USING AUGMENTED REALITY FOR ORGANIZATIONAL LEARNING: AN OVERVIEW OF POSSIBLE APPLICATIONS AND POTENTIALS

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Abstract

Organizations and enterprises face a fast-paced and rapidly changing environment today. To be able to keep up with the environment's changes, organizational learning is important. Augmented reality (AR) might be a technology that can help to improve the efficiency and possibilities of organizational learning. AR offers a technical possibility to extend the real environment with additional information. Teaching is one of the various areas in AR that might make sense for. Here, the added value from AR, such as an increase in learning success and motivation, has been identified. At the same time, collaborative learning and working on virtual models are possible through AR. In this process, people can understand contexts more efficiently through real-time feedback, as well as a different perspective on objects and processes. Despite its potential, the application of AR for organizational learning is a topic that is underexplored. This study aims to shed light on the potential that AR can have for educational purposes. Based on a review of existing literature, we show different applications of AR for learning and outline and summarize the results of prior studies.

1. INTRODUCTION

Organizations and enterprises face a fast-paced and rapidly changing environment today. Reasons are, among others, technological developments, changing regulations, and the increasing relevance of sustainable behavior. To keep up with all the recent developments and to stay competitive, companies need the ability to adapt quickly to the changes that occur. However, to be able to remain flexible and to enable organizational change, organizational learning is necessary. Organizational learning is important for organizations and a precondition and preparation for organizational change, or as Tu and Wu (2021) state, by "integrating resources and creating new knowledge, organizational learning is key to carrying out business strategies and achieving sustainable competitive advantage" (p. 504). Organizational learning is a field that has been explored a lot in existing research. Topics that have been investigated include, among others, the role of organizational learning to improve an enterprises' green innovation capabilities (Tu & Wu, 2021), or their potential for high-tech enterprises (Lin et al., 2020) or SMEs (Abbas et al., 2020).

The impact and potential of digital technologies for teaching and organizational learning have already been subject to research (Nair et al., 2022; Nimmi et al., 2022). One technology that might offer several opportunities in the context of education is augmented reality (AR). Although the potential of AR has been investigated for education purposes already, its application for organizational learning remains underexplored. To the best of our knowledge, there is no comprehensive review that summarizes existing research on AR applied in organizational learning and outlines its potential. Given the benefits of AR for organizational learning, this lack of research is surprising. We believe that a structured review and summary of the existing knowledge could not only help practitioners to get an overview of this promising AR application. Additionally, we believe that a systematic review of literature can serve scholars as a platform for future research (Paul & Criado, 2020). We, therefore, aim to investigate AR's potential for organizational learning by addressing the following research question:

RQ: How can AR be used for organizational learning and education purposes and what are resulting benefits and applications?

To answer the research question, we conduct a literature review and systematically collect and analyze existing research on this topic. The search was conducted in both Scopus and Web of Science, which are the largest and best-known scientific databases (Forliano et al., 2021). We identified different articles that are presented in the study at hand.

2. FOUNDATIONS OF AR

To better classify the term augmented reality, Milgram et al. (1995) introduced the reality-virtuality continuum. The reality-virtuality continuum aims to answer the question of how AR is connected to virtual reality (VR). While AR has a real environment, AV has a virtual one. Milgram et al. (1995) define the shared space of AR and AV as mixed reality (MR). A definition for the term AR is offered by Azuma (1997). He defines AR as any system that has the following three properties. The three properties are combining real and virtual, being interactive in real time, and existing in three-dimensional space. This definition does not limit AR to a specific technology, but to existing properties. Lee (2012) states that the environment is real, but augmented with information and images from the system. However, this limits the augmented information to the visual domain. FitzGerald et al. (2013), on the other hand, criticize the need to pay much more attention to the development of digital media, which allow us to augment or enrich our environment with further information. Thereby there is visual, auditory or haptic information (FitzGerald et al., 2013). van Krevelen and Poelman (2019) state that besides the previously mentioned senses, smell is not excluded as augmentation.

Wang et al. (2018) divide the devices for using AR into three different mobility categories. They distinguish wearable, handheld, and fixed devices. Head-mounted displays (HMD), such as the Microsoft HoloLens, are mentioned as attractable devices by Wang et al. (2018). Gesture-recognizing devices are embodied, for example, by pinch gloves (gloves with built-in sensors). The category of handheld devices includes all mobile devices, such as tablets, smartphones, and other ways of holding a display in the hand. Likewise, personal digital assistants and laptops are considered mobile devices. Furthermore, according to van Krevelen and Poelman (2019), handheld transportable projectors are included (FitzGerald et al., 2013; Freitas & Campos, 2008; van Krevelen & Poelman, 2019; Wang et al., 2018).

The third category is the locally fixed devices, such as a computer screen (Wang et al., 2018). The nature of the devices again offers three different forms of visualization (van Krevelen & Poelman, 2019). In the so-called video see-through method, one or more cameras are first used to record the field of view. This is subsequently augmented by the computer and then played back in the display, providing the user with additional information. This method is currently the cheapest and easiest to implement (Azuma, 1997; van Krevelen & Poelman, 2019). Furthermore, there are optical see-throughs. In this case, optical fiber combiners are placed in front of the user's eyes. Through these, the information is projected to the correct locations in the field of view.

This technique has the advantage over the video see-through method of being parallax-free since the projecting letters are transparent. A disadvantage, however, is the price (Azuma, 1997; van Krevelen & Poelman, 2019). Projective visualization, on the other hand, does not require devices directly in front of the user's eyes but rather uses one or more projectors that augment the information into the environment. Disadvantages are that the projectors have to be recalibrated when the environment is changed and they are not usable in outdoor areas, where the conditions for brightness and contrast are not for brightness and contrast are not given (van Krevelen & Poelman, 2019).

3. FINDINGS

In a study by Chiang et al. (2014), the influence of AR on the learning success of fourth-grade students in biology was tested. The study was conducted with the aid of a tablet and the haptic gesture control provided via it. The students were asked to look for specific plants on the school grounds and were given directions to selected locations via GPS. The possible locations were augmented into the overall image of the camera as small image sections so that the students had the various targets and the real environment in front of their eyes. At the previously defined locations, the students could then compare the available plants with those of the image sections. To secure the results, photos of the respective plant were uploaded via the Internet and the task was marked as completed. Further, links presented on the screen could be used to obtain more information. It was found that AR significantly increases learning success and motivation. Furthermore, it was found that cognitive load was not significantly increased by AR (Chiang et al., 2014). This may be due to the fact that supportive information could be retrieved at any time when it was needed.

In a similar study, Esposo-Betan and Santos (2017) investigated the use of tablets to provide information about books in a library. In this process, a book could be augmented with digital information. To do this, the book first had to be scanned with the camera, then a comparison was made with a database, which returned the information to be displayed as an augmentation on the book. A wide variety of media could be used as information, including links to further information-giving pages. Most study participants indicated that AR assisted them in finding information and helped them learn more about the library's resources. In this regard, 75 percent of study participants indicated that no prior technical knowledge was necessary to use the AR application. To this end, it should be noted that a large portion of the study subjects was under the age of 30. Over 94 percent of the respondents indicated that they would like to see this system on a larger scale for the library.

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