ORIGINAL RESEARCH PAPER

Nursing

THE EFFECT OF VIRTUAL REALITY – HEAD-MOUNTED DISPLAY IN AUTISM SPECTRUM DISORDER -A SYSTEMATIC REVIEW

Pamitha Elizabath Baby	Department of Child Health Nursing, SI-MET College of Nursing, Senior Lecturer, Malampuzha, Palakkad.Kerala, India
Dr.Sr.Tresa Anto	Department of Child Health Nursing, VicePrincipal, Jubilee Mission College of Nursing, Thrissur, Kerala. India

ABSTRACT

Background: Virtual reality has been a focus of evidence-based studies in educating autistic children for more than a couple of decades. It is suggested that the evolving technology creates a real-world that targets social and life skills training in a very safe, controllable, and repeatable scenario. The development of affordable head-mount displays leads a pivotal role in its wide range acceptability. The paper aims to discuss these concerns in detail. **Design/methodology/ approach**: Focused on the empirical studies that used VR among children with Autism, a systematic search of the electronic document was done. **Findings:** The literature review identified limited studies in this area characterized by types of application, individual differences of participants, and the technology implemented. **Research limitations/implications:** It is essential to have more studies in the educational settings with the use of technology to substantiate the recommendations that could be made on its implementation, results, and reliability.

INTRODUCTION

Autism or autistic spectrum disorder (ASD) is a neurodevelopmental condition characterized by core differences in social communication, interaction, and repetitive behaviors across a variety of contexts (American Psychological Association, 2013)[2]. The last few decades (1990–2010)have seen an increase in educational and health-based application studies designed to identify effective support for this population (Pellicano et al., 2014)[14]. Despite this research, the academic, social-economic and mental health outcomes for children and adults on the autistic spectrum remain poor (Eaves and Ho, 2008)[9]. As a result, finding more effective ways to improve outcomes for autistic individuals through effective, and appropriate, applications and approaches remains a research priority for individuals and their families (de Bruin et al., 2013)[8]. With approximately1 in 100 children in the UK (Brugha et al., 2012)[5] and 1 in 68 in the USA (Baio, 2014) receiving a diagnosis, this remains an important issue that needs addressing by a range of stakeholders; education being just one[3].

Despite nearly twenty years of research, the potential of VR for autism education remains an aspiration rather than a reality (Parsons, 2016,)[13]. Virtual Reality through Head Mounted Display has created an immense interest to concentrate on the day-to-day life activities among autistic individuals.
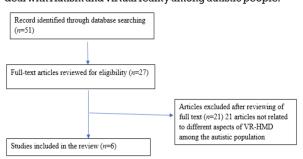
MATERIALS AND METHODS

Reviewers searched six databases for systemic reviews published in English language peer-reviewed journals from 1900, using "AND" and "OR" Boolean combinations by search engine; ERIC-10, British Education Index(BREI)-8. Research Autism Database-13.Google Scholar-14 and ISI Web of Knowledge-7 using the keywords: "Autism .virtual reality with HMD"

Inclusion

The included studies were evaluated according to predefined criteria. Data not about autism and virtual reality using HMD were excluded from the study. Information from these 51 studies was extracted. Based on inclusion criteria on Scope: Focus on autistic children, young people, and adults. The study type was empirical-quantitative or qualitative and systematic reviews of empirical data in peer-reviewed journals. From 1900 onwards and written in English Figure 1 shows the flow chart for the 51 articles retrieved and reviewed for this research strategy.

Exclusion

The study excluded those who discussed the other method to deal with Autism and virtual reality among autistic people.

Figure 1: A flow chart for the 51 articles retrieved and reviewed for this research strategy in Autism and virtual reality with HMD

Overview of studies

A pilot study was conducted by (Newbutt.et.al,2016) to explore the willingness and acceptability of virtual reality technologies particularly by using a headset(VR-HMD) among the autistic population; were 29 samples from community rehabilitator organizations around the age of 32 yrs majority of them were males(n=22)with an intellectual disability less than 70 that was assessed using WASI. The intervention was phased under phase 1 and phase 2 that remained 10 and 30 minutes respectively.

Three short and simple scenarios include a virtual cinema to introduce technology, a virtual café –to check the eye contact with the character, a virtual safari-to engage in a moving and simulated virtual world. Phase 2 was implemented for a higher learning experience like Apollo ll mission and the other one provided a realistic scene with lakes and mountain navigation like a Tuscan house.

The first phase was enjoyed by most of the samples but in the second phase, 4 of them complain about dizziness, tiredness, and withdrawal before the completion. The verbal and non-verbal responses were noted by a trained observer and the whole process was videotaped. A post-survey was conducted to know about immersion, experience, willingness, and acceptance of the Head Mount Display using a Likert Scale (The Independent Television commission-sense of presence inventory) that assessed: spatial presence, engagement, ecological validity, negative effects. The study explored the high acceptance and willingness towards an artificially created "real world".Less sample size and convenient

sampling were the limitations for the generalizability of the study[11].

The second study is the review of joint attention and information processing in children with HFASD done by Mundy. et.al (2016). By assessing the "gaze-leading" for responding to joint attention and initiating joint attention by "gaze-following" among HFASD(IQ-103), ADHD(IQ-101), and Typical Development group(IQ-112) measured using Weschler. By using a headset the virtual reality avatars were gazed at and followed through eye movements. The basic concept of this study was joint attention leads to information processing and social cognition. The findings and conclusion paved the way to the evidence that atypical information processing during joint attention is one of the features of ASD[10].

Strickland et..al(1996) conducted two case studies among autistic children of 7.5 and 9years old with an IQ of 91 and 62 respectively, who were classified under mild to moderate autism using CARS. The acceptance of the headset and gazing at the cars and identifying its color through a head-mounted display and pointing the signboard and moving towards it was the task to be accomplished. TAECCH method was used for it with teachers and parents as co-therapists. Even though there were individual differences the task was accomplished by the children. The study suggested that virtual reality could be used for more learning experiences among autistic children. [15]

A study conducted by Cheng. et.al (2015) among children with ASD by using a 3D immersive virtual environment system to enhance social understanding and social skills. The effectiveness of the3D social understanding system was assessed on three average intelligent autistic children; that was tested using the WASI scale. The immersive virtual environment was used to improve target behaviors like non-verbal communication, social initiations, and social cognition over a period of ABC methodology, where A-baseline, B-Intervention, and C-maintenance through two scenarios; one in the classroom and the other in a bus. Teachers and two researchers observed and videotaped the responses through

SBS and SEC and repeated the study after 20 days to know the longevity effect of the experience The average of the three readings by the observers was taken into consideration and concluded that virtual environment immersion on target behavioral modification was effective and the study recommended that it could be done on a larger autistic population with different intelligent quotient as there is variation in the response. [7]

Adjorlu et.al (2017) conducted a study among autistic children to investigate the feasibility and effectiveness of virtual reality on daily living skills by introducing it in a real shopping scenario. The sample size was 9 among them 8 males and one female belonging to the age group of 12 to 15yrs. Four of them were included in the experimental group and 5 of them in the control group. Baseline data and post-treatment assessments were done using questionnaires and observations. A virtual list and virtual basket were provided for the experimental group and different color coding was provided so that the chance of bias could be reduced to a greater extent. The photographs of the basket were taken so that the variations could be identified. The result was satisfactory after conducting 7 sessions in that. The confidence level to be in a crowded place had increased; that was self-reported by the autistic children. [1]

Lal Bozgeyikil.et.al(2017) conducted a study among autistic children with an objective of virtual reality for Vocational Rehabilitation of individuals with disabilities to assess and train them with cognitive and physical disabilities. The system used here offers training on six vocational skills that will be useful for man jobs like cleaning, loading back of a truck, money management, shelving, environmental awareness, and social skills. the study was conducted among nine neurotypical individuals in the control group and nine HF-ASD individuals under the experimental group. The study assessed the effect of distracters on task performance. The result pointed there were improvements in all he trained skills and no negative effects of distracters. The system using VR is a promising training tool for individuals with ASD as it is fun and interactive. [4]

Table 1 Empirical Papers Relating To The Use Of VR-HMDs Among Autistic Children: Learning. Assessment And Intervention.

Reference	Focus of Behaviour	Population	Research design	Equipment	Setting	Major Findings
Adjorlu et al. (2017)	Whether skills learned in VE could be transferred to a real supermarket	9 children with ASD Aged 12-15 years Exp. Group n=4 Control Group n=5 8 males and 1 female	Group based comparison study for 10 days & 7 sessions	Desktop computer and HMD	School & community supermarkets	Stimulation through VR helped the exp. group to retain the ability to find locations of products accurately & with confidence
Bozgeyikli et.al (2017)	VR effectiveness for vocational training & the effect of distracters on the performance of a task	9 adults with HFASD 9 typically developing adults Aged 25-29 IQ> 70	Group-based comparison study 2hr sessions for 2 days	Desktop computer and HMD	University laboratory	Improvement in trained skills for autistic samples
Cheng et.al(2015)	Improve target behaviors of non-verbal communication, social initiations & social cognition	3 children with ASD Aged 10-13 years Male n=3 IQ> 80	Single-subject experimental study 3 sessions over 6 weeks	Laptop and HMD	School	Target behaviors improved, from baseline to intervention through maintenance
Mundy et.al (2016)	Investigate whether information processing during joint attention may be atypical on ASD	32 with HFASD 27 with ADHD 23 typically developing children Aged 9-13 years IQ>100	Group-based comparison study	HMD	University laboratory	An atypical pattern of information processing response to joint attention observed among the HFASD sample
Newbutt et.al (2016)	Whether it is a safe & enjoyable experience with VR-HMD	29 autistic adults Aged 32years Male n=22, Female n=7	Two phases exploratory case study	Laptop and HMD	Community rehabilitation centre	High general acceptance by the participants. Self-reported anxiety was not increased on using VR-HMD

Strickland et.al (1996)	Level of acceptance of HMD & ability to complete a task	2 mild to moderate autistic children Aged 7-9 years Male n=1 Female n=1	Multiple probe design	HMD	Lab-based in the university setting	Sample wore the HMD & complete the task successfully

CONCLUSION

There has been a significant increase in the number of studies related to autism and interventions in the last decade. It is still insufficient as a response to the stimuli is different among different individuals with varying intelligence quotients. It is an amazing task to create a" real-life" situation along with reducing the overwhelming effect of stimulations. Virtual reality through head-mounted devices has made a revolutionary change in the areas of activities of daily living. learning, health-related activities, vocational and professional fields of autistic children. Differently-abled children should be supported to grow without fear and be respectable persons in the society to lead a productive life should be the motto of day by day developing technologies. Furthermore, studies have to be conducted to frame the best among autistic children.

REFERENCES

1. Adjorlu, A., Høeg, E.R., Mangano, L. and Serafin, S. (2017. "Daily living skills training in virtual reality to help children with an autism spectrum disorder in a real shopping scenario", In Mixed and Augmented Reality (ISMAR-Adjunct), 2017 IEEE International Symposium on IEEE, pp. 294-302.
2. American Psychiatric Association (2013). Diagnostic and Statistical Manual of Mental Disorders (DSM-5®). American Psychiatric Pub. Arlington.
3. Baio, J. (2014). "Prevalence of autism spectrum disorder among children aged 8 years autism and developmental disabilities monitoring network, 11 sites, United States", Surveillance Summaries, Vol. 63
4. Bozgeyikli, L., Bozgeyikli, E., Raij, A., Alqasemi, R., Katkoori, S. and Dubey, R. (2017). "Vocational rehabilitation of individuals with autism spectrum disorder with virtual reality", ACM Transactions on Accessible Computing, Vol. 10 No. 2, pp. 1-25.
5. Brugha, T., Cooper, S.A., McManus, S., Purdon, S., Smith, J., Scott, F.J. and Tyrer, F. (2012). Estimating the Prevalence of Autism Spectrum Conditions in Adults, The NHS Information Centre, London.
6. Charman, T., Dockrell, J., Peacey, N., Peacey, L., Forward, K. and Pellicano, L. (2011). What is Good Practice in Autism Education?, UCL Institute of Education, London.
7. Cheng, Y., Huang, C.L. and Yang, C.S. (2015). "Using a 3D immersive virtual environment system to enhance social understanding and social skills for children with autism spectrum disorders", Focus on Autism and Other Developmental Disabilities, Vol. 30 No. 4, pp. 222-36.
8. de Bruin, C.L., Deppeler, J.M., Moore, D.W. and Diamond, N.T. (2013). "Public school-based interventions for adolescents and young adults with an autism spectrum disorder: a meta-analysis", Review of Educational Research, Vol. 83 No. 4, pp. 521-50.
9. Eaves, L.C. and Ho, H.H. (2008). "Young adult outcome of autism spectrum disorders", Journal of Autism and Developmental Disorders, Vol. 38 No. 4, pp. 739-47.
10. Mundy, P., Kim, K., McIntyre, N., Lerro, L. and Jarrold, W. (2016). "Brief report: joint attention and information processing in children with higher functioning autism spectrum disorders", Journal of Autism and Developmental Disorders, Vol. 46 No. 7, pp. 2555-60.
11. Newbutt, N., Sung, C., Kuo, H.J., Leahy, M.J., Lin, C.C. and Tong, B. (2016). "Brief report: a pilot study of the use of a virtual reality headset in autism populations", Journal of Autism and Developmental Disorders, Vol. 46 No. 9, pp. 3166-76.
12. Newman, F. and Scurry, J.E. (2015). "Higher education and the digital rapids", International Higher Education, Vol. 26, pp. 13-14.
13. Parsons, S. (2016). "Authenticity in virtual reality for assessment and intervention in autism: a conceptual review", Educational Research Review, Vol. 19, pp. 138-57.
14. Pellicano, E., Dinsmore, A. and Charman, T. (2014). "What should autism research focus upon? Community views and priorities from the United Kingdom", Autism, Vol. 18 No. 7, pp. 756-70.
15. Strickland, D., Marcus, L.M., Mesibov, G.B. and Hogan, K. (1996). "Brief report: two case studies using virtual reality as a learning tool for autistic children", Journal of Autism and Developmental Disorders, Vol. 26 No. 6, pp. 651-9.