Augmented Reality in the Field Of Education

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Abstract- ***Augmented reality is defined as the technology in which virtual objects are blended with the real world and also interact with each other. Although augmented reality applications are used in many areas, the most important of these areas is the field of education. AR technology allows the combination of real objects and virtual information in order to increase students' interaction with physical environments and facilitate their learning. Developing technology enables students to learn complex topics in a fun and easy way through virtual reality devices. Students interact with objects in the virtual environment and can learn more about it. For example; by organizing digital tours to a museum or zoo in a completely different country, lessons can be taught in the company of a teacher as if they were there at that moment. In the light of all these, this study is a compilation study. In this context, augmented reality technologies were introduced and attention was drawn to their use in different fields of education with their examples. As a suggestion at the end of the study, it was emphasized that the prepared sections should be carefully read by the educators and put into practice in their lessons. In addition, it was also pointed out that it should be preferred in order to communicate effectively with students by interacting in real time, especially during the pandemic process.***

Indexed Terms- Virtual, Education, Digital, Augmented Reality

I. INTRODUCTION

Augmented Reality is a technology that enhances the real world by affixing layers of digital elements onto it. These elements include computer-generated graphics, sound or video effects, haptic feedback, or sensory projects.

The intention behind adding this digital information is to provide an engaging and dynamic customer experience that is enabled with the input received from varied hardware like smart glass, smart lenses, and smartphones.

Augmented reality in education is surging in popularity in schools worldwide. Through augmented reality (AR), educators are able to improve learning outcomes through increased engagement and interactivity. And that's just for starters. AR even has some surprising advantages over virtual reality (VR). Augmented Reality (AR) is often mistaken with Virtual Reality (VR). The main difference between the two is that while Virtual Reality replaces the entire real environment with an artificial one, Augmented Reality is applied in a direct view of an existing real environment and adds elements like sounds, videos, or graphics onto it.

AR's relative seamlessness of digital objects within the "real world" encourages interactivity and engagement. It maximizes students' ability to spend their time learning curricular subjects while minimizing the time spent learning how to use the new tech.

In addition, as discussed in Stanford News on VR's applications within the classroom and "the effect of the body's actions on the mind," AR can also inspire empathy in an individual. It offers two-dimensional methods of presenting information versus the traditional one-dimension. This combination of interactivity and engagement with emotion, in turn, could enhance the ability of students to remember what they've learned– and lead to faster acquisition of information and skills.

Therefore, AR provides students with opportunities to deepen their knowledge within several areas, including:

- Reading
- Working with numbers
- Spatial concepts

- Playing
- Content creation
- Real-life environments & scenarios

This can include everything from field trips to exposure to training within different professions.

When combined with assignments involving teamwork, AR similarly helps provide new opportunities for students to learn how to communicate and collaborate with one another. It could potentially also be the same technologies they will use in the workforce later on.

When adopting AR there is also no need for a complete curriculum overhaul: it can be even more effective in supplementing current pedagogical materials by simply adding more contextual experiences. It can be used to just stimulate interest and discussion in different subject areas and be the basis for class activities.

With AR, classroom education can be extraordinary and more interactive, as AR can enable teachers to show virtual examples of concepts and add gaming elements to provide textbook material support. This will enable students to learn faster and memorize information.

Human memory doesn't forget visuals easily. Here are some examples of Augmented Reality in education.

An AR app, called "Dinosaur 4D+," with a set of flashcards enables users to view 3D dinosaurs, scanning through the card. With this, students can see the actions of dinosaurs and use app features to rotate, zoom, and more. Besides, the application also provides some information about each dinosaur.

The "Element 4D" AR app is another promising example of Augmented Reality in education, which makes learning chemistry fun. The application enables users to find the atomic weight, chemical elements, the reaction between two chemicals, and their names by simply putting two paper cubes for a special element block. Isn't it amazing?

II. REVIEW OF LITERATURE

T. P. Caudell and D. W. Mizell, "Augmented reality: an application of heads-up display technology to manual manufacturing processes," in *Proceedings of the Twenty-Fifth Hawaii International Conference on System Sciences, 1992*, 1992, vol. ii, pp. 659–669 vol.2. – We describe the design and prototyping steps we have taken toward the implementation of a heads-up, see-through, head-mounted display (HUDSET). Combined with head position sensing and a real world registration system, this technology allows a computer-produced diagram to be superimposed and stabilized on a specific position on a real-world object. Successful development of the HUDset technology will enable cost reductions and efficiency improvements in many of the human-involved operations in aircraft manufacturing, by eliminating templates, formboard diagrams, and other masking devices.

T. N. Arvanitis, A. Petrou, J. F. Knight, S. Savas, S. Sotiriou, M. Gargalakos, and E. Gialouri, "Human factors and qualitative pedagogical evaluation of a mobile augmented reality system for science education used by learners with physical disabilities," *Pers. Ubiquitous Comput.*, vol. 13, no. 3, pp. 243–250, Nov. 2007. - Technology-enhanced learning, employing novel forms of content representation and education service delivery by enhancing the visual perception of the real environment of the user, is favoured by proponents of educational inclusion for learners with physical disabilities. Such an augmented reality computer-mediated learning system has been developed as part of an EU funded research project, namely the CONNECT project. The CONNECT project brings together schools and science centres, and produces novel information and communication technologies based on augmented reality (AR) and web-based streaming and communication, in order to support learning in a variety of settings. The CONNECT AR interactive learning environment can assist users to better contextualize and reinforce their learning in school and in other settings where people learn (i.e. science centres and home). The CONNECT concept and associated technologies encourage users to visit science centres and perform experiments that are not possible in school. They can also build on these

experiences back at school and at home with visual augmentations that they are communicated through web-based streaming technology. This paper particularly focuses on a user-centred evaluation approach of human factors and pedagogical aspects of the CONNECT system, as applied to a special needs user group.

M. Dunleavy, C. Dede, and R. Mitchell, "Affordances and Limitations of Immersive Participatory Augmented Reality Simulations for Teaching and Learning," *J. Sci. Educ. Technol.*, vol. 18, no. 1, pp. 7–22, Sep. 2008. - The purpose of this study was to document how teachers and students describe and comprehend the ways in which participating in an augmented reality (AR) simulation aids or hinders teaching and learning. Like the multi-user virtual environment (MUVE) interface that underlies Internet games, AR is a good medium for immersive collaborative simulation, but has different strengths and limitations than MUVEs. Within a design-based research project, the researchers conducted multiple qualitative case studies across two middle schools (6th and 7th grade) and one high school (10th grade) in the northeastern United States to document the affordances and limitations of AR simulations from the student and teacher perspective. The researchers collected data through formal and informal interviews, direct observations, web site posts, and site documents. Teachers and students reported that the technology-mediated narrative and the interactive, situated, collaborative problem solving affordances of the AR simulation were highly engaging, especially among students who had previously presented behavioral and academic challenges for the teachers. However, while the AR simulation provided potentially transformative added value, it simultaneously presented unique technological, managerial, and cognitive challenges to teaching and learning.

Y.-C. Hsu, J.-L. Hung, and Y.-H. Ching, "Trends of educational technology research: more than a decade of international research in six SSCI-indexed refereed journals," *Educ. Technol. Res. Dev.*, vol. 61, no. 4, pp. 685–705, Apr. 2013. - This study applied text mining methods to examine the abstracts of 2,997 international research articles published between 2000 and 2010 by six journals included in the Social Science Citation Index in the field of Educational Technology (EDTECH). A total of 19 clusters of research areas were identified, and these clusters were further analyzed in terms of productivity by country and by journal. The analysis revealed research areas with rising trends, stable status, and low attention. This study also identified areas of research emphasis by journal and research strength by country. A discussion of results through the lens of Critical Theory of Technology is also included. The authors hope to inform the EDTECH community about the trends of EDTECH research on topics and regions of research contributions. The authors also believe that such examination of trends can help facilitate fruitful discussions of directions for future research, and possible international collaboration across various geographical regions.

K.-H. Cheng and C.-C. Tsai, "Affordances of Augmented Reality in Science Learning: Suggestions for Future Research," *J. Sci. Educ. Technol.*, vol. 22, no. 4, pp. 449–462, Aug. 2012. - Augmented reality (AR) is currently considered as having potential for pedagogical applications. However, in science education, research regarding AR-aided learning is in its infancy. To understand how AR could help science learning, this review paper firstly has identified two major approaches of utilizing AR technology in science education, which are named as *image-based AR* and *location-based AR*. These approaches may result in different affordances for science learning. It is then found that students' spatial ability, practical skills, and conceptual understanding are often afforded by image-based AR and location-based AR usually supports inquiry-based scientific activities. After examining what has been done in science learning with AR supports, several suggestions for future research are proposed. For example, more research is required to explore learning experience (e.g., motivation or cognitive load) and learner characteristics (e.g., spatial ability or perceived presence) involved in AR. Mixed methods of investigating learning process (e.g., a content analysis and a sequential analysis) and in-depth examination of user experience beyond usability (e.g., affective variables of esthetic pleasure or emotional fulfillment) should be considered. Combining image-based and location-based AR technology may bring new possibility for supporting

science learning. Theories including *mental models*, *spatial cognition*, *situated cognition*, and *social constructivist learning* are suggested for the profitable uses of future AR research in science education.

III. RESEARCH METHODOLOGY

- Findings

The most striking result to emerge from the data is that most of the studies (40.6%) were applied in the field of "Science." This result indicates that most of the research done in AR applied to education has been concentrated on identifying the benefits of AR in science education 12.5% of the studies reviewed applied AR in "Social Sciences" and 15.6% applied AR in Engineering, manufacturing and construction The results of our review show that the less explored fields of education are "Health and welfare" (3.1%) and Services and Others (travelling, transport, security services and hotel) with 6.3% of the studies reviewed Since one study can report more than one purpose, each study can meet more than one subcategory. It can be seen from this data that most of the studies used AR with the purpose of explaining a topic (43.7%) and augment information (40.6%) Furthermore, according to the results, very little was found in the literature on using AR for activities for "Exploration" and discovering the world through AR (3.1%) and no studies were found with focus on using AR for evaluating a topic (0%) and the use of AR for other educational purposes (0%) different from the ones mentioned before Turning now to the "Time dimension" of the studies reviewed, table 14 shows that almost all of the studies were identified as "Cross-sectional" (93.7%) and only 6.2% of the studies were identified as "Longitudinal Study." According to our research, only 3.1% of the studies were carried out considering a sample of students from vocational educational training institutions Scholarcy Highlights

- Introduction and definitionsIn recent years, technology-enhanced learning (TEL) research has increasingly focused on emergent technologies such as augmented reality, ubiquitous learning (u-learning), mobile learning (m-learning), serious games and learning analytics for improving the satisfaction and experiences of the users in enriched multimodal learning environments (Johnson, Adams Becker, Estrada, & Freeman, 2014)
- Technology-enhanced learning (TEL) research has increasingly focused on emergent technologies such as augmented reality, ubiquitous learning (u-learning), mobile learning (m-learning), serious games and learning analytics for improving the satisfaction and experiences of the users in enriched multimodal learning environments (Johnson, Adams Becker, Estrada, & Freeman, 2014). These researches take advantage of technological innovations in hardware and software for mobile devices and their increasing popularity among people as well as the significant development of user modeling and personalization processes which place the student at the center of the learning process
- This differs from the notion of a Virtual Environment (VE) where the user is completely immersed inside a synthetic environment
- Since augmented reality (AR) is an emergent technology, it is important to get an overview of the advances and real impact of its use in educational settings, describing how AR has been used for generate more student-center learning scenarios
- What are the evaluation methods considered for augmented reality applications in educational scenarios?
- According to the results, very little was found in the literature on using AR for activities for "Exploration" and discovering the world through AR (3.1%) and no studies were found with focus on using AR for evaluating a topic (0%) and the use of AR for other educational purposes (0%) different from the ones mentioned before

- Method

We considered the guidelines proposed by (Kitchenham, 2004) and adapted to this literature review: Planning: Selection of Journals Definition of inclusion and exclusion criteria of studies Definition categories for the analysis. We included one additional journal from the ET-FL-JCR-SSCI list so that the number of journals considered can be equal Those journals are the most relevant journals in Educational Technology according to our analysis. The list of categories for the analysis classified by

research questions (RQ) is as follows: RQ1 - What are the uses, purposes, advantages, limitations, effectiveness and affordances of augmented reality in educational settings?. According to the results, very little was found in the literature on using AR for activities for "Exploration" and discovering the world through AR (3.1%) and no studies were found with focus on using AR for evaluating a topic (0%) and the use of AR for other educational purposes (0%) different from the ones mentioned before Another category analyzed in this systematic literature review deals with the "Reported Advantages" of AR in educational settings. There are many evaluation mechanisms that have not been explored because the technology is not enough mature, so there is a gap between the affordances of AR, its advantages, uses, research methodologies and the evaluation mechanisms applied

CONCLUSION

In this paper a systematic literature review was reported. In total 32 studies from journals were analyzed by using the content analysis method. We analyzed the following factors of the studies selected: Field of education, target group, type of AR, reported purposes, advantages, limitations, affordances and effectiveness of AR in educational settings. We defined a validated method for selecting journals through a methodologically strong and consistent process that can be applied for systematic reviews in other topics. AR has been mostly applied in higher education settings and compulsory levels of education for motivating students. In addition location-based AR is being widely applied. This can be due to the availability of sensors in mobile devices like the accelerometer, gyroscope, digital compass and the possibility of using GPS. This work contributes to existing knowledge in AR in educational settings by providing the current state of research in this topic. This research has identified relevant aspects that need further research in order to identify the benefits of this technology to improve the learning processes