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VIRTUAL REALITY A PRAGMATIC TECHNIQUE FOR MULTI SENSORY STORY TELLING TO IMPROVE THE SOCIAL COMMUNICATION OF CHILDREN WITH SPECIAL NEEDS

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Abstract

Student with special needs often encounter problems where they lack their basic needed skill. These kids face challenges in interacting with the society. These kids often have a low level of social communication. The purpose of this proposed research is to investigate the effectiveness of Multi-Sensory Storytelling (MSST) to improve the social communication of children with special needs/Multiple Disabilities (MD) using technically advanced Virtual Reality (VR) and Computational Intelligence tools. This proposed research work is mainly focusing on age group of 6-10 years old children with special needs. Their levels of communication and life skills have been assessed by standard pre assessment intervention. Based on that customized training strategies on MSST have been formulated using VR techniques and Artificial Intelligent Methods. The experimental sessions have been planned to conduct for a time period of 60mins session for alternate days for twelve weeks course of the duration. The progresses of the customized training programs have been validated through post assessment interventions. The result indicated that among the kids of 20% girls and 80% of boys and the outcomes found to have a gradual improvement (27%) in their social communication with advance technology supported multi-sensory storytelling method. This research work demonstrated by a controlled group of children with autism and their level of improvement has been witnessed. This research work makes the children who live in their own world to lead a normal child; it makes us to treat them both physically and mentally as normal kids to do their day-to-day activities.

Keywords:

Multiple Disabilities, Special Kids, Multi-Sensory Storytelling, Virtual Reality, Computational Intelligence

1. INTRODUCTION

Across the globe, Learning Academic Skills of student is a highest priority among all populations of students. The educators should identify the appropriate educational experience achieved by each student is equivalently important in normal teaching learning process. Especially, teachers must choose most appropriate method to increase the communication and life skills of children with Multiple Disabilities (MD). Multi-Sensory Storytelling (MSST) is one of the best methods for the enhancement of day to day communication and life skills among the children with MD.

The idea of a Multi-Sensory Storytelling is not only to provide stimulation for users with disabilities, but also to be calming. Through many studies by the research team, the results had proven the effectiveness of using story telling activities in multisensory environments for children with various types of disabilities. Still, there is a good research scope to enhance the social interaction of special needs through the MSST. Student with special needs often encounter problems where they lack their basic needed skill. These kids face challenges in interacting with the society. These kids often have a low level of social communication. The multi-Sensory Environment is mainly used to facilitate a failure-free experience, allowing enjoyable stimulation without the need for verbal abilities or requiring specific outcomes in children with special needs. Using a multi-sensory room, therapists, teachers and parents can help assess a child's sensory problems, leading to frequent improvements to quality of life, and to find effective new treatments. Studies have shown that multi-sensory environments alleviate stress, anxiety and discomfort for children with disabilities.

Many people who are seldom heard, a sensory basis to communication may be necessary. There are many different approaches and tools that may help with this according to the person's sensory preferences and abilities. A special educator can be able to advice on the appropriate approach to take for any individual. Sensory storytelling is the prominent method carried out by the use of relevant objects chosen for their sensory qualities. This is also identified as an enjoyable activity for individuals with Profound and Multiple Learning Difficulties (PMLD). Over the last decade, significant research has been undertaken globally for the use of storytelling with individuals with PMLD, particularly through the use of MSST techniques. In this proposed study the effectiveness of the MSST approaches are carried out for various children who are special needs.

The purpose of this proposed project was to investigate the effectiveness of multisensory storytelling to improve the social communication of children with special needs using latest technologies such as Assistive Technology, Virtual Reality, Augmented Reality, etc., and Computational Intelligence. The main objective of this proposed study is to improve the social communication of children with special needs using Artificial Intelligent Technology based efficient multi-sensory story telling method.

2. RELATED WORKS

It is frequently reported that individuals with Autism spectrum Disorder (ASD) respond to sensory stimuli differently than their typically development peers. Sensory issues are often among the earliest symptoms observed by parents, with studies reporting anywhere from 45-95% of children with ASD presenting sensory perceptual abnormalities of some kind.

Ghaderi et al. [1] published work on the effectiveness of storytelling for improving auditory memory of student with

reading disability in macivan city, Iran. This research proposed a quasi-experimental study with pre assessment test and post assessment test design with a control group. 30 set of students were selected and separated as 2 categories (15 experimental and 15 control people). The result showed that story telling had a significant impact on improving the auditory memory among the students with reading disability.

As in [2], 'telling stories is one of the simplest, most enjoyable and most transformative activities on earth'. Storytelling exists in all cultures and all settings, and stories have been used to entertain, to make sense of the world and events, to share understanding and to help with coping and healing since time immemorial. However Smith, writing in 2004, argues that storytelling seemed to have fallen out of favor, both in society in general and in education. He notes that fewer parents spend time telling their children the traditional 'bedtime story', as their offspring are increasingly entertained via TVs, computers and other digital media. At the same time, he argues that within the National Curriculum, from Year 4 upwards, storytelling is superseded by activities such as reading aloud, discussion and interviews.

The authors in [4] published work on, 'is story telling therapy useful for children with autism spectrum disorder and severe mental retardation'. This study tried to demonstrate the possibility of working on the social skill of young ASD patients with severe mental disabilities using a therapeutic story telling approach. Both pre assessment test and post assessment test during the work was recorded. The result indicated and confirmed that a significant increase in attention delivered by ASD patients with respect to storytelling scene.

A decade later, the authors [2] is still concerned that the oral component of stories has been minimized, and identifies that all activities relating to story and narrative have been pigeon-holed within 'literacy' and 'literature'. Thankfully, storytelling is a hardy activity, and there has been a resurgence of interest in the role of storytelling across education in general and with regard to specific areas of activity and populations of students in particular.

Over the last decade, significant research has been undertaken in the UK, in conjunction with the charity PAMIS, and abroad – principally in the Netherlands and Germany – into the use of storytelling with individuals with PMLD, particularly through the use of multisensory storytelling techniques. Research has identified that multisensory storytelling can help individuals with PMLD cope with sensitive issues, such as living with epilepsy, dental treatment or sexual behaviour [3] [5]. Such stories can help with the development of literacy skills [6] [7] and can support interaction and enjoyment [8].

Authors such as [9] and [10] have argued for the importance of storytelling in primary education – not only within English but across the whole curriculum. Storytelling has been shown to be effective in improving language skills in secondary school pupils [11]. And the value of storytelling has been identified for, among others, children dealing with bereavement [12], children on the autism spectrum [13] and children – and adults – with profound and multiple learning disabilities (PMLD) [8].

The authors in [14] published a work on, multisensory storytelling (MSST) makes sense. This paper focus particularly on a single kid with profound multiple disability and it continuously observed all its behavior. The MSST helps a lot in improving their sensory skills and the level of improvement is witnessed here [15] [16].

The inference obtained by the literature indicated that each method has its own merits and demerits. To overcome the limitations effective MSST is proposed for various multiple disability children to improve the social communication. The Multi Sensory Story Telling approach is proposed with various special needs such as Cerebral Palsy (CP), Autism Spectrum Disorder (ASD) or Attention Deficit Hyperactivity Disorder (ADSD) and Low Vision (LV) or Lazy Eye. The conventional and modern approaches of storytelling are adopted to investigate the effectiveness and improvement of social communication of the special needs. The proposed research is expected to deliver better subjective and objective results on the selective children.

3. MATERIALS AND METHODS

The information technology or computational intelligence is more essential and suitable technologies for MSST; it is about telling a personal story especially made for a particular listener and in addition with sensory stimulation. The Figure 1 illustrates the entire process of the proposed research in implementing the Multi-Sensory Storytelling approach for children with various special needs such as Cerebral Palsy (CP), Autism Spectrum Disorder (ASD) or Attention Deficit Hyperactivity Disorder (ADSD) and Low Vision (LV) children.

Prior to the formal MSST training, the children are assessed and grouped using Functional Assessment Checklist for Programming (FACP) and Short Sensory Profile to identify the present level of communication and life skills. Then the appropriate MSST training strategies are planned for every individual and the required tools are estimated. The appropriate tools such as VR device, system integration, haptic devices, materials, toys, voice, music, multi-sensory environment, technology support etc., are selected for intensive MSST program. The MSST is carried for 12 weeks duration for the entire course. Both qualitative and quantitative methods are used to assess the multisensory environment results i.e. positive impact with the children by MSST program. Furthermore, the findings related to the participant's communication skills, life skills, social interaction with peers and improvement of intelligence level by the research sessions are assessed.

3.1 SELECTION OF SUBJECTS AND TRAININGS

This proposed method is mainly focus the age group of 6-10 years old students. They have been subjected to pre assessments test post assessment test for estimating their communication abilities. The low level of social communication children especially ASD cases have been considered for this study. Also, very few ADSD and marginally CP cases have also been included with the study. The computational intelligence based MSST contents using VR have been developed and assured viability of the proposed contents with the support of expert special trainers. The experimental sessions have been conducted for a time period of 60minutes session for alternate days and it's offered as twelve weeks duration as a customized individual training program.

This work proposed to design VR based multi-sensory storytelling is an effective tool to provide the autistic children to develop their basic skill and to lead a better communication and

life skills. Any types of ASD patient can also be scrutinized and their levels are identified and they are treated according to their IQ level. The continuous pre assessment and post assessment test results have been helped in observing the improvement along the social communication and facilitate to redefine the MSST training program during the stipulated time period.

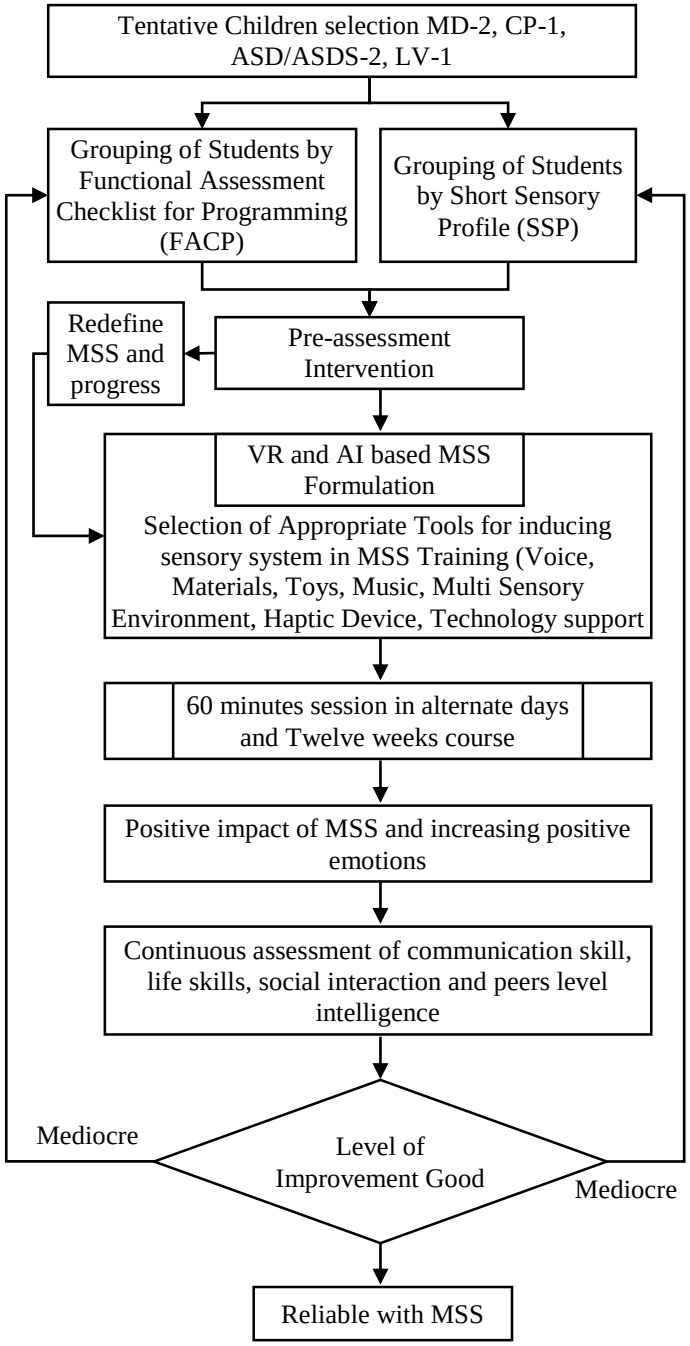

Fig.1. Functional Flow Diagram of MSST for various Children with Special Needs

4. RESULT AND DISCUSSION

In this research work, a new VR based MSST method has been planned and implemented for developing social skills among the children with ASD. In the present day scenario there is an increase in the level of autistic children in the population. The main objective of this research is to observe and analyze how this particular audience reacted when presented with a multi-sensory environment as regards as specific learning purposes. The computational intelligence based preliminary results indicate that multi-sensory content may achieve better results (both in experiments and in direct observation).

The pre assessment test is formulated in consultation with the special trainers to scrutinize a controlled group of children to conduct the pilot study at Coimbatore region in India. There are numerous behavioral challenges are observed among these children which include Eye contact, Beat on chin with fist, Cries excessively, Throws object, Make loud noise & screams, Sucks thumb, Does not sit in a place for a long time, Repetitive work, Murmurs, Paper Tears, etc.,. In this pilot study, children's level of social communication and behavioral challenges have been assessed by checklist method and categorize their level using computational intelligence.

Table.1. Sensory System Activities and Their Social Behaviors

Sensory Activities	Social Behaviors and Characters
Color recognition	Improves eye and hand co-ordination
Object recognition	Improves brain interaction, identification and memory
Object Counting	Improves memory skill
Auditory test	Improves hearing skill and response
Puzzle Games	Improves fine motor skill, identifies shapes, eye and hand co-ordination, problem solving
Tactile Activities	Improves tactile skills
Bubble Games	Improves eye contact and interaction
Ball games	Improves motor skill
Balloon games	Improve eye contact and eye hand coordination is improved
Emotional Training	Improves the social and behavioral skill

Table.2. Score Rubrics for Sensory Activities

Score	Level of Social Communication
0	Below Average
1	Average
2	Good
3	Better
4	Best
5	Excellent

Table.3. Clinical Behavioral Assessment and Sensory Activities Assessment

Sample Subjects	Age	Behavioral Characteristics	Clinical Level of autism	Pre-Assessment Score (out of 5)	Remarks of Response
Case 1	8	Calm and obsessed with alphabets and numbers	Good	4	Best
Case 2	10	Continuous murmuring and obsessed with animal and always stay dreamy	Typical	0	Below Average
Case 3	7	Calm, playful and obsessed with sounds and environment	Average	3	Better
Case 4	9	Uncontrollable and obsessed with puzzle and shapes	Good (hyperactive)	4	Best
Case 5	11	Fear towards people and doesn‘t interact and always crying	Average	1	Average
Case 6	6	Beat on chin with fist, aggressive, lack of concentration	Typical (rett syndrome)	0	Below Average
Case 7	9	Repetitive, calm and obsessed with color and irritative with sound	Typical	2	Good
Case 8	8	Little aggressive and obsessed with sound	Below Average	3	Better
Case 9	6	Calm , lacks complete eye contact and need speech improvement	Average	1	Average
Case 10	7	No eye contact, obsessed with round objects, late response	Typical	1	Average
Case 11	8	Improved level of communication and obsessed	Good	2	Good
Case 12	10	Can‘t stand or move and aggressive	Typical	0	Below Average
Case 13	6	Calm, obsessed with puzzles and active	Good	1	Average
Case 14	8	Aggressive and continuous chewing, good response, lack of eye contact	Below Average	2	Good
Case 15	8	Silent, takes time to understand	Average	3	Better
Case 16	8	Very active and obsessed with puzzles.	Good	2	Good
Case 17	7	Always drowsy, silent and good understanding.	Below Average	3	Better
Case 18	7	Highly Active, good level of interaction, need encouragement.	Good	2	Good
Case 19	6	Takes a lot time to understand, lack concentration, repetitive.	Below Average	2	Good
Case 20	11	Calm, low level of response, repetitive lack concentration.	Below Average	1	Average
Case 21	9	Calm, active and interactive.	Good	4	Best
Case 22	8	Very active, high level of interaction and has low vision.	Normal	2	Good

The Table.1 indicates the different behavioral characters of all children are assessed through various activities and the quantitative score as shown in Table.2 has been awarded for their response to estimate their present level of social communication to validate with the clinical observation. These activities are more profound contributions and aimed for an improvement in the social communication by implementing individualized multi-sensory activities based on the observation made on the samples.

The total number of children in different age groups at the Jeyam Special School is 22 with various disabilities. In all cases, the level of autism has been clinically estimated and the behavioral assessment has been carried out for all the children using various parameters such as Color Recognition, Object Recognition, Counting of Objects, Auditory test, Puzzle games, etc., The average score of assessment and the response to the assessment have been compared with the clinical behavioral assessments as represented in Table.3.

The VR based computational intelligent MSST training program include various hardware and software materials. The training sessions have been conducted with VR device, system integration, haptic devices, materials, toys, voice, music, sensory system inducing materials, multi-sensory environment, technology support etc. The moral stories which are taught in regular Indian schools have been developed with computational intelligent VR gadget and various toys and other hardware materials to create an ambience and multi-sensory environment. Many stories have been considered for this study which include the cap-seller and the monkeys, the hare and the tortoise, the fox and the grapes, the story of goldilocks and the three bears, crane and the fox, the thirsty crow, ant and the dove, monkey and crocodile, the lion and donkey, monkey and the cats, etc.

Each session has facilitated with inclusive environment, quizzes, interactive and virtual demonstrations, questionnaire and record the assessment scores for analyzing the level of improvement among the children with special needs. This training program has also been redefined according to the progress of individual kid’s adaptability and comfort. The simple threshold and linear classifier models are adopted to classify and analyze the normal training scores and VR based MSST training scores. The average round-off scores of sensory activities of individual child has been estimated through proposed method which is shown in Table.4.

Table.4. Pre-Assessment, Normal and MSST Training Scores of all Sample Subjects

Sample Subjects	Pre- Assessment Score	Normal Training Score	VR-MSST Score
Case 1	4	4	5
Case 2	0	1	3
Case 3	3	3	4
Case 4	4	5	5
Case 5	1	1	4
Case 6	0	0	1
Case 7	2	3	4
Case 8	3	3	5
Case 9	1	3	4
Case 10	1	3	3
Case 11	2	3	4
Case 12	0	0	1
Case 13	1	2	3
Case 14	2	4	4
Case 15	3	4	5
Case 16	2	2	4
Case 17	3	4	5
Case 18	2	2	4
Case 19	2	4	5
Case 20	1	2	4
Case 21	4	5	5
Case 22	2	3	4

The pre-assessment, normal training and VR based MSST training scores are compared and estimated the level of social communication and life skill improvement among the children with special needs. The outcomes of the proposed VR based MSST training indicated 58% of improvement when compared with pre-assessment score. But, the MSST training delivered better social communication and life skill improvement which is 30% higher than the normal training results.

5. CONCLUSION

The proposed VR based computational intelligent Multi-Sensory Storytelling method has been implemented for children with special needs. This research work is demonstrated by a group of children with ASD and their level of improvement is witnessed by special trainers in school and caregivers. The selected sample subjects have 20% girls and 80% boys mainly suffering with ASD. The results of the proposed method indicated that there is gradual improvement in social communication and life skills among the children. This method is also delivered 58% better results from pre-assessment status and 30% higher than normal training methods. The obtained results are validated with the expert clinical trainers and special educators who offered training to the children with special needs. This research offers the children who live in their own world to lead a normal child and it makes trainers to provide them optimum training sessions on both physically and mentally as a normal children to do their day to day activities. This work is also designed as multisensory storytelling is an effective tool to provide the autistic child for developing their basic skill and to lead a better life. Any types of ASD child and normal child can be scrutinized and their levels are identified and they are treated according to their IQ levels. The pre assessment and post assessment test results delivered quantitative value for the observed qualitative improvement in social communication and life skills.

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