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Leveraging Immersive Learning for Special Needs Education

by

Ogwuegbu, David Azunna
Department of Computer Science
Federal College of Education (Special), Oyo, Nigeria
david.ogwuegbu@gmail.com, ogwuegbu.david1086@fcesoyo.edu.ng

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Ajobiewe, Damilola Nnamaka, Ph.D
Department of Computer Science
Federal College of Education (Special), Oyo, Nigeria
ajobiewe.damilola2247@fcesoyo.edu.ng
https://orcid.org/0000-0001-6734-3858

&

Marlin, Alexander Olawale
Department of Computer Science
Federal College of Education (Special), Oyo, Nigeria
marlin.alexander2117@fcesoyo.edu.ng

Abstract
Adopting immersive technologies into the teaching and learning process has provided an emerging means by which knowledge acquisition can occur. This upcoming approach, regarded as immersive learning is viewed to be of immense benefits in imparting knowledge to learners with special needs, and this is the crux of the discourse presented through this paper. Importance of immersive learning in education was given with reasons, which include enhanced engagement, active learning, personalized learning, and accessibility. An overview of special needs education was offered together with categories of persons with special needs among which are learning disabilities, intellectual disabilities, physical impairments, and sensory impairments. Obstacles encountered in following the conventional approach to special needs education were itemized, which include segregation, limited resources, inequity, and stigma and labeling. Rationale for embracing innovation in special needs education were given. In addition, an overview of immersive technologies was presented. Steps for developing immersive learning programs for special needs education were stated, which include understanding learners' needs, involving stakeholders, designing accessible experiences, and incorporating feedback mechanisms. Future trends and innovations on utilizing immersive learning for special needs education were also given among which are AI-powered personalization, advanced simulation environments, wearable and mobile solutions, and accessibility and inclusivity focus.

Keywords: Immersive learning, Immersive technologies, Special needs education

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I. **Introduction**

A. **Background**

In an age characterized by rapid technological progress and an increasing focus on inclusive education, the field of special needs education has emerged as a prominent domain for innovation. In our pursuit to provide educational settings that effectively accommodate the distinct requirements of students with disabilities the use of immersive technology has emerged as a potential approach to augment the educational encounter. This becomes necessary following the limitations of traditional approach to learning in effectively mitigating the hindrances encountered in acquiring educational experiences by persons with special needs.

The field of special needs education comprises a diverse range of disabilities, which may include, but are not limited to, autism spectrum disorders, attention deficit hyperactivity disorder (ADHD), dyslexia, intellectual disabilities, visual or hearing impairments, and physical disabilities. Each of these impairments poses distinct obstacles for both educators and students. Conventional pedagogical approaches, while successful for a considerable number of children, encounter challenges in adequately addressing the distinct learning modalities, sensory sensitivities, and personalized requirements of students with disabilities. Immersive learning technologies provide a potentially viable answer in this context (Drigas et al., 2022).

However, immersive learning, defined by its capacity to transport learners into interactive, three-dimensional settings, has proved its potential to engage students in a multimodal and highly individualized educational experience. Immersive technologies have the capability to immerse students in virtual settings or superimpose digital information onto the actual world. This allows for the customization of material, pace, and sensory inputs to cater to the individual requirements and preferences of each learner. This flexibility not only serves to tackle the obstacles encountered by students with impairments, but also presents educators with the chance to use novel pedagogical approaches that were previously unattainable. Immersive learning, which includes virtual reality (VR) and augmented reality (AR), has been utilized extensively in general education contexts and has the potential to be implemented in special needs education. The use of immersive learning environments for individuals with severe intellectual disability (SID) and autism spectrum disorder (ASD) has been the subject of research. In special education and rehabilitation, virtual reality systems have been implemented to facilitate intervention, monitoring, and evaluation. The perspectives of learners indicate that immersive learning environments can contribute to their learning activities, with design principles such as coherence, minimalism, and accessibility recommended. It has been discovered that technology-enhanced learning (TEL), including virtual reality (VR), increases accessibility and helps students with special educational needs (SEN) manage with impairments, although it may not guarantee inclusion. Additionally, augmented reality technology has demonstrated positive results in the education of individuals with special needs, thereby supporting effective teaching strategies (Lai & Cheong, 2022).

This paper aims to investigate the many uses of immersive learning within the realm of special needs education. It also discusses the potential of immersive technology in improving the accessibility, inclusiveness, and efficacy of educational interventions for students with disabilities. By conducting a comprehensive examination of extant scholarly literature, empirical investigations, and real-world applications, this study aims to elucidate the many

strategies for customizing immersive learning to cater to the distinct requirements of individuals with disabilities, therefore possibly transforming the domain of special education. Through the use of immersive experiences, there exists the potential to unleash the whole capabilities of those with disabilities, therefore cultivating a society that is more inclusive, allowing every student to flourish in their educational endeavors.

B. **Importance of immersive learning in education**

The transformational effect that immersive learning has on the teaching and learning process is why it is becoming more and more important in education (Shadiev & Li, 2022). Immersive technologies, namely virtual reality (VR) and augmented reality (AR), have the capacity to create educational settings that are deeply engaging and interactive, therefore offering substantial enhancements to the process of learning (Srikong & Wannapiroon, 2020). Immersive learning holds significant importance within the field of education due to a few key reasons:

1. **Enhanced Engagement:** Immersive learning environments have been designed to effectively capture the attention of students and sustain their interest through the provision of immersive, interactive, and multisensory experiences. The observed heightened level of engagement has the potential to foster a concomitant increase in intrinsic motivation, thereby facilitating a more active and participatory approach towards the acquisition of knowledge and engagement in educational activities (Dyulicheva & Glazieva, 2022).

2. **Active Learning**: Immersive technologies foster active learning by transforming students into engaged participants rather than just passive viewers. The ability to engage in the exploration and manipulation of digital things facilitates the development of a more profound comprehension of intricate ideas.

3. **Personalized Learning:** Immersive learning has the capacity to be customized according to the unique requirements and preferred learning modalities of individual pupils. Educators have the ability to modify the content and speed of instruction in order to cater to the unique needs of individual students, hence providing a customized learning experience that facilitates learners' advancement at their preferred rate.

4. **Accessibility:** The use of immersive learning methodologies has the potential to enhance the accessibility of education for students with impairments. For instance, virtual reality (VR) has the capability to replicate experiences that may provide challenges or be unattainable for some students within the confines of the actual realm. This includes virtual field excursions or simulations of historical events (Kapp, 2012).

5. **Experiential Learning:** Immersive environments have been found to facilitate experiential learning, providing students with the opportunity to engage with concepts in a more tangible and interactive manner, as opposed to solely relying on traditional methods such as reading or listening. The utilization of this approach has demonstrated notable efficacy, particularly within the domains of scientific inquiry, historical analysis, and vocational education (Kapp, 2012).

6. **Complex Problem Solving**: Immersive simulations have the capability to accurately reproduce real-world events that need the use of intricate problem-solving abilities. In

a secure and regulated setting, students have the opportunity to develop their decision-making skills and engage in critical thinking (Dyulicheva & Glazieva, 2022).

II. **Understanding special needs education**

A. Overview of special needs education

Understanding special needs education (SNE) is critical for educators, politicians, parents, and society as a whole towards ensuring that people with disabilities have access to excellent education and the chance to prosper and actively engage in their communities (Farrell, 2003). The term "special needs" encompasses a wide array of obstacles or conditions that might have an impact on an individual's capacity to engage in everyday activities, such as schooling. The definition of SNE in the Education Act 1996 is: 'a child has special educational needs…if he has a learning difficulty which calls for special educational provision to be made for him' (section 312). The Act then defines 'learning difficulty' stating that a child has a learning difficulty if: (a) he has a significantly greater difficulty in learning than the majority of children of his age; (b) he has a disability which either prevents or hinders him from making use of educational facilities of a kind generally provided for children of his age in schools within the area of the local education authority; or (c) he is under the age of five and is, or would be if special educational provision were not made for him, likely to fall within paragraph (a) and (b) when of, or over that age' (Farrell, 2003). The aforementioned obstacles might include physical, sensory, cognitive, or emotional aspects. The intensity and effect of special needs might exhibit considerable variation, necessitating tailored assistance and accommodations to facilitate people in surmounting obstacles and attaining their maximum capabilities. The following are few prevalent categories of individuals with special needs:

1. **Learning Disabilities**: Neurodevelopmental disorders, sometimes referred to as learning disabilities, are characterized by impairments in an individual's capacity to successfully acquire, process, or retain knowledge. Common learning difficulties include a range of cognitive impairments that hinder individuals' ability to acquire and process information effectively some of which are highlighted below:
    - **Dyslexia**: Difficulty with reading, spelling, and word recognition.
    - **Dyscalculia**: Difficulty with mathematical concepts and calculations.
    - **Dysgraphia**: Difficulty with writing and fine motor skills.
    - **Auditory Processing Disorder**: Difficulty processing auditory information.
2. **Intellectual Disabilities**: Intellectual impairments are distinguished by constraints in cognitive functioning and adaptive behaviour. The disorders in question exhibit a spectrum of severity, spanning from minor to severe, and often become apparent prior to reaching the age of 18. Conditions such as Down syndrome and Fragile X syndrome are included under this category.
3. **Autism Spectrum Disorders (ASD)**: Autism is a complex neurodevelopmental disorder that affects social interaction, communication, and behavior. It encompasses a spectrum of conditions, including autism, Asperger's syndrome, and pervasive developmental disorders.

4. **Attention Deficit Hyperactivity Disorder (ADHD)**: ADHD is a neurodevelopmental disorder that affects an individual's ability to focus, control impulses, and manage hyperactivity. It can impact learning and behavior in various settings.

5. **Physical Impairments**: Physical impairments include a range of conditions that impact an individual's ability to move or engage in physical activities. Several examples may be provided:

    - **Cerebral Palsy**: A group of movement disorders caused by damage to the brain.
    - **Muscular Dystrophy**: A genetic disorder that leads to muscle weakness and degeneration.
    - **Spina Bifida**: A congenital condition in which the spinal cord does not develop properly.

6. **Sensory Impairments**: Sensory impairments are problems with how the body perceives things, like seeing or hearing less well.

    - **Visual Impairments**: They range from partial sight to total blindness.
    - **Hearing Impairments**: They can vary from mild to profound, affecting an individual's ability to hear and communicate.

7. **Emotional and Behavioral Disorders**: Emotional and behavioral disorders include things like sadness, anxiety disorders, conduct disorders, and bipolar disorder, which all affect how a person controls his or her emotions and acts.

8. **Speech and Language Disorders**: Speech and language problems have a significant impact on an individual's capacity to communicate effectively. These illnesses include a range of speech and language abnormalities, such as stuttering, speech sound disorders, and language disorders.

Although persons with special needs include the gifted and talented, migrant fishermen, the socially excluded, and so on, in this discourse, our focus is on persons with impairments.

B. **Challenges in traditional special needs education**

Traditional special education, despite its good intentions, has confronted a number of obstacles over the years. These obstacles have accentuated the need for reforms and innovations in the field in order to better meet the special requirements of people with disabilities. Some of the most significant obstacles in traditional special education include:

1. Segregation
2. Limited Resources
3. Inequity
4. Lack of Inclusive Practices
5. Stigma and Labeling
6. Parental Involvement

C. **The need for innovative approaches**

The significance of using creative strategies in special needs education is of utmost importance, considering the dynamic nature of the educational environment and the objective of ensuring equal educational opportunities for all students. Incorporation of innovative methodologies has the potential to effectively tackle several obstacles encountered within conventional special education systems, hence augmenting the entire educational experience for persons with disabilities. Here are some compelling reasons for embracing innovation in special needs education:

1. **Enhancing Engagement**: Incorporating innovative pedagogical approaches, such as gamification, virtual reality, and interactive applications has the potential to effectively capture and engage students with disabilities, beyond the limitations of conventional instructional techniques. These technologies facilitate the engagement of several senses and foster interactive experiences, so enhancing the enjoyment and significance of the learning process.

2. **Personalized Learning**: The use of adaptive technology and data-driven methodologies enables educators to customize education based on individual students' distinct requirements and preferred learning modalities. The use of personalized learning pathways has been shown to be beneficial for students with disabilities since it allows them to go at their unique speed and concentrate on specific areas where they need more assistance.

3. **Inclusion and Accessibility**: Innovative tools and practices enable greater inclusion of students with disabilities in mainstream classrooms. Assistive technologies, accessible digital content, and universal design for learning (UDL) principles can remove barriers to learning and participation.

4. **Improved Assessment**: Innovative assessment methods, such as formative assessments and real-time feedback via technology can provide educators with a more accurate image of a student's progress and abilities, enabling them to modify instruction accordingly.

5. **Professional Development**: The utilization of innovative professional development programmes and resources has been identified as a valuable strategy for educators to remain up-to-date with the most recent research findings, best practices, and technological advancements in the field of special education. This continuous learning process is of utmost importance in ensuring the delivery of instruction of the highest quality.

6. **Parent and Caregiver Engagement**: Improved cooperation among educators, parents, carers, and students may be facilitated through cutting-edge communication technologies and platforms. Families may remain involved in their child's educational journey and updated about their child's development thanks to these resources.

III. **Immersive learning in special needs education**

A. **Overview of immersive technologies**

Immersive technology in education, from mobile devices to sophisticated virtual reality headgears requires a transition beyond pragmatic understandings. This technology is gaining popularity. Augmented reality glasses demonstrate this trend in technology and consumer

products. Immersive technology is quickly becoming a powerful tool for accelerating digital transformation (Li et al., 2022), allowing learners to become fully immersed in the learning process, practice acting in stressful situations, and interact with inaccessible objects, which improves learning effectiveness. Immersive technologies are becoming more popular owing to their efficiency, cost, and student acceptance and integration. This device might improve special education teaching. According to Ryan et al. (2022), immersive technologies redefine and revolutionize experience. Immersive technology is estimated to boost product development efficiency from idea through assembly (Liu et al., 2021). Immersive technologies employ sound, sight, and touch to immerse consumers in an augmented or virtual world. They aim to be more realistic and engaging than 2D displays or interfaces. Immersive apps immerse users in virtual worlds using visual, auditory, and haptic sensors. Lifelike visuals and interactive aspects enhance this experience. Immersive technology may help people with different learning styles learn.

The potential utilization of immersive technologies is broad (Liu et al., 2021). Below are several immersive technologies that can be used to facilitate learning:

1. **Virtual Reality (VR):** VR allows real-time interaction with 3D multimedia spaces, helping educators and therapists construct safe learning environments (Sideraki & Stathopoulou, 2023). VR can detect and track head movements, allowing virtual object exploration and interaction. Video games, training simulations, and education use it.

2. **Augmented Reality (AR):** Recent advances have made AR a valuable tool for teaching by integrating the actual and virtual worlds in immersive situations (Cevikbas et al., 2023; López-Belmonte et al., 2023). AR aids navigation, gaming, and marketing by bringing digital data to life. In AR, virtual images overlay reality (Ahuja et al., 2022). AR can make textbooks more dynamic and interesting. Textbooks use 3D models, videos, and animations to do this. AR immerses pupils in content, helping them understand and remember it (Hussain & Park, 2023). AR language learning applications may overlay educational content on real objects for rapid translations and pronunciation aids.

3. **Mixed Reality (MR):** This technology lets digital objects interact with and respond to surroundings using virtual and augmented reality. The HoloLens from Microsoft lets people interact with holographic objects in their environment. Mixed Reality is a new way to engage with virtual worlds (Ahuja et al., 2022).

B. Developing effective immersive learning programs for special needs

The development of immersive learning programs tailored for learners with special needs necessitates meticulous planning, extensive collaboration, and thoughtful consideration of the distinctive requirements and obstacles encountered by these learners (Ahuja et al., 2022).

Here are steps to help create such programs:

1. **Understand Learners' Needs**: Conduct exhaustive assessments of the abilities, learning styles, and obstacles of learners with special needs. This information is essential for adapting the immersive experience.

2. **Involve Stakeholders**: Involve everyone from teachers and therapists to parents and learners in the creation of the program. Their knowledge and experience are priceless.

3. **Design Accessible Experiences**: In order to guarantee the accessibility of the immersive content, it is necessary to consider the inclusion of all students, including

those with physical disabilities or sensory impairments. The utilization of universal design principles and assistive technologies, as required, is recommended in order to enhance accessibility and inclusivity.

4. **Incorporate Feedback Mechanisms**: Include mechanisms for learners to provide feedback within the immersive environment. This can help educators understand the learners' experiences and make necessary adjustments.

5. **Offer Training and Support**: Train educators and support staff on how to use the immersive technology effectively. Provide ongoing support to address any technical or instructional challenges.

6. **Promote Social Interaction**: Create opportunities for social interaction within immersive environments to facilitate communication and collaboration among learners.

7. **Foster Inclusivity**: Facilitate the implementation of inclusive practices to ensure equitable participation and optimal benefits for all learners irrespective of their individual abilities, within the immersion program.

8. **Collaborate with Experts**: It is important to engage in collaboration with esteemed professionals specializing in the domains of special education, assistive technology, and accessibility in order to ascertain the efficacy of the program.

C. Future trends and innovations

Leveraging immersive learning for special needs education is likely to see several exciting future trends and innovations. The following are some possible developments to be aware of:

1. **AI-Powered Personalization:** Artificial Intelligence (AI) will play a more significant role in tailoring immersive learning experiences to individual learners. AI algorithms can adapt content, pacing, and interactions in real-time to meet the specific needs of learners with special needs, making the learning process even more personalized and effective.

2. **Advanced Simulation Environments:** Immersive technologies will continue to advance, offering more sophisticated and realistic simulation environments. This could include virtual environments that closely mimic real-life scenarios, helping students with special needs develop practical life skills and social interactions.

3. **Wearable and Mobile Solutions:** As technology becomes more portable and affordable, wearable devices and mobile applications could become integral to special needs education. These devices can provide on-the-go support, assistive tools, and access to immersive content outside the traditional classroom.

4. **Accessibility and Inclusivity Focus:** Future innovations will prioritize accessibility and inclusivity. Developers and educators will work together to ensure that immersive learning experiences are designed with all types of disabilities in mind, including physical, cognitive, sensory, and communicative impairments.

5. **Collaborative Learning Environments:** Immersive technologies will facilitate collaborative learning experiences, allowing students with special needs to interact

with their peers and educators in virtual spaces. This can promote socialization, teamwork, and communication skills in a controlled and supportive environment.

IV. Conclusion

Immersive learning technologies have great potential in transforming educational experience for learners with special needs. These technologies allow educators to customize information for various learning styles by creating a dynamic and interactive learning environment. This degree of personalization is expected to improve children with special needs' and understanding in standard classrooms. Those with sensory processing impairments or other limitations may benefit from immersive learning's multisensory nature. They can easily and enjoyably explore and engage with knowledge. Immersive learning's gamification may also make learning more fun, encouraging engagement and participation of learners with special needs in educational activities. However, integrating immersive learning into Special Needs Education involves careful planning, educator-technologist cooperation, and a commitment to accessibility and diversity. To ensure all learners benefit from these developments, cost, technical accessibility, and training must be addressed. Taking advantage of immersive learning in the education of learners with special needs is viewed to promote better educational opportunities for all learners, regardless of ability or disability. As technology advances, it is imperative that efforts are made towards utilizing the development towards enhancing the education of learners with special needs.

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