

Effects of Integrating Augmented Reality in Early Childhood Special Education

Savitha K.K, Renumol V.G

Abstract: Various research studies showed the praiseworthy impact of technology tools in the education process of the special kids. The intention of this comparative study was to explore how Augmented Reality (AR) based educational application would support mild and moderate Intellectually Disabled (ID) children of age 5-10. Eight ID students from a Block Resource Center in Kerala, India were participated in this study. They were divided into two groups. Children with hyperactivity were selected as experimental group, and they had extra support from AR-based tool via smartphone. The control group students were trained by using conventional method. After measuring the parameters such as learning outcome, response to the learning material, learning time and memory capacity, the data has been analyzed. From the analysis results, it noticed that the participants from the experimental group exhibited improvements in all the parameters than those in the control group. In addition to the experiment, a survey was conducted among their parents and the resource teachers to know their feedback about the effectiveness of the application. The observed parameters and the survey results indicate that the implementation of AR-based educational applications in early childhood special education system is worth to explore further.

Keywords : augmented reality, early childhood special education, intellectual disability, special educational need.

I. INTRODUCTION

Education is a process to opening a door to acquire knowledge, skills and values for children, which will enable them to live better. Like usual children, special children also deserve free and proper education. But teaching special educational need (SEN) children is a challenging task for teachers. Various research studies have shown positive impact of technology tools in the education process of the children with special needs. However, literature says that it is necessary to consider various educational and instructional issues when introducing Augmented Reality (AR) based tools in the teaching-learning process [4]. Another study says that AR can provide instructional supports for the disabled students, where they have used AR as a navigation tool in autistic children [8].

Basically it is difficult to identify the specific learning

problems in children with disabilities. Extreme restlessness and lack of ability to concentrate are some of the issues found in those children. Finding their learning problems in the elementary school itself may help the children to improve their academic and social performance [2]. There are many obstacles in providing educational environments for SEN children,

which include delays in providing services, lack of specialised teachers, lack of knowledge to use technology etc. [11]. Providing appropriate training to the teachers through professional development programmes may make learning process of SEN children at par with normal children [17]. Integration of ICT in early childhood education has an essential role to help children to learn [10].

Individualised Education Program (IEP) for each special children supports the education services for every special child in public school. Moreover, special education system is implemented for caring special children separately. Quality of such systems depend on how the teacher organises the class with the available resources and enhances interaction and participation of the students [3]-[19]. These days many techniques and strategies are getting introduced for special children to achieve their academic goals. However, to find the best strategies for designing appropriate educational program for the special need children is still under research [13]. The intention of this work was to examine how Augmented Reality (AR) based educational application would support mild and moderate Intellectually Disabled (ID) children of age 5-10.

II. LEARNING DISABILITY IN INTELLECTUALLY DISABLED STUDENTS

Intellectual Disability is a developmental disability. Its causes include inherited and atmospherical factors [7]. It is defined by an IQ test with the value below 70. ID children exhibit slowness in learning and talking, behavioural problems, social interaction issues, hyperactivity, problems to adjust in the changing situations etc. If the IQ test score is in the range of 50 to 70, it is called mild intellectual disability. If it is from 35 to 50, it is known as moderate intellectual disability [20]. Mild categories of children perform less in their academic activities and it requires careful analysis to separate mild ID children from the children with learning disability. Moderate ID is shown within the early ages of the children. People with moderate ID need more individual care in their public life. Since their academic abilities are limited, they can learn from simple interactive things and take part in simple activities.

Manuscript published on November 30, 2019.

* Correspondence Author

Savitha K.K*, Division of IT, School of Engineering, Cochin University of Science and Technology, India.., Email: savithakk@gmail.com

Renumol V.G, Division of IT, School of Engineering, Cochin University of Science and Technology, India. Email: renumolv@gmail.com

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an [open access](#) article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

III. AUGMENTED REALITY AS AN INSTRUCTIONAL EQUIPMENT

AR is an innovative technology that will enable learners to learn the world of knowledge through the interaction of essential objects in the real environment. Most of the studies state that children achieved a lot in the learning environment by using AR [1].

AR has the ability to attract and persuade students in the restricted school atmosphere. It enables the students to see the real objects, which means that it supplements reality than completely replacing it [6]. Using AR in the education field, the teacher can show 3D/4D view of the object to the students as an alternative of using traditional method in the classroom [16]. Teachers can show the objects to the students in various perspectives. The 3D/4D view of the objects can easily be recognised and memorised by the students than the 2D pictures in the conventional teaching method [14]. AR is a powerful learning tool that can help students to attain subject knowledge and sustain that knowledge continuously by the interaction with the smartphone [12]. AR based mobile applications propose a great future for learning and training [9]-[18]. Functionality, working, and application of AR can create uniqueness in the education system for the disabled children. Literature says that, mobile AR technology can boost the learning outcome of the students [3]. It gives a realistic experience for the students by the 3D view of the objects they want to visualise [16].

IV. METHODOLOGY AND PARTICIPANTS

Depending on the type of learning disability, each child has different educational requirements. Before starting the experiment, it is observed that teaching and learning process of the ID children is very difficult and they need more interactive and interested learning material. Therefore special consideration is needed for AR in the early stage development as well as for the children with disability [5]-[16]. In this situation, it is found that there is lot of scope in the emerging technology AR. Our study aims to analyze the improvements in ID students when they use an existing AR educational application for learning animal names in English. In this experiment, our focus was to improve their perception through AR than the traditional approach of training. The intention of this experiment was to check whether AR as a teaching tool would give improvements in parameters such as learning out-come, attention, memory retention, understanding of the material and reducing learning time. Characteristics of this research were empirical and quantitative [15]. It was conducted by observing and measuring the above mentioned parameters from the students during the experiment under the observation of resource teachers. After the experiment, a questionnaire was supplied to fill among the resource teachers and parents to be aware the effectiveness and the necessity of using technology as a teaching tool.

Eight mild-moderate ID students were participated in this study. There were six boys and two girls of age 5 to 10. They were from Block Resource Center, Chelannur, Calicut district, Kerala, India. The Programme Officer of the center has assigned a resource teacher to assist in the experiment. They provided all the support for us from the starting day to the last

day of the experiment. The topic to learn was animal names in English. The participants were not much aware of letters and animal names in English. For this study, we classified the students into two groups. The experimental group was formed by four children with hyperactivity, because they had more attention deficiency problem than the other children. These students were allowed to interact with the AR educational application via smartphone and flash cards. Remaining four students were grouped as the control group, and they were allowed to learn by conventional method. Each student has followed an individualised training method and allotted 50 minutes for their training. During the training, the parameters such as identification, attention, learning time and response to the learning material were observed and measured. The experimenter was supported by the resource teacher to measure the values of each parameter. After the training the set of parameters were analysed for each group.

Before the learning begins, the students in each group asked to identify the English alphabets A to E by showing letters on a paper, and gave a value for it. Then the training started for each group separately. The control group students learned animal names starting from A to E, such as A for Ant, B for Bear etc. in conventional method. For the experimental group, an existing AR educational application was used to teach animal name for the alphabets from A to E. The application includes its own flashcards for each alphabet. Each flashcard was scanned by the smartphone camera in which the AR application was installed. Hence the students could view the 3D image of the animal with their sound, name spells, and behaviour of that animal. They could rotate that 4D image and vary the size by their choice. They could see the effects as the original animal was in front of them. It was really interactive and the students felt that the animal was a real one. After this training, they were free for 30 minutes. Then they attended an assessment process individually. It was to check how much improvement each has in the identification of alphabets and memory recalling capacity of the student to remember animal name for the corresponding alphabet. The parameters were measured by showing each alphabet. In addition to the experiment, a survey was coordinated among the resource teachers and the parents of the participants. The survey questionnaire included ten questions, about the demonstrated application and its scope. The objective of the survey was to know the effectiveness, necessity and interest in the ICT based educational tool for the special children in their school life as well as in the home.

V. RESULTS AND DISCUSSIONS

This study includes several observation steps to reach the final result and conclusion. Statistical procedures were used for the processing of the values. The percentage value of parameters were analysed between and after the training for both the groups and it is represented as bar charts in Fig. 1 and Fig. 2 respectively. Each bar specifies its own percentage value. Blue bar denotes control group students and red bar denotes experimental group. In the observed outcome, a remarkable variation was noticed in the students from the experimental group.



Prior to the training, the children were really restless and they had no interest in the learning process. Between the training, the experimental group students showed their happiness, involvement and interest in the AR application. Application in the smartphone had really impressed them. Their expression when they see the 4D view of the image was awesome.

The application could enhance the student's perception ability when they try to visualise and interact with the 4D view of the animals.

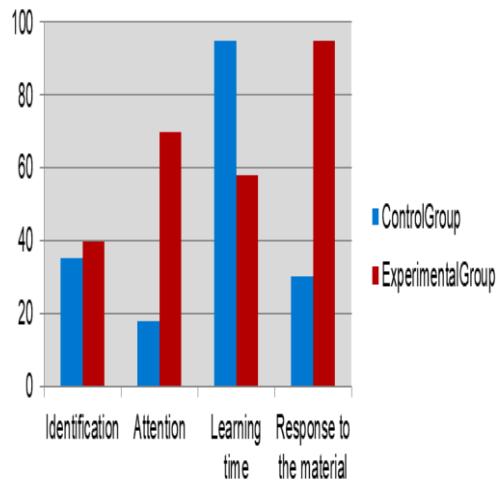


Fig. 1.The parameters evaluated between the training for each group

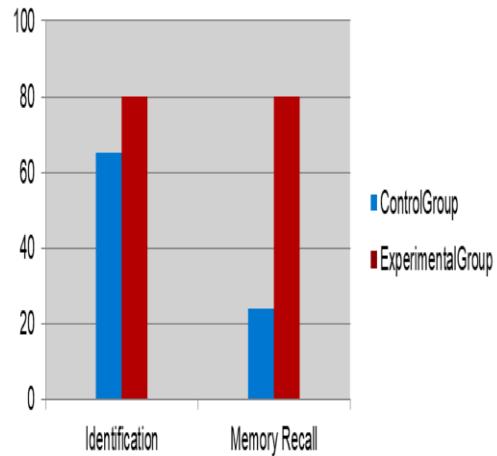


Fig. 2.The parameters evaluated after the training for each group

In addition to the experiment, a survey was conducted among the parents and the resource teachers. There were ten questions in the survey, to indicate their level of agreement with the usage of technology. The overall survey result indicated that the resource teachers and the parents support the usage of technology tool for their children. They were so happy to see the children's expression when using AR application. The experiment reveals that the real world experience through AR application has great scope to improve the academic activities of ID children. These tools provide the flexibility that the parents can also help the children to use this technology tool in their home.

VI. CONCLUSION

The intention of this work was to know the influence of AR technology in the education system of ID children. With the use of this emerging technology, the resource teachers and parents could improve their children's attention and interest to the class session compared to the conventional method of teaching. By using AR educational application, the resource teacher could demonstrate the topic better with a smartphone and could improve the children's interest in the learning activities. The observed results show that using technology in everyday life of special children can improve their academic and behavioral characteristics. The resource teachers also suggested that the application can help them to transfer the knowledge easily. The parents were so happy to see their children's happiness, interaction and interest when using AR tool. From the experiment and survey results, we conclude that there is lot of scope in integration of AR technology in special education especially for the students with intellectual disability.

ACKNOWLEDGMENT

We would like to express our gratitude to the Block Program Officer and the resource teachers of the Block Resource Center, Chelannur, Calicut, Kerala, India, for helping us in this experiment. We are extremely thankful to the parents and the students, who patiently participated in our study. We also acknowledge the Heads of the schools of the participants for providing the space to do the experiment.

REFERENCES

1. Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review*, 20, 1-11.
2. Bakken, L., Brown, N., & Downing, B. (2017). Early childhood education: The long-term benefits. *Journal of research in Childhood Education*, 31(2), 255-269.
3. Chopra, N. (2016). Quality early childhood education for disadvantaged children: an investigation in the MCD schools. *International Journal of Early Years Education*, 24(1), 49-62.
4. Cabero Almenara, J., & Barroso, J. (2016). The educational possibilities of Augmented Reality. *Journal of New Approaches in Educational Research*, 5(1), 44.
5. Chen, P., Liu, X., Cheng, W., & Huang, R. (2017). A review of using Augmented Reality in Education from 2011 to 2016. In *Innovations in Smart Learning* (pp. 13-18). Springer, Singapore.
6. Agarwal, C., & Thakur, N. (2014). The Evolution and Future Scope of Augmented Reality. *International Journal of Computer Science Issues (IJCSI)*, 11(6), 59.
7. Daily, D. K., Ardinger, H. H., & Holmes, G. E. (2000). Identification and evaluation of mental retardation. *American Family Physician*, 61(4), 1059-67.
8. McMahon, D., Cihak, D. F., & Wright, R. (2015). Augmented reality as a navigation tool to employment opportunities for postsecondary education students with intellectual disabilities and autism. *Journal of Research on Technology in Education*, 47(3), 157-172.
9. Hwang, G. J., Wu, P. H., Chen, C. C., & Tu, N. T. (2016). Effects of an augmented reality-based educational game on students' learning achievements and attitudes in real-world observations. *Interactive Learning Environments*, 24(8), 1895-1906.
10. Hu, X., & Yelland, N. (2017). An investigation of preservice early childhood teachers' adoption of ICT in a teaching practicum context in Hong Kong. *Journal of Early Childhood Teacher Education*, 38(3), 259-274.
11. Jadán-Guerrero, J., & Guerrero, L. A. (2015). A virtual repository of learning objects to support literacy of SEN children. *IEEE Revista Iberoamericana de Tecnologías del Aprendizaje*, 10(3), 168-174.

Effects of Integrating Augmented Reality in Early Childhood Special Education

12. Jamali, S. S., Shiratuddin, M. F., Wong, K. W., & Oskam, C. L. (2015). Utilising mobile-augmented reality for learning human anatomy. *Procedia-Social and Behavioral Sciences*, 197, 659-668.
13. Lin, C. Y., Chai, H. C., Wang, J. Y., Chen, C. J., Liu, Y. H., Chen, C. W., ... & Huang, Y. M. (2016). Augmented reality in educational activities for children with disabilities. *Displays*, 42, 51-54.
14. Mahale, P., & Yeddu, S. (2016). Android-based Augmented Reality to Enhance Education System. *International Journal of Computer Applications*, 146(6), 18-21.
15. Tashko, R., & Elena, R. (2015). Augmented reality as a teaching tool in higher education. *International Journal of Cognitive Research in Science, Engineering and Education*, 3(1).
16. Saidin, N. F., Halim, N. D. A., & Yahaya, N. (2015). A review of research on augmented reality in education: advantages and applications. *International Education Studies*, 8(13), 1.
17. Smeets, E., & Roeleveld, J. (2016). The identification by teachers of special educational needs in primary school pupils and factors associated with referral to special education. *European Journal of Special Needs Education*, 31(4), 423-439.
18. Sung, Y. T., Chang, K. E., & Liu, T. C. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. *Computers & Education*, 94, 252-275.
19. Syrjämäki, M., Sajaniemi, N., Suhonen, E., Alijoki, A., & Nislin, M. (2017). Enhancing peer interaction: an aspect of a high-quality learning environment in Finnish early childhood special education. *European Journal of Special Needs Education*, 32(3), 377-390.
20. <https://www.encyclopedia.com/medicine/psychology/psychology-and-psychiatry/mental-retardation>

AUTHORS PROFILE



Savitha K.K is a Research Scholar at Cochin University of Science and Technology, Kerala, India. She earned her undergraduate degree from Calicut University, India and master's degree from Anna University, Tamil Nadu, India. She has 9 years of experience in the teaching profession. Her research interest includes technologies in the education system of the special children. She has received a best paper award from an international symposium on "Innovations for Promoting Sustainable Inclusive Development" and research collegium – 2019 on "Emerging Paradigms in Disability and Social Work" held at Bharathidasan University, Tiruchirappalli, Tamilnadu, India. Her current research is to make the impact of emerging educational technology for the special children.



Renumol V G, PhD, is a Professor and Head of the Department of Information Technology at Cochin University of Science and Technology, India. She has earned her undergraduate and postgraduate degrees from the same University. She received her Ph.D. from Indian Institute of Technology, Madras, India and she received Post-Doctoral Fellowship from Indian Institute of Technology, Mumbai, India. She has received a best paper award from an international symposium on "Innovations for Promoting Sustainable Inclusive Development" and research collegium – 2019 on "Emerging Paradigms in Disability and Social Work" held at Bharathidasan University, Tiruchirappalli, Tamilnadu, India. Her research area includes Cognitive Psychology in Education, Computing Education, Educational Technology, Emerging Technology and ICT in Special Education.