UDC 376: 004.853 (574)

AUGMENTED REALITY AS A POTENTIAL FOR LEARNING IN INCLUSIVE EDUCATION IN KAZAKHSTAN

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Augmented Reality (AR) offers us unique opportunities by providing virtual information or objects into our environment and improving users' perception and interaction with the real world. AR is a technology that uses the physical environment and imposes digital information on top of the physical world, creating an interactive space in which users can explore, discover, interact, and learn [1, 1-39]. According to Azuma [2, 355-385], AR should have the following properties that could properly describe it, including real world and virtual worlds, real-time user interaction and registration in three-dimensional space. Virtual Reality (VR) is a technology that interchanges the real world with virtual (artificial) world including "a rich sensory experience" [3, 8]. Compared to VR, AR is defined as a smooth transition from reality to virtuality, implying that the user, not noticing the phase of transition, can move from the real world to the virtual world [4, 1-5]. So the user's perception improves and it allows interacting with digital information and manipulating in user's physical environment. Today smart phones and other mobile devices have the required battery power, computing power, Internet connectivity, multimedia capabilities, and location-based services to make AR practical for educational use [5, 137]. Using AR in the class may enhance the effectiveness of teaching and learners' motivation. Furthermore, it may also provide favorable conditions to understand and learn material in inclusive classrooms regarding their special needs and abilities. Therefore, this paper aims to examine deaf students' attitude toward using the AR technology (in smart phone application) in inclusive classroom compared to the VR technology.

AR technology in education

Generally, studies of AR in education show that AR admits two possible learning cases. Both of them confirm that AR is an interactive experience between a real-life user (a student) and a digital content [6, 1], [1, 2], [7,1323], [8, 6]. In the first case, using AR in education requires a

student to interact with a trigger image to view augmented digital information. In another one, AR allows a student to view relevant three-dimensional information posted in the physical world online without using trigger images.

The results of AR research using triggers support all previous research in several ways. First, Liu's study which is dedicated to vocabulary activities for teaching a foreign language to high school students using AR with image triggers [9, 515–527]. Second, Vilkoniene's research shows that students' content knowledge in biology may be improved by using AR in learning [10, 37]. Vilkoniene used AR for imaging and interactive organ manipulation. The latter study confirms that AR without triggers was an effective learning tool for learning in natural environment [11, 380]. Thus, all abovementioned studies including two learning cases highlight a high level of students' motivation and amusement to learn subjects using AR which may promote their better understanding and memorization of the subject content.

AR in inclusive education

Today very few studies have been identified on AR for children with disabilities. Richard, Billaudeau, Richard, and Gaudin used AR-based image triggers to teach elementary school students with intellectual disabilities [12, 105]. In AR, children could manipulate and match 2D and 3D objects. Disabled children have easily learned to manage image triggers to move digital content in order to properly accomplish relevant tasks. They showed a very high level of involvement and required a little training to achieve a good result.

McMahon, Cihak, Gibbons, Fussell, and Mathison used the AR mobile application to teach six high school students with intellectual disabilities to identify products with certain food allergens [13, 25]. The study found that the AR interface allows students to determine quickly and accurately whether food is safe for a person who has a certain food allergy. The mobile application used in this case is designed based on a bar code scan to provide additional information for learners as well.

AR is a promising technology that can be a powerful assistive technology for people with disabilities. AR can increase the academic and functional abilities of children with hearing impairment (deaf or partly-impaired), disorders of the musculoskeletal system, and intellectual disabilities. Therefore, this study is based on the possibilities of AR in inclusive education which may positively affect the lives of students with disabilities and improve their learning.

The potential of AR in the inclusive education

Education for all means education for everyone. This simple formulation has a deep meaning: if all citizens are equally important for the state, it should provide them with effective access to education as a social wellbeing. Inclusive education is one of the components of the educational policy of the state, aimed at including all children in the educational process, despite differences in health, economic status, social identity, ethnic origin, language, religion, sex and individual abilities. Kazakhstan is trying to create an inclusive educational environment which targets the development of the students' personality and recognizing their uniqueness, originality and the right to better education while modernizing the educational system. So the guiding principle is how much the environment is willing to adapt to individual needs of various categories of children through its own flexible restructuring taking into account the special educational needs of each child.

Based on the results of previous foreign experiences, AR may provide additional growth of opportunities for students with disabilities. It allows creating a favorable environment for the intelligence development, improvement of professional skills and abilities, professional development and creative thinking as well as contributing to the disabled students' experiences in creative activity within the educational environment. Therefore, I have thought about conducting a survey about using AR and VR technologies in inclusive education with deaf children and children with hearing impairment. The AR technology has been applied to the mobile application and the VR technology has used to desktop application in order to determine their attitudes to learning subjects using these technologies. Students were asked to try AR and VR technologies in inclusive classroom of "Architecture Design" course. *(Figure 1 and 2)*

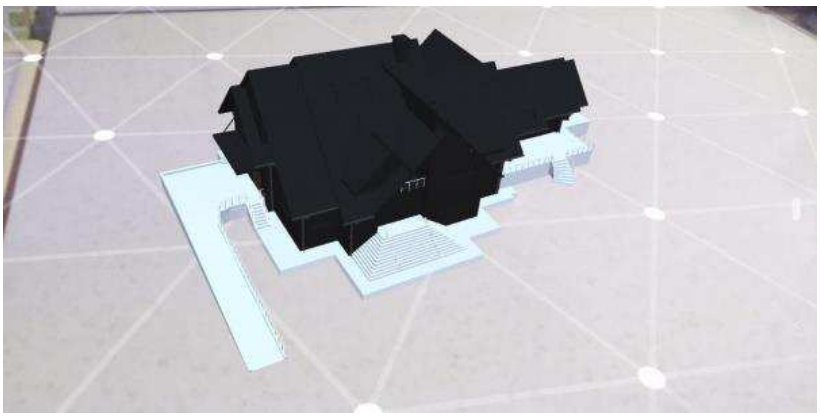

Figure 1. Using the AR mobile application: students are introduced to the constructed buildings in AR.

Figure 2. Using the VR desktop application: students are introduced to the interior design through VR.

Twenty students of the inclusive classroom were asked to complete the survey after getting acquainted with VR and AR technologies. The survey included questions about students' general preference and understanding of the technologies in the educational context.

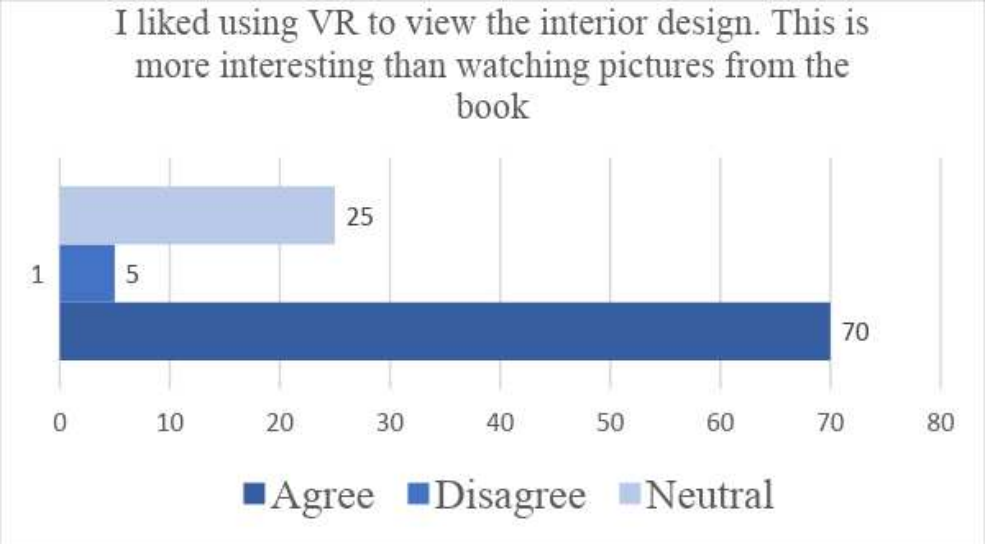

Figure 3.

Although the virtual reality helmets are not very practical for inclusive educational use with the hearing impairments, disabled students were inclined to respond “agree” because it was their first learning experience and initial impressions of using virtual reality in the professional course.

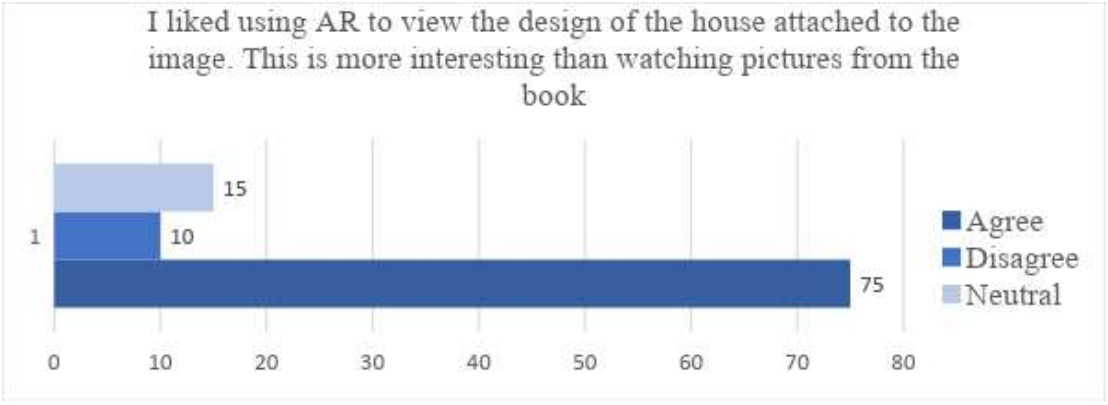

Figure 4.

Using AR applications, all students could view the house from different angles by rotating the plan or moving around the plan. They were motivated by the fact that they could influence AR by moving objects in real time.

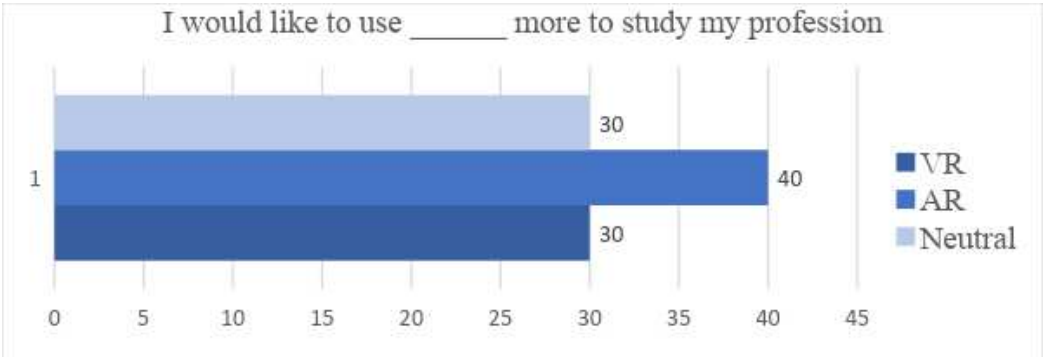

Figure 5.

The final question asked students to choose whether the VR and AR technologies may improve their educational process. Thirty per cent of the respondents were neutral and the same per cent were for VR technology, while forty per cent, the major part of disabled students, chose AR technology as a mean of educational improvement. This shows that disabled students prefer the AR technology more than the VR in the classroom.

Conclusion

Learning with the AR technology is a powerful tool for the development of inclusive education because it can display relevant information to meet students' personal needs regarding their special abilities and individual strengths. There are many practical issues such as limited funds and resources, limited time for teachers’ training as well as immediate information provision for all participants in the educational process including children with disabilities.

The results of this study showed that the introduction of technology like AR in inclusive education carries only positive experience for children with disabilities in comparison with VR which obliges students to wear special items (helmets, etc.) to be involved in education. The AR technology contributes to improve students’ educational interest and gain new learning experience.

Moreover, survey results with deaf students highlighted that AR is more preferable than VR. Students' choice may be explained by the fact that they know sign language and replacing the real world with the virtual deprives them from communication totally. In contrast, AR allows them to communicate and watch the virtual information while being in the real world. Therefore, we hope that this study will be the first step towards the adoption of AR as a means for the development of inclusive education in Kazakhstan.

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