The Impact of Augmented Reality on E- learning Systems in Saudi Arabia Universities Overview

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Abstract

At the age of globalization and ongoing changes, education increasingly plays a crucial role in these processes. Efforts of Saudi Arabian educators to synthesize information technology learning with conventional methodologies have contributed to the growing interest in Information Technology as an ultimate learning tool. The present study focusses on Augmented Reality (AR) and explores its potential applications in the educational context. Hence, this study aims to demonstrate the potential of AR as a learning tool and suggest how it can be best adopted at Saudi Arabian universities. The findings will serve as a practical guide on how domestic educational facilities can incorporate AR into their programs. The study sets out to explore the impact of AR on e-learning systems at Saudi Arabian universities and the key contributing factors for the successful adoption of AR at Saudi Arabian universities. From the literature, it was found that IT infrastructure, IT agility, interaction stability, self-learning ability, curriculum, student background, ease of use and Usefulness consider essential factors. The findings of the present study are to be examined in future research.

Keywords: Augmented Reality (AR), E-learning, students', Education, Saudi Arabia.

Introduction

Education is one of the key driving factors behind the development of society and the nation. The national government is tasked with facilitating the educational processes and introducing new techniques, methodologies, and strategies that unlock the learning potential of students. The long-term objectives of Saudi Arabia entail that the national system of education needs to be complemented with the capacities offered by innovative technologies [1]. With a declared commitment of the Ministry of Education to the development of the educational domain [2], it is clear that innovative technology-based learning solutions need to be incorporated by educational facilities.

Today, the discussion on utilizing augmented reality is one of the current and hot debates in the world of education. Due to indefinite advantages of augmented reality, day-by-day. schools and universities in Saudi Arabia are taking the chance by becoming part of these technology revolutions. Consequently, it's important to

conduct a study that highlight the importance of augmented reality and investigate the key success factors for AR implementation in Saudi Arabia.

The current age is the era of information and communications technology, where major changes have occurred involving new scientific discoveries, development of digital environments, robots, artificial intelligence as well as virtual education. Technology has become a major driver behind the change, which has a major impact on learning and teaching methodologies. It played an important role in the production of technological innovations and the implementation of innovative educational programs, which improved educational opportunities. The method of teaching and studying today differed from before, as technological innovations made various changes in how to provide and receive education. The employment process became an important part of the education system. Schools and universities began to integrate them into the learning process in order to improve the teaching and learning process [3]. Thus, the research aims at conducting an analysis of viability of utilizing AR in Saudi Arabian universities and the major factors that lead to its success. This will be attained by first having a review of the already existing scholarly research available about AR and thereafter analyzing the various factors that affect the implementation of AR in E-learning.

Literature Review

Investigation of AR in the learning context is increasingly relevant considering substantial benefits offered by innovative technologies in the educational realm. Pavan [4] posits that technology-based learning solutions are the ultimate aspiration of modern society. According to Olalde and Guesalaga [5], simulation-based technologies contribute to the acquisition of diverse and massive information by students and their subsequent development of comprehensive awareness of learning concepts. There is extensive literature on the use of innovative technology in education. The literature reviewed is divided into 5 clusters (e-learning, e-learning technologies, augmented reality (AR), augmented reality (AR) in learning, augmented reality (AR) in e-learning, factors impacting the Implementation of AR in learning) that deal with different aspects of technology-based learning.

The increasing adoption of e-learning models has been facilitated by the rapid technological development entailing an enhanced role of computers and networks in education. In the view of Clark and Mayer [6], e-learning is a synthesis of multiple learning activities facilitated through information technology. Horton [7] elaborates on this definition by arguing that e-learning enables students to enjoy the freedom of formulation, creation, and organization of the learning process. Other perspectives on e-learning presuppose that e-learning is a shift away from the conventional classroom in terms of curriculum accessibility [8], while Button, Harrington, and Belan [9] attribute the concepts of Internet learning, computerized electronic learning, and distance education to the notion of e-learning as its definitive characteristics. It is also noteworthy that e-learning is viewed as a combination of informal and formal learning patterns that significantly improve the transfer of knowledge alongside the distribution of learning materials. The analysis of literature on e-learning reveals several categories of e-learning, namely stand-alone courses, virtual classrooms, embedded e-learning, games, simulations, mobile learning, and knowledge management.

The revolutionary concept of e-learning is premised on advances in the technological realm. Bernard et al. [10] argue that the advent of innovative equipment, devices, and cutting-edge tools makes it possible for students and teachers to partake in learning interactions that were impossible in the past. Abdullah & Ward [11] point to multiple technologies that are incorporated in e-learning, which provides a unique synthesis of traditional teaching methods and novel opportunities. For example, Button, Harrington, and Belan [9] posit that

the use of radio within the conventional classroom is not novel, yet recent technological advances enable educators to use streaming as one of the tools of radio incorporation. Urh, Vukovic, and Jereb [12] explain the peculiarities of using video technologies in the classroom. In particular, it is possible to employ them to help students comprehend visual images instead of reading or listening. Kipper and Rampolla [13] argue that the use of AR in e-learning makes the learning process more engaging. As illustrated by the example o f Pérez-López & Contero [14], learners can make virtual tours to Mars, which offers an unparalleled learning experience compared to conventional teaching practices.

Misra, Torre, Falcão, Apduhan, and Gervasi [15] describe AR as a computer-mediated reality, mixed reality, and augmented environment. The use of these terms in the learning context is synonymous with the application of innovative technologies as they help to reinvent the learning process. According to Kysela &Štorková [16], augmented reality entails the superimposing of virtual information toward real objects. Coined by Ivan Sutherland (1968), the term 'Augmented Reality' has evolved significantly to embrace new features and capacities. Today, the concept of AR is vast and in its generic terms pertains to the technologies that make it possible to expand the real world (Stevenson, 2010). To put it differently, AR is the variation of virtual reality that establishes a synthetic environment for users.

Alongside other areas of human activity, like marketing, medicine, entertainment, and advertising, education is perceived as one of the most promising fields [17,16]. Olalde & Guesalaga [5] state that education has a high potential for AR because it can enrich the learning experience by enhancing the scope of interactions within the classroom and ensuring the meaningfulness of the learning process. Thus, Ozdemir, Sahin, Arcagok, and Demir [18], posit that increased academic achievements in students should be credited to AR.

The role of AR in e-learning has been analyzed from several angles, ranging from young to adult education. Rezende, Albuquerque & Ambrosio [19] suggest that AR offers new learning opportunities in terms of collaboration, experimental learning, as well as makes the overall learning process more interesting. The study by Pérez-López & Contero [14] proves this point by demonstrating better learning outcomes in students of anatomy and body structure courses. Moreover, the study by Bacca et al. (2018) provides evidence that AR significantly contributes to the effectiveness of mathematics and geometry education.

Dalim et al. [20] point out that the adoption of AR in education is increasing, yet the acceptance rate remains to be low. Hence, it is of paramount importance to identify the factors impacting the acceptance of AR at Saudi Arabian Universities. The studies on the implementation of AR have been thematically categorized into IT infrastructure, IT agility, interaction stability, the capability of self-learning, curriculum, student background, easiness of use, and usefulness.

IT infrastructure has been recognized as a key source of competitive advantage hence an essential determinant of success rate for universities. IT infrastructure is necessary for supporting learning process. Some of the elements that fall under IT infrastructure include the software, hardware, data centers, facilities, networks, alongside AR equipment applied in the learning context. As opposed to VR technologies, AR is more cost-effective due to low cost implications [20]. It is the collaboration of all these factors ensure adequate facilitation of AR in any learning setup. Without the support of the correct infrastructure, it would be difficult to attain effective AR in learning environments. On the other hand, the need for a variety in learning technologies according to the demands of students leads to rapid changes in market trends. Enabling agility will sufficiently help universities to respond quickly to market changes and needs of the students.IT Agility presupposes that AR results in more effective and efficient solutions [21]. To put it differently, agility entails rapid technological responses to learning opportunities and interaction-based delivery of learning materials. The evolving nature of the digital technology requires more agile state- of art technologies that fit in the dynamically changing e-

learning technologies. The highest priority should be in satisfying the needs of both teachers and students while ensuring continuous delivery of re-evaluated curriculum.

In terms of Interaction Stability, AR should factor in the satisfaction of users with application consistency. According to Cheng and Tsai [22], future AR technologies should prioritize stability and interactions as the ultimate acceptance requirements. The capability of self-learning suggests that AR is an exceptional tool in terms of learning and teaching as it provides unique interactive environment capabilities. The AR should be quite stable in ensuring that interactions are quite predictable and effective. They should not be subject to easy manipulation. Cascales et al. [23] ague that AR contributes to self-learning from early childhood to university due to multiple interaction strategies that facilitate an enjoyable and friendly environment. As regards the curriculum, AR helps to engage students in the learning process and sustain their attention span. It becomes more easier when such systems are more available and easily comprehensible. The easy facilitation of access and learning makes it easier   for learners to have an easier learning environment while the teachers are able to foster effective learning environment. Radu [24] posits that the effectiveness of AR learning is largely premised on AR's central role in curriculum and pedagogy requirements. From the perspective of student background, the use of AR in education should be based on the learners' background. Hence, their living conditions and previous experience should be considered [25]. The available technologies should be perfectly matching learners'skills. This would make adoption easier within the integrated classroom environs while teachers also utilize effective strategies to facilitate proper technological integration in the learning process.

Another aspect is the easiness of use. AR is considered a technological breakthrough, while its tools are user-friendly. Thus, as argued by Ma et al. [26], AR-related interfaces and interaction tools make it a superior learning tool. The usefulness of AR suggests that AR applies to many learning areas [26]. In the first place, its usefulness is manifested through the work of surgeons and is perceived as a transitional link towards computer-aided surgery. The flexibility of its usefulness becomes such a perfect tool for suiting learning requirements. The range of its usefulness makes more viable.

Conclusions

AR is a promising technology for the educational field, but its benefits have not been fully explored yet. This paper has presented a review of the existing literature on AR. The impact of AR on the learning process has been discussed. E-learning has been analyzed from several angles, namely e-learning technology, the concept of AR, as well as the application of AR in learning and e-learning. It has been found that with the effective collaboration of IT infrastructure AR become more effective in learning environments. Additionally, effective agility and stability of the AR also enhance its effectiveness in the learning environments. Effective AR technologies also make it easier for sustenance of self-learning by students. It should also be matching the learner's experience and background in dealing with related technologies. Based on this, it hence becomes much clear that if all these factors are put into consideration AR can bring in substantially positive impact in the learning environments.

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