2023 European Conference on Educational Research:
The Value of Diversity in Education and Educational Research,
22-25/08/2023
Glasgow, United Kingdom

Preservice teachers' Physics Education: A Design-Based Learning Augmented Reality case study

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Abstract

Augmented Reality (AR) superimposes virtual objects to the physical environment, enabling augmented experiences to users. AR has been applied to a variety of fields including education offering immersive, authentic, and meaningful learning experiences to students. Research reports that AR, if it is applied appropriately, can have a positive impact on educational settings. AR enables visualisation of abstract concepts, enhances long-term retention, increases learning motivation and engagement and can improve learning achievement (Akçayır, & Akçayır, 2017; Garzón, Pavón, & Baldiris, 2019). Immersive technologies have the potential to transform education by enabling learning experiences that otherwise are inaccessible, expensive, or even dangerous (Jesionkowska, Wild, & Deval, 2020). According to the "VR/AR Industrial Coalition: strategic paper" published be the European commission (2022), AR/VR is very much related to the development of pupils and students, and with its potential as a tool for remote learning, it can support education in remote and rural areas, improving access to education. As declared in the Future of Education Briefing Notes (UN Secretary-General, 2022) released during the Transforming Education Summit 2022, in order for the digital transformation of education to happen, teachers should harness the power of technology and be able to be become micro-curriculum designers and content developers. While AR can offer new opportunities and transform education, its use in classrooms is rather limited. There are numerous challenges associated with the integration of AR in education. Two of these challenges are the lack of teachers' digital skills to use AR in the classroom (Removed, 2021) and the lack of experience in employing AR in the learning design (Ibáñez & Delgado-Kloos, 2018). Teacher education should build the technological and instructional design capacity of preservice teachers enabling them to "be at the frontlines of helping students to navigate their changing world in contextually relevant and age-appropriate way" (UN Secretary-General,

2022). However, while AR technology has come popular in areas such as mathematics and science, few teachers use this technology in science classes (Removed, 2023) and little research exists on how to introduce and integrate AR with specific pedagogical methods to teach science (Arici et al 2019). The current study investigates the applicability of AR in a Design-Based Learning (DBL) approach to teach Physics in preservice teachers' education. Moreover, the study is aiming at exploring preservice teachers' views about the integration of AR in Physics teaching. Design-Based Learning is a student-based learning approach, grounded in constructionism that requires students to use their theoretical knowledge to develop an artifact or a solution to a real-life problem (Ariff, & Nurulaini, 2022; Han & Bhattacharya, 2001). The rationale of choosing the DBL approach is because it promotes critical thinking and creativity (Gómez Puente, van Eijck, & Jochems, 2013) and it is appropriate for science teaching (Ibáñez & Delgado-Kloos, 2018). The DBL process typically consists of four main phases: problem understanding, information gathering, solution generation, and evaluation (Puntambekar & Kolodner, 2005). The current study is aiming to investigate the use of AR in a design-based learning approach to teach Physics to pre-service teachers. Specifically, the study aims to answer the following questions:

1. How Design-Based Learning Augmented Reality can be deployed in preservice teachers' Physics education?
2. What are preservice teachers' views about Design-Based Learning Augmented Reality in teaching Physics?