screen displays, that can have a more positive reaction during these VR experiences (Howard, 2017).

Howard (2017) suggested that VR can add excitement to traditional occupational therapy sessions. Studies performed by Howard (2017) and Bryanton et al., (2006) tested Virtual Reality Rehabilitation (VRR) programs where patients used their toes to flick a coconut and scored were

awarded based on the performance of the distance flicked. Patients found that the VR program was more exciting and enjoyable than a traditional rehabilitation program and demonstrated that the patients exerted increased effort (Howard, 2017; Bryanton et al., 2016). Howard (2017) and Bryanton et al., (2016) concluded that VR was efficient in increasing motivation and interaction during participation in VR intervention. The use of a gaming-based intervention such as the immersive VR can add an exciting twist to traditional occupational therapy sessions and can incorporate an engaging virtual environment compared to traditional rehabilitation.

Occupational Therapy Guiding Models

One of the chosen models to guide our product is the Ecology of Human Performance (EHP) model. The EHP model was chosen to guide the product as it incorporates the interactions with the person, context and tasks to improve performance (Dunn, Brown & McGuigan, 1994). Dunn, Brown and McGuigan (1994) stated that the person can not be separated from their context or ecology, and it is the central force of their behavior and performance. Turpin and Iwama (2011) explained that the EHP model conceptualizes the environment as a broader context which shapes both the person and the tasks being performed. The EHP model has a heavy influence on the natural environment, which for many clients, is their homes. Context, from the EHP perspective, also consist of the healthcare practitioners and family members that interact with the clients (social environment), the time of day and scheduling between time zones (temporal context), and the overall behaviors and attitudes that present within the homes (cultural context) (Dunn, Brown, & McGuigan, 1994). Dunn, Brown, and McGuigan (1994) emphasized the importance of utilizing the client's natural context. A client living in the rural setting has the natural context of their home, place of living, or other work environment. The product

encourages the use of telehealth to allow clients to participate in sessions in their home. The games practitioners use in their sessions are identified as the tasks described in the EHP model. The practitioners observe and facilitate the client's client factor and cognitive and motor skills.

The person consists of variables such as their interests, values, experiences and their sensorimotor, cognitive, and psychosocial skills (Turpin and Iwama, 2011). Turpin and Iwama (2011) explained that the personal variables influence the tasks a client performs and the quality of the client's performance in the desired tasks. Dunn, Brown and McGuigan (1994), define the tasks as "an objective set of behaviors in order to accomplish a goal that are highly variable among individuals and that cluster together, forming an individual's roles" (p. 80). The interactions occurring between the person, context, and task influence the performance of the individual. An individual's performance range is described as the individual's ability to utilize cues from the environment to influence their skills and abilities. OT's observe the client's performance during the evaluation and intervention processes and adapt to their needs (Dunn, Brown & McGuigan, 1994).

Each individual receiving OT services performs differently with their personal factors and performance skills. Occupational therapy practitioners should consider the client factors and performance skills of each client before selecting interventions within the immersive VR system. The tasks related in the VR system are the games the clients perform within the system. Examples of the games consist of Job Simulator and Vacation Simulator. The games require individuals to utilize their abilities and skills to complete the task at hand (Dunn, Brown & McGuigan, 1994). The use of the immersive VR system and telehealth combine the virtual

context with the client's natural environment which provides cues and features to support or hinder occupational performance.

The context corresponding with the VR system consists of the virtual immersive VR environment and client's least restrictive environment. The use of the immersive VR system and telehealth combine the virtual context with the client's natural environment of their homes. The EHP model social environmental concept also consists of the healthcare practitioners and family members that interact with the clients. The temporal context consists of the time of day and scheduling between time zones with the VR and telehealth systems. The cultural contexts are identified as a client's overall behaviors and attitudes that present within the homes (Dunn, Brown, & McGuigan, 1994).

The OT practitioner utilizes telehealth with the utilization of the Zoom platform to perform the evaluation and intervention processes. The EHP model can be used to guide OT practice in delivering services to clients living in rural settings with the use of immersive VR and telehealth. Dunn, Brown, and McGuigan (1994) described the use of intervention approaches during the intervention planning and implementation processes. The intervention approaches include establish/restore, alter, adapt/modify, prevent, and create (Dunn, Brown & McGuigan, 1994). Each of these approaches were considered with telehealth and VR interventions in mind.

Establish/restore focuses on the personal factors to improve their skills, whether establishing a new skill or restoring lost skills (Dunn, Brown, & McGuigan, 1994). As individuals lose performance skills, occupational therapy practitioners utilize the immersive VR to assist with the development of skills to increase their functional performance in meaningful occupations. Practitioners are able develop and observe clients perform the tasks and facilitate

their ability to restore the skills or develop new skills to overcome the barriers presented by their diagnoses.

The alter intervention approach addresses the context. Turpin and Iwama (2011) described the alter intervention approach as changing the environment or aspects of the environment to allow a person to perform a desired task. The occupational therapy practitioner matches the individual's interests and skills with demands within the context. Practitioners alter the context by utilizing the virtual environment within a client's home setting. The adapt/modify approaches consist of changes to the tasks. Practitioners may make changes to the games to increase a client's performance. Prevent and create approaches focus on preventing problems or creating opportunities by making changes to the person, context, or task before issues occur (Dunn, Brown & McGuigan 1994). The immersive VR works as assistive technology such as creating opportunities and facilitating performance during a task. The occupational therapy practitioner may work to prevent inappropriate behaviors that may impede performance during the game playing. Utilizing the intervention approaches allow practitioners to use holistic and client-centered approaches. The high importance of the person, task, and context transaction to improve occupational performance and the intervention approaches developed within the EHP model are relevant and critical for the product development. The EHP model as a guide allows occupational therapy practitioners to utilize immersive VR and telehealth to encourage occupational engagement for individuals living in rural populations.

The Human Activity Assistive Technology (HAAT) model consists of the components of human, activity, assistive technology, and the context (Giesbrecht, 2013) and has strong relation to the concepts of the utilization of VR in occupational therapy. According to Hersh and Johnson

(2008) the component of human/person was defined as a being with attributes of sensory inputs, central processing and effectors or motor outputs. While the component of activity was defined as the tasks or procedures, in which the human/person would like to achieve (Hersh & Johnson, 2008).

Likewise, the assistive technology component was defined as an external enabler or device used to overcome a contextual barrier, while context was defined as a physical and social environment in which the human/person and the assistive technology device operate (Hersh & Johnson, 2008). Human, activity, assistive technology, and context within the HAAT model influence successful engagement during participation in meaningful occupation and often have a dynamic interaction between human, activity, and assistive technology and the influence of context both individually and collectively (Giesbrecht, 2013; Cook & Miller Polgar, 2008). According to Giesbrecht (2013) the HAAT model applies the four concepts: human, activity, assistive technology, and context to many specific realms of disability and technology and enhances the application to specific areas of practice within the phenomenon such as mobility, communication, and environmental control. The above four concepts of the HAAT model contributes to the fit and success of an assistive technology system for individuals with disabilities (Giesbrecht, 2013). Furthermore, human, activity, assistive technology, and context present a strong emphasis on occupation or activity and meaning for the individual consistent with occupational therapy and client-centered principles (Giesbrecht, 2013). By implementing the HAAT model during occupational therapy practice, these guiding theoretical principles and concepts will assist in the enhancement of the usability and accessibility of VR during the intervention process.

Summary

The goal of the product is to provide occupational therapy practitioners with instructions and opportunities of utilizing the combination of immersive VR gaming and telehealth to deliver services to clients living within rural communities. Today's society is technology dependent and the use of technology in occupational therapy practice has drastically increased. Many populations such as the rural population have difficulty receiving health services such as occupational therapy. The use of telehealth to administer occupational therapy services has benefitted the rural population. VR can provide a platform, in which individuals in the rural community with a variety of disabilities and who are unable to perform occupations in certain settings can now actively participate in activities and occupations. According to Just et al., (2016) the utilization of VR has been shown to improve multiple facets of the rehabilitation process, which can include patient motivation and participation in occupational therapy. Through the use of VR, this technology can educate clients and practitioners on new techniques of rehabilitation and occupational performance. The VR system can be utilized during the evaluation, intervention, goal planning, and discharge processes and have been developed for the treatments or rehabilitation of stress, post-stroke, pain, and other physical or mental deficits assessed by occupational therapists (Manera, 2016).

Methodology is discussed in Chapter III. This chapter discusses the process and steps performed by the team for the creation of the manual. An overview of the manual and its relation to guiding theoretical framework in occupational therapy is also included.

Chapter III: Methodology

A detailed literature review was performed to develop evidence to support the use of telehealth combined with immersive VR in occupational therapy practice for clients living in rural communities. This comprehensive literature review was completed using scholarly research from CINAHL, PubMed, Elsevier, journal articles from the AOTA, and other peer-reviewed journals. The key terms rural populations/settings, technology/assistive technology, Oculus Quest©, and virtual reality were utilized during the literature review search. The roles of occupational therapy practitioners were researched throughout the literature review process with each of the key terms. Based on the literature, evidence was found to support the utilization of immersive VR in occupational practice to bridge the gap of health services for clients residing in rural communities.

VR has developed rapidly in the last couple years and it is one of the most promising and challenging technologies, but openly allows one or more people to interact with a virtual environment that simulates the client's real world (Liu et al., 2019; Gatica-Rojas & Méndez-Rebolledo, 2014). Weiss et al., (2004) justified that VR has a variety of qualities that can make it highly suitable as an intervention tool, including the ability of active learning, objectively measure behavior in a challenging but safe place, and the freedom to individualize treatment during sessions. Research indicated that immersive VR can be used to help treat a variety of physical diagnosis in occupational therapy such as stroke, spinal cord injury (SCI), motor disturbance, and vestibular dysfunction. Furthermore, psychosocial diagnosis such as dementia, mental condition injuries (MCI), Parkinson's disease, burns, and eating disorders. Weiss, Bialik, and Kizony (2003) utilized telehealth and VR to focus on helping individuals with disabilities

engage in occupations through the use of telehealth and VR and explained the ability to change the virtual environment by grading the task and being able to adapt the task to the clients' capabilities based on their diagnosis.

Based on the literature reviewed, the team developed a manual to guide occupational therapy practitioners and their clients in rural communities in using the combination of immersive VR as a therapeutic intervention and telehealth as the service delivery. The team developed the steps an occupational therapy practitioner will perform including education to the client on the technology use within the product. The team performed each step to develop the most efficient route to allow for an effective therapist-client interaction. The team determined appropriate screenings and assessments that may be used with the product based on previous research articles. The team included a description to allow the practitioners to utilize other screenings or assessments as deemed fit. The manual also provides occupational therapy practitioners with ten examples of therapeutic VR games to utilize during therapy sessions. The team searched through the Oculus website to establish games that would allow practitioners to use the immersive VR with increasing their clients' performance range and overall function. The games developed are classified as interventions or tasks clients will perform to increase their functional performance in their daily lives.

The development of the product was guided by the combination of the Ecology of Human Performance (EHP) Model and the Human Activity Assistive Technology (HAAT) Model. The team examined multiple models to indicate the appropriate models to guide the product. The EHP model was chosen based on its high influence of tasks compared to activities or occupations, the increase in clients' performance range, and the combination of the clients'

virtual context with their natural context. The HAAT model was chosen based on its client-centered approach and it focuses on how each individual interacts with the assistive technology device to develop an outcome.

During the development of the product, the detailed literature review provided support for the use of telehealth combined with immersive VR in occupational therapy practice for clients living in rural communities. The key terms allowed the team to develop an effective understanding related to the background of immersive VR and occupational therapy services. The models determined by the team provided a framework and guiding process to further occupational therapy services during the utilization of immersive VR and telehealth.

Chapter IV: Product

The product is a manual for occupational therapy practitioners using immersive virtual reality (VR) in combination with telehealth, specifically the Oculus Quest© system with clients living in rural communities. The manual consists of eight chapters that provide information related to the use of immersive VR in the occupational therapy practice. Initial chapters set a foundation for the manual user and consists of; introducing practitioners to the manual, guiding models used to develop the product, available screenings and assessments, set-up processes, beginning session instructions, potential interventions, discharge planning, and resources available for practitioners to use to discover additional information if needed.

Chapter one of the manual is simply an overview for practitioners to describe how the manual is organized. Chapter one explains the information that will be relayed while reading through the manual. Chapter two in the manual identifies two theoretical models that the team used to assist in the product development with the Ecology of Human Performance (EHP) model and Human Activity Assistive Technology (HAAT) model. Key concepts of the two models are offered with application examples of using immersive VR and telehealth for rural communities. The chapter also includes visual diagrams for practitioners to use to better understand the link between the models and the product. Chapter three identifies a list of suggested screenings and assessments practitioners can administer via telehealth or in person. The assessments are designed to evaluate clients' performance skills along with identifying if the clients are eligible to utilize the immersive VR system and interventions within the system.

Chapters four and five include step-by-step instruction for technology set-up and instructions for practitioners to follow when beginning sessions. Step-by-step instructions are

separated by the responsibilities for practitioners and their clients to follow prior to sessions beginning. The chapters explain the importance of practitioner preparation and experience.

Chapter six provides a list of potential interventions available within the Oculus Quest©. It is noted that practitioners are responsible for purchasing the games and activities to administer to clients. The chapter includes practitioner responsibilities for technology distribution as well. Chapter seven lists recommended steps practitioners should take when discharging clients. The chapter includes performing reevaluations and goal adjustments as needed, determination of loan extension versus technology pickup, and providing additional resources for clients if needed. The final chapter lists the references used by the team to develop the information within the manual. Practitioners are encouraged to use the resources in their practice and incorporate into their internal libraries.

Chapter V: Summary

The team collaborated on ideas to advocate for clients that live in rural populations with use of technology that would provide a holistic and client-centered approach in the occupational therapy process. The team decided to utilize the Oculus Quest© Immersive VR system through the use of telehealth to increase the availability of occupational therapy to clients in rural communities. Next, The team searched relevant sources, including published research works to inform ideas for implementation of the Oculus Quest© system into occupational therapy, as well as the ability for administering technology and occupational therapy processes through telehealth. Following the development of the literature review, the team explained their methodology and processes for product development. The team then created the product for occupational therapy practitioners to utilize in future sessions and to increase their overall intervention library. The team acknowledged limitations within the product and developed future recommendations and implementations of the product.

Limitations of this manual can include financial status, limited funding, technology disbursement, and availability of Wi-Fi. In addition, this manual has not been implemented before. Financial status of the client could be a limitation due to the possibility that insurance will not cover the loan of the computer and headset/controls which are necessary for the immersive VR. Another limitation of the manual includes limited funding from the occupation clinic providing services. This can affect the number headsets/controls that can be used and sent to the clients as well as the amount or variety of games used for intervention. Availability of Wi-Fi/internet in the client's home can also be a limitation due to the necessary use of Wi-Fi for the Oculus Quest© VR system. Finally, this manual has not been implemented before and the

utilization of immersive VR through telehealth during occupational therapy sessions is a relatively new concept.

The information in this project can be implemented by the utilization of the product/manual in the occupational therapy practice profession. The purpose of this project is to provide a product that will allow occupational therapy practitioners to learn and facilitate the use of immersive VR during the occupational therapy process. The product consists of a manual that allows practitioners with a new way of providing therapy services to the rural population and assists in educating on how to use the Oculus Quest© VR system in combination with telehealth. Immersive VR used during intervention will promote client engagement in meaningful activities. Occupational therapy practitioners can capitalize on this as they search and develop games and activities within the immersive VR system that match the personal values, interests and factors of each individual client. The manual provides theory application to utilization of the Oculus Quest© VR system, common assessments used for the occupational therapy process and building client-specific goals, and example activities that practitioners may use if applicable to their clients.

Based on the team's findings within the literature review and product development, the team has determined that the product would benefit the occupational therapy practice. Even with the limitations listed above, the Oculus Quest© VR system will improve accessibility to occupational therapy services and facilitate increased functional performance outcomes for clients living in rural communities.

Piloting the product and additional research are recommended to determine the product's effectiveness. The team recommends distributing the manuals to occupational therapy practitioners providing telehealth services to clients living in rural communities. The future

researchers should provide technology for the clinics/practitioners to increase participation and utilization of the product. Diffusion of this innovative product may have the capacity to positively influence occupational therapy practice, client's lives, and have a positive impact on rural persons and communities.

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Appendix