



## Research articles

**Impact of virtual reality on attention and memory in school going children**

Yukta J. Budhwani, Waqar M. Naqvi \*, Chaitanya A. Kulkarni, Sakshi P. Arora

Ravi Nair Physiotherapy College, Datta Meghe Institute of Medical Sciences, Wardha, Maharashtra, India.

**ABSTRACT**

Virtual reality has tremendously accelerated the rate of recovery along with active patient participation in the field of health sciences. Researches show that this revolutionary technology has shown miraculous results particularly in the fields of neurosciences, musculoskeletal science and psychology. Various studies focusing on conditions like Depression, Parkinson's disease, ADHD, PTSD, Stroke, etc. have shown some promising results. Virtual reality immersion therapy (VRIT) or Virtual reality exposure therapy (VRET) is designed to isolate the user from their surrounding sensory inputs and an illusion of immersion inside a computer-generated interactive environment is provided which makes the therapy not only interesting and entertaining but also motivating and effective. In this study, 50 participants will be enrolled. All the participants will be recruited as per the inclusion criteria and will be given a 30minute Oculus quest therapy for 4 consequent weeks per day. Appropriate scales for the assessment of memory and attention will be used to evaluate the results of the study. This study aims to investigate the impact of virtual reality on attention and memory of school going children. Numerous studies focusing on conditions related to neurology and psychology have shown some promising results. This progress makes it essential to research the impact of virtual reality and thus provide guidelines for the field of education and technology. It is assumed that virtual reality uses latent acquisition when used for learning, increasing memory and retention, by producing spatial presence and a stronger immersion experience.

**Keywords:** Virtual reality, Oculus quest, Neurosciences, Musculoskeletal science, Psychology, Retention, Children.

Received - 20-09-2021, Reviewed - 02/10/2021, Revised/ Accepted- 26/10/2021

**Correspondence:** Waqar M. Naqvi\*, ✉ [waqar.naqvi@dmimsu.edu.in](mailto:waqar.naqvi@dmimsu.edu.in)

Ravi Nair Physiotherapy College, Datta Meghe Institute of Medical Sciences, Wardha, Maharashtra, India.

**INTRODUCTION**

"A relatively small VR device can even act as a whole science lab. VR gives the power to scale and make learning more dynamic and engaging"-ADOBE. [1]. Virtual reality (VR) has shown some revolutionary changes by incorporating auditory and video feedback mechanisms. [2]. It is an amazing technology when it comes to learning and education. It is a simulated experience that can be similar or completely different from the real world. [3].

VR involves the use of various devices; one such is an Oculus Quest. Oculus Quest is a virtual reality system that allows an individual to experience a virtual reality world. It helps you to immerse yourself in a simulated reality while also allowing you to engage with it realistically based on the individual's gesture. [4].

Several researches in the fields of neurology and psychology reveal that a mental map of an environment from the perceived information is created in the brain through our senses that include: - sight, smell, hearing and touch as these senses are absent from the real world and

the brain starts to think that the virtual world is real. [5]. The information thus processed becomes our perception of reality. Researches also prove that the more information we try to take in, the more our cognitive ability improves. This is due to the fact that our brain observes familiar things and as a result it predicts what will happen next. [6]. VR has the ability to enhance the neural connections that are needed for learning and memory. As a result, students and trainees can learn quicker and more efficiently. The most significant attribute of VR is the ability to prompt emotional reactions, that heighten the user's capacity of learning. [7].

The process of attention and working memory are interlinked. It is suggested that they may involve overlapping of neural mechanisms. [8]. Working memory (WM) is the ability to maintain information in the absence of sensory input. While attention is the process by which a specific target is selected for further processing and the neural resources directed towards that particular target. [9]. The content of working memory can be used to direct

attention which in turn can determine the information encoded into the working memory. [10].

Now, this working memory develops during childhood itself. [11]. That means the memory capacity increases throughout childhood and adolescence which are very important for the development of cognitive abilities including complex reasoning. [12]. Problems with distraction are widespread in the 21<sup>st</sup> century but for people with developmental delays or behavioural challenges they can have more damaging effects. [13]. For example, susceptibility to distraction is associated with worse school and social performance, lower high school graduation rates and increased incidence of serious accidents. [14]. Hence, researches are now directed towards the use of VR in Attention deficit hyperactivity disorder (ADHD) that helps the patients to gain better attention abilities and reduced impulsivity, as well as help them with planning, organising and executing daily tasks. [15].

## MATERIAL AND METHOD

This study will be carried out in the Human research lab of Ravi Nair Physiotherapy College (RNPC), Sawangi (Meghe), Wardha. Research Protocol has got Approval from the Institutional Ethics Committee of Datta Meghe Institute of Medical Sciences Deemed to be University. All participants will be told about the goals and procedures before inclusion. Those participants who satisfy the inclusion requirements must give informed consent before they enter the research. The participants will undergo a 30minute Oculus quest therapy per day for 4 consequent weeks. The inclusion criteria will be including both males and female participants between 11-16-year-old age group. The participants must have the ability to understand and follow instructions and should intend to partake in the study. There should be no history of visual or cognitive impairments. The exclusion criteria will be including participants should not be less than 11 years or more than 16 years of age. They should not be diagnosed with any other neurological problems/disorders. The participants should not be registered in another clinical trial and should not have any history of ophthalmological/ visual disorders, cognitive impairments or auditory and visual impairments.

### Sample Size Consideration

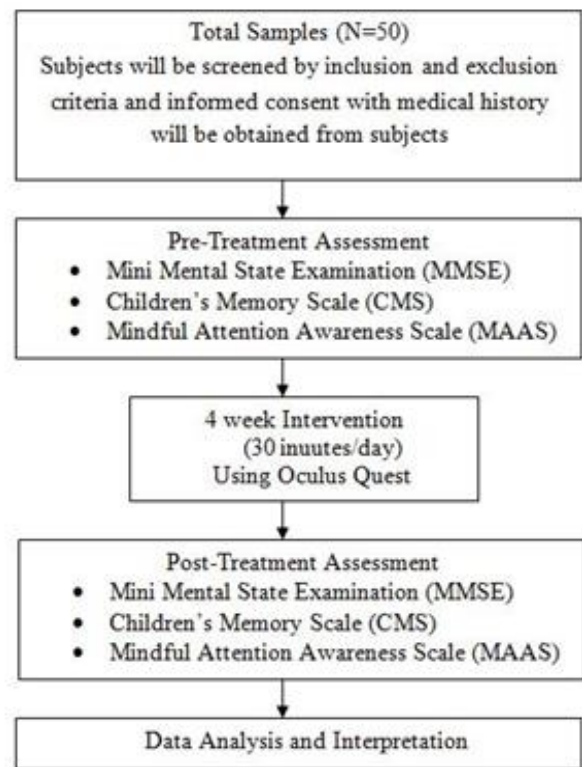
The study protocol is a group study investigating the impact of VR on attention and memory in school going students. After getting approval from the Institutional Ethics Committee of Datta Meghe Institute of Medical Sciences (DMIMS), Deemed to be University (DU), the participants to be recruited will be between the age group of 11 to 16-year-old. Before inclusion, the participants will be explained about the objectives and approaches of the study, and written patient consent forms will be signed by them. The participants will be randomised through the Simple Random sampling technique. Quasi experimental design will be used in this interventional study.

Outcome measures will be assessed before the beginning of the study and after the completion of the study.

### Intervention Design

A carefully monitored interventional protocol will be designed for the subjects. The participants will undergo a daily 30minute Oculus Quest (VR) treatment. The subjects will have to complete six activities (playground, kitchen, shooting gallery, boxing arena, fencing arena, basketball court) in the immersed world. For this purpose, the Oculus Quest will be used which will keep the experience intact and make it feel like a real world. These games are intended to increase the power of attention and retention in the selected students and thus improve their memory and cognitive abilities. The study procedure is shown in Figure 1.

Figure 1: Study flowchart



### Participant Timeline

Each patient will be required to complete 4 weeks of rehabilitation after enrolment in the study. The evaluations will be performed at baseline and their last session.

### Outcome Measures

Primary outcome measures will be Mini Mental State Examination (MMSE) which assesses different subsets of cognitive status including attention, language, memory, orientation, visuospatial proficiency; Children's Memory Scale (CMS) which assesses children's memory abilities by comparing memory and learning to ability, attention, and achievement in the age group between 5-16 years of age; Mindful Attention Awareness Scale (MAAS) which is a 5-item scale designed to assess the short-term or current expression of a core characteristic of mindfulness, namely, a

receptive state of mind in which attention, informed by a sensitive awareness of what is occurring in the present, simply observes what is taking place. Secondary outcome measures will be WORLD reversal scoring technique, Five-digit number reversal scoring, and Serial seven subtractions.

### Follow Up

All participants will be followed up at 4 weeks after intervention and follow up record forms will be completed. The time of the last intervention training session will be recorded. Electronic follow up intervention records will be preserved. When participant drops out of the trial, the reason for withdrawal will be recorded in detail. Comprehensive and supportive participant communication will be undertaken. Data regarding participant's withdrawal from the trial will be included in the final analysis.

### Data Management

The data of the study will be stored with full safety measures with limited access for later review by a biostatistician, a researcher in charge.

### Statistical Analysis

The SPSS latest version will be used to perform statistical analyses. Analysis of variance (ANOVA) will be used to compare the group effect. Individual studies will be checked for homogeneity of the two study groups using the Student's t examination. To determine the impact of two steps, all statistical tests should be performed with a 95 percent confidence interval (p-value 0.05). Mann-Whitney U will be used for comparing Groups at baseline.

### DISCUSSION

Many researches are directed towards the uses and impacts created by the revolutionary technology of Virtual reality. The scope of learning in the case of the Oculus Quest particularly includes a wide range of opportunities. Some of which includes Travel which includes visit places with Wikipedia integration to learn about them, VR events which includes attending live concerts, games, etc. and workout in VR which includes virtual fitness studio that brings the energy of group fitness classes to your home which is equipped with dance workouts as well for those who like. It is basically designed to make the exercises less mundane and boring. It can be used by anyone no matter what the individual's fitness level is. Interestingly, these exercises keep on updating so that you don't have to do the same thing twice. It also provides advice from top fitness instructors along with monitoring one's current performance and improvement after every single session. Meditation which is made simpler and visual so that one can bring peace, calm and joy, movies i.e. a fun part here is that it allows social interaction through its amazing features so that you can watch movies with friends, strangers, etc and make the experience intact, virtual meetings where spatial is a start-up that enables people to meet through VR. Previously, everyone needed a headset to join a

meeting. However, spatial announced that it will now support desktops, androids, etc and the platform is completely free and open to everyone. Here, you can play around with 3D models, expanding and miniaturizing them and scribbling on them with your hands like a NASA engineer might. You can also, write your notes, share your screen, upload presentations and what not.

Much of the current interest is directed towards memory and retention impacts along with engaging the one viewing it. Within this study, we intend to study the efficacy of the Oculus Quest in increasing the attention and memory of children and thereby record the pre and post interventional results to compare the same. The outcome of this survey will give proof to support or not support this hypothesis.

### CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

### ETHICAL STANDARDS STATEMENT

All procedures will be in accordance with the Helsinki Declaration of 1975, as reference in 2008.

### INFORMED CONSENT

Informed consent will be obtained from all patients before including in the study.

### REFERENCE

1. The Science of Virtual Reality, How VR Helps with Memory Retention –VRFocus [Internet], [cited 2021].
2. Grossberg S, 2019. The Embodied Brain of SOVEREIGN2, From Space-Variant Conscious Percepts During Visual Search and Navigation to Learning Invariant Object Categories and Cognitive-Emotional Plans for Acquiring Valued Goals, *Front Comput Neurosci*, 13, 36.
3. De Pasquale C, Chiappedi M, Sciacca F, Martinelli V, Hichy Z, 2021. Online Videogames Use and Anxiety in Children during the COVID-19 Pandemic, *Child Basel Switz*, 8(3), 205.
4. Faria AL, Andrade A, Soares L, I Badia SB, 2016. Benefits of virtual reality based cognitive rehabilitation through simulated activities of daily living, a randomized controlled trial with stroke patients, *J Neuroeng Rehabil*, 13(1), 96.
5. Bijlenga D, Vollebregt MA, Kooij JJS, Arns M, 2019. The role of the circadian system in the etiology and pathophysiology of ADHD, is time to redefine ADHD? *Atten Deficit Hyper act Disorder*, 11(1), 5–19.
6. Virtual Reality Might Be the Next Big Thing for Mental Health [Internet], *Scientific American Blog Network*, [cited 2021].
7. Thapa N, Park HJ, Yang J-G, Son H, Jang M, Lee J, Kang SW, Park KW, Park H, 2020. The Effect of a Virtual Reality-Based Intervention Program on Cognition in Older Adults with Mild Cognitive Impairment, A Randomized Control Trial, *J Clin Med*, 9(5), 1283.
8. Klingberg T, 2006. Development of a superior frontal-intraparietal network for visuo-spatial working memory, *Neuropsychologic*, 44(11), 2171–2177.
9. Purser HR, Farran EK, Courbois Y, Lemahieu A, Mellier D, Sockeel P, Blades M 2012. Short-term memory, executive control, and children's route learning, *J Exp Child Psychol*, 113(2), 273-285.
10. Bahmani Z, Clark K, Merrikhi Y, Mueller A, Pettine W, Isabel

- Vanegas M, Moore T, Noudoost B, 2019. Prefrontal Contributions to Attention and Working Memory, *Curr Top Behav Neurosci*, 41, 129–153.
11. Ang SY, Lee K, 2008. Central executive involvement in children's spatial memory, *Mem Hove Engl*, 16(8), 918–933.
  12. Bourgeois A, Badier E, Baron N, Carruzzo F, Vuilleumier P, 2018. Influence of reward learning on visual attention and eye movements in a naturalistic environment, A virtual reality study", *PloS One*, 13(12), e0207990.
  13. Blume F, Hudak J, Dresler T, Ehlis AC, Kühnhausen J, Renner TJ, Gawrilow C, 2017. NIRS-based neurofeedback training in a virtual reality classroom for children with attention-deficit/hyperactivity disorder, study protocol for a randomized controlled Trials, 18(1), 41.
  14. Parsons TD, Riva G, Parsons S, Mantovani F, Newbutt N, Lin L, Venturini E, Hall T 2017. Virtual Reality in Pediatric Psychology, *Pediatrics*, 140, S86–S91.
  15. Macaluso E, Ogawa A, 2018. Visuo-spatial orienting during active exploratory behaviour, Processing of task-related and stimulus-related signals, *Cortex*, 102, 26–44.

**How to cite this article**

Yukta J Budhwani, Waqar M Naqvi, Chaitanya A Kulkarni, Sakshi P Arora, 2021. Virtual reality, Oculus quest, Neurosciences, Musculoskeletal science, Psychology, Retention, Children. *Jour. of Med. P'ceutical & Allied. Sci. V 10 - I 6, 1362, P- 3969-3972* doi: 10.22270/jmpas.V10I6.1362