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Faculty at Saudi Electronic University attitudes toward using augmented reality in education

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Abstract

This study aims to examine the possibility of implementing the Augmented Reality (AR) application in higher education by answering three questions: Which extended faculty at the Saudi Electronic University are familiar with such applications, what the perceptions do they hold toward using it in education, and what barriers do they believe may hinder implementing this technology. An online survey was designed and distributed to faculty members at two colleges selected randomly to collect data from participants. Even though the faculty were at an accepted level of familiarity with this technology, they did not use it in their classes. Results showed that faculty have a positive attitude toward the use of AR and have confidence in its potential to enrich the learning environment. This result is connected to the AR advantages the faculty were in agreement with. Results also showed that faculty have concerns about some barriers that might impact implementation of AR in the education environment, such as the lack of technical support.

Keywords Faculty · Attitude · Technology · Augmented reality

1 Introduction

Augmented reality (AR) is a direct or indirect live view of the real world environment the elements of which are augmented through computer-generated perceptual

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information. These elements are augmented across auditory, visual, and haptic sensory modalities. Over a period of time, AR has evolved in many industries and the education industry is one of them. Billinghurst and Dunser (2012) stated that AR in education will affect the conventional learning and teaching processes. This is mainly because AR has the potential to change the timing, place, and location of study along with introducing new and innovative learning methods.

Bressler and Bodzin (2013) added that AR has the further potential to make learning interesting along with engaging students. It has also the benefit of making learning more apprehendable. Collins (2009) pointed out that the learning process in the equation industry is not limited to sharing knowledge and ideas but includes enhancing the level of interaction and creativity to a new level. Educators know that learning is all about engaging students along with making them interested in different subjects. AR has the ability to change the outlook towards education and learning by using additional and innovative methods of teaching students. DeLucia et al. (2012) stated that AR will further transform classrooms by making them engaging and not just focusing on the learning and reading parts.

Saudi Electronic University (SEU), the only university in Saudi Arabia specializing in e-learning, offers blinded learning programs along with life-long education. SEU is taking the lead in implmenting technology in education in order to provide high quality learning to all students. This study tries to assess the faculty attitude toward any technology before utlizing it in the univieristy, thus smoothing implementation of the technology. Moreover, AR is a new technology application in the field of education. A study that sheds light on any obstacles that might hinder the actual implemntation in education is important.

Recognizing that there are benefits as well as challenges associated with the use of AR in education, it is important to assess them critically to have a better degree of understanding. The major purpose of this discussion is to identify the application of AR in education along with discussing the advantages and disadvantages. Further focus will be on highlighting the obstacles in regard to adoption of AR in education in a critical manner.

2 Research questions

1. Are faculty at Saudi Electronic University familiar with AR?
2. What is the faculty attitude toward the use of AR in teaching?
3. From the faculty point of view, what obstacles might hinder their using AR in the classroom?

3 Literature review

3.1 Application of augmented reality

Forsyth (2011) stated that AR can be utilised in a number of ways through wide arrays of media in the form of desktops, smartphones, and mobile devices. This technology is further adaptable to a number of situations. The application of AR is vast, starting from

enhancing instructions in the conventional classroom setting to extending content outside the classroom along with combining other technologies to enrich different individual applications. For conventional classroom usage, there are certain limitations in the form of availability of the resources. Additionally, due to lack of budget and time constraints, learning can be a challenge for a number of students.

Desktop AR is a great tool that allows students to use real and computer-generated images. Iordache and Pribeanu (2009) used desktop AR by integrating the use of glasses, headphones, and painting devices, thus allowing students to have hands-on exploration of real objects. Computer images were used to show the process and a pointing device was used to guide the learning. Serio et al. (2013) found further that visual art classes have a greater impact when students can explore the classroom through webcams and desktops. This motivated students along with encouraging them to be more active and engaged. Students had further access to multimodal representation in the form of 3D models, audio, and videos.

Annetta et al. (2012) further found that a majority of the students own smartphones and the number of students carrying their personal smartphone increases with every passing day. Smartphones further allow users to garner a great deal of information in a variety of locations. Additionally, GPS and QR Codes can be used to track the movement of students. It was further found that the technology related to the AR does not need to be exclusive to the AR experience.

This is mainly because AR in the form of QR codes allows students to use and visualise ideas along with sharing them with other students (Enyedy et al. 2012). Integrating technologies has further benefits in the form of enhancing the overall learning experience. Kamarainen et al. (2013) added that combining technologies can have multiple benefits in the form of better learning experiences that one technology can never do.

Research shows that the usefulness of AR is effective regardless of the subject area or grade level in terms of allowing students to actively engage in the learning process. AR applied in complex problem-solving areas enhances the level of teamwork to create better educational experiences in Math, Science, and English. It has a positive impact on involvement, engagement, and motivation and can offer a much needed push towards innovative learning in a systematic manner. The application of AR is not affected by age group, benefitting people of any age. It can be used to make any subject interesting and innovative, which helps in creating student interest to help build a robust educational foundation (Collins 2009).

Saltan and Arslan (2016), note that AR enhances the real world scenarios through integration of virtual and computer-generated content. The technology can either be adopted as marker-based or even marker-less (Saltan and Arslan 2016). AR's notable application within the educational area especially so; the formal education indicates that the application has resulted to a positive impact on overall learning and learner's attitudes towards education (Saltan and Arslan 2016). Accordingly, it is able to result to improvement of a student's cognition and interaction and foster educational settings through propelling progressive pedagogies; instructional strategies and, also arrangement and delivery of content at hand. Yilmaz (2018) argues that as a result of AR advancement, related applications have been translated from a mere blank area into an overall rich learning experience especially within the educational field as a whole (Yilmaz 2018). In the educational field, AR has resulted to increasing its applicability

through provision of newer opportunities thereby improving interaction of learners and to learn by enjoying (Yilmaz 2018). As a result of this pertinent feature, students are able to enjoy an active learning process; permitted effective, efficient and meaningful learning (Yilmaz 2018). Other related benefits of adopting AR in educational sector lies in the fact that it enhances attention and motivation; interpreting and problem solving as well as creative thinking skills (Yilmaz 2018). Akcayir and Akcayir (2017) agree that AR can sufficiently assist with overall support learning and teaching process as a whole. However, it is noted that the application diminishes cognitive load and in fact, results to cognitive overload (Akcayir and Akcayir 2017). It however; results to other set of benefits link integration of virtual and real-based objects in the real life scenario. Other notable challenges identified in the course of using AR in educational environment rest with the fact that it results to pedagogical issues like a pertinent need for more class time; unsuitability of crowded classrooms as well as inadequacy that emanates from experience with technology amongst students (Akcayir and Akcayir 2017). In a study conducted between 2011 and 2016 using the Social Sciences Citation Index database emphasized on the usability of AR in educational field, which has resulted to a great deal of benefits like learning gains and extensive set of motivation (Chen et al. 2017). Certainly, it has resulted to a better learning performance and thereafter, promoting overall learning motivation especially since content supplied through AR applications are rich in graphics and other notable interaction features altogether (Chen et al. 2017).

Even though the success of AR in the field of education is still at the nascent stage, there is no doubt that using it in a planned and well-defined manner has a variety of benefits and advantages. The application of AR is not restricted only to the education industry and many other industries have benefitted in terms of utilising technologies and availing wide arrays of information. Overall, it can be said that the application of AR looms large in the field of education and can often be applied to other industries seeking multiple benefits.

3.2 Technology aspects for implementing the augmented reality

Augmented Reality (AR) is a technology that has been developed in such a way that it superimposes images generated by a computer over the view of the world that is seen by the user. Studies that have been conducted in recent years have found that AR can be made use of in the process of teaching and learning (Cowling and Birt 2018). AR as a tool for learning should adopt a model that introduces the infrastructure, teaches students to use it, and finally, enhances their learning experience.

The process of AR introduction in higher education should first involve the development of infrastructure. This is an essential procedure because it involves the acquisition of the necessary technologies, such as computers, and other technologies that utilize AR. The latter can be done through interaction with the tutor in such a way that the latter is able to provide guidance concerning the implementation process and the way that the technology should be designed to work (Kaufmann 2003). The technology that is introduced should be designed in such a way that it is easy to use within the learning environment so that it is well accepted (Rasimah et al. 2011; Sumadio and Rambli 2010); enhancing the learning experience of users. Furthermore, the introduction of easy to use AR technology has the potential of making sure that even those

individuals who have not used it before are interested because it essentially creates a new experience (Dalim et al. 2017). The introduction of AR technological infrastructure in higher learning institutions ensures that there is the establishment of positive attitudes towards them; promoting an environment where AR uses is more easily accepted.

The implementation of AR should also involve teaching users how to make use of the infrastructure that has been put in place. Under such circumstances, the technology should be designed in such a way that enables students to easily build conceptual models that are in line with the lessons that they have undertaken and understood (Di Serio et al. 2013; Kaufmann 2003). In addition, students should be taught how to make use of AR to develop new content and make use of it to further their learning process. It is also pertinent to consider that there is need for a flexible learning direction, which ensures that there is the successful adaptation of the knowledge collected using the old way of learning to the new experience.

A definition of specific tasks of the AR technology prior to its being implemented should be made in order for students to have an enhanced learning experience. The users, in this case the students, should be involved in the process through being taught about the specific tasks that they are expected to undertake through the use of the AR infrastructure that has been put in place (Cheng and Tsai 2013). It ensures that there is the achievement of the goal of shifting from a teacher-supported learning to learning that is based on the unique experiences of the students themselves. Thus, AR technology can be tailored to ensure that it adapts to the differing individual learning and performance methods.

3.3 Advantages and disadvantages of using augmented reality

Some of the key advantages of using AR in education are in the form of offering impressive visualisations that are not possible in the traditional classroom, creating interest, increasing the engagement of students, enhancing the level of interest, and improving the quality of education.

Morrison et al. (2011) added that AR helps in generating high-quality visuals and pictures that help in learning in a better manner. Additionally, students love to watch something rather than reading or writing and such experiences might motivate them. Sirakaya and Kiliç Çakmak (2018) cited some advantages of AR in an educational enivironment, such as attracting sudents to learn, increasing students' motivation to attend classes, concretizing abstract concepts, facilitating comprehension lessons, developing students' creativity and supporting authentic learning.

DeLucia et al. (2012) added that AR helps in building and sharing experiences and can be used as a student engagement tool. Finally, it improves the quality of education when students learn from different people at different places.

AR has certain disadvantages, too, in limiting human connections, lacking flexibility, addiction to the virtual world, and functional issues. Forsyth (2011) added that traditional education settings are dependent on human interaction while AR uses software that can affect the relationships shared with human beings. It also lacks flexibility as the software is programmed in a way that answers certain queries which can be seen as a disadvantage.

Serio et al. (2013) further added that software can go wrong and might affect the learning period until the problem is fixed. Finally, AR has the possibility of increasing

virtual addiction that can affect the quality of life. Thus, with certain benefits and advantages there are disadvantages that might mitigate the long-term benefits until there is a way forward in dealing with stated disadvantages.

3.4 Obstacles to adopting augmented reality in education

Wang (2012) pointed that even though AR has taken giant strides in terms of enhancing the level of learning and innovation, certain obstacles that need to be dealt in a systematic manner remain. One key issue is how little exposure people have to the benefits of AR in the field of education. Few people are aware of the wide range of usage and applications of AR in the education industry. Furthermore, AR needs to be improved and innovated in order to be used appropriately Students need a great deal of exposure to this technology in order to make it accessible and acceptable in the long run (Wither et al. 2011). Alkhattabi (2017) cited some obstacles which may hinder implementing AR in education: lack of appropriate ICT infrastructure, the need for IT skills, resistance to change and the cost of devices and AR application.

4 Methodology

4.1 Participants and data collection

The target population of the study is the faculty at Saudi Electronic University in Saudi Arabia. There are a total of 511 faculty members. Two colleges were randomly selected to participate in this study. An online survey was developed and sent to all faculty in both colleges. Sixty-six faculty members responded, making the sample 13% of the target population Table 1.

4.2 Instruments

Based on the literature, a questionnaire was developed by the researchers and was assessed for validity and clarity by three faculty members in the field of Educational Technology. Then, it was improved based on their comments. The questionnaire consisted of three sections. The first collected demographic data about the participants such as gender and age. The second collected data about participants' familiarity with and usage of AR. The third section collected data about the faculty's attitude toward and obstacles to the use of AR in education. Tables 2, 3, 4 and 5 present more details about the items of the questionnaire.

Table 1 Cronbach's Alpha Coefficient of the survey constructs

	Construct	Cronbach's Alpha Coefficient	Number of items	Mean
1	Attitude	0.94	14	3.9
2	Obstacles	0.78	10	3.6

Table 2 Demographic data of participants

Variable	Level	Frequency	Percentages
Gender	Male	30	45%
	Female	36	55%
Age	Younger than 30	6	9%
	Between 30 to 45	52	79%
	Over 45	8	12%

4.3 Data analysis

The Statistical Package for Social Science (SPSS) for Windows, Version 20.0, was used to analyze the collected data. To answer the research questions, descriptive statistics including means, standard deviations, frequencies, and percentages were used.

5 Results

5.1 Reliability of the questionnaire

Cronbach's Alpha Coefficient for internal consistency was used to examine the reliability of the instrument. The questionnaire included two constructs: attitudes and barriers. Fourteen items examined the attitude (Table 4) and 10 items examined the barriers (Table 5). Alpha coefficients of the attitude scale = .9 while the reliability of barriers construct was .78, both of which are acceptable levels for Cronbach's Alpha. To examine the item loading on each construct, confirmatory factor analysis was used and the level of loading was acceptable. Table 1 shows the Alpha coefficient, number of items, and mean of each scale.

Table 3 Faculty familiarity with and their use of Augmented Reality

	Item	Levels	Gender	Frequency	Total	Percentage	Mean	SD
1	Your familiarity with Augmented Reality	Low	Female	12	24	36%	1.8 (out of 3)	0.72
			Male	12				
		Average	Female	17	30	46%		
			Male	13				
		High	Female	7	12	18%		
			Male	5				
2	Have you ever used any Augmented Reality applications?	Yes	Female	12	24	36%	0.4 (out of 2)	0.48
			Male	12				
		No	Female	24	41	64%		
			Male	17				

Table 4 Faculty's attitude toward the use of AR in education

	Items	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	M	SD
1	Use of Augmented Reality in education enhances student-content interaction	20 30%	36 55%	9 14%	1 1%	0	4.1	0.69
2	Use of Augmented Reality in education enhances students' creativity	22 33%	30 46%	14 21%	0	0	4.1	0.73
3	Use of Augmented Reality in education makes learning more apprehendable	17 26%	33 50%	15 23%	1 1%	0	4	0.74
4	Use of Augmented Reality in education enhances students' engagment	18 27%	36 55%	9 14%	3 4%	0	4.0	0.77
5	Use of Augmented Reality in education motivates students to learn	18 27%	32 49%	15 23%	1 1%	0	4.0	0.75
6	Use of Augmented Reality in education helps grab students' attention	19 29%	29 44%	15 23%	3 4%	0	3.9	0.84
7	Use of Augmented Reality in education increases students' enjoyment	19 29%	33 50%	14 21%	0	0	4.0	0.71
8	Use of Augmented Reality in education increases students' satisfaction	14 21%	31 47%	21 32%	0	0	3.8	0.72
9	Use of Augmented Reality in education facilitates learning abstract concepts	14 21%	41 52%	17 26%	1 1%	0	3.9	0.72
10	Use of Augmented Reality in education provides a safe learning environment rather than conducting dangerous experiences	13 20%	29 44%	20 30%	4 6%	0	3.7	0.83
11	Use of Augmented Reality in education supports authentic learning	12 18%	36 55%	17 26%	1 1%	0	3.8	0.70
12	Use of Augmented Reality in education provides students with learning that matches their learning styles	12 18%	36 55%	17 26%	0	1 1%	3.8	0.75
13	I would like to use Augmented Reality in my teaching	20 30%	28 43%	14 21%	4 6%	0	3.9	0.90
14	In general, Augmented Reality is a useful application in education	18 27%	35 54%	12 18%	1 1%	0	4.0	0.72

5.2 Demographic data

Of the 66 participants who completed the survey, 36 (55%) were females and 30 (45%) were males. The majority of participants (52, 79%) ranged in age from 30 to 45 years, eight (12%) were over 45, and only six (9%) were younger than 30.

5.3 Research questions analysis

Two items were used to answer the first research question, Are faculty at Saudi Electronic University familiar with AR? The second part of the questionnaire was used to collect data that answer this question and had two questions. The first asked about faculty familiarity with Augmented Reality and had three levels (low, average, high). Thirty-six percent of participants ranked their familiarity as low, while the majority

Table 5 Obstacles to use of AR in education

	Items	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	M	SD
1	Lack of IT infrastructure will hinder the use of Augmented Reality in education	20 30%	32 49%	13 20%	1 1%	0	4.0	0.75
2	Lack of technical support will hinder the use of Augmented Reality in education	20 30%	34 52%	10 15%	2 3%	0	4.1	0.76
3	Cost of devices and applications will be an obstacle to the use of Augmented Reality in education	17 26%	30 46%	15 23%	3 5%	1 1%	3.9	0.9
4	Use of Augmented Reality in education requires high technical skills	17 26%	26 39%	20 30%	3 5%	0	3.8	0.85
5	My subject area does not support the use of Augmented Reality	11 17%	16 24%	17 26%	18 27%	4 6%	3.2	1.2
6	I believe that using Augmented Reality in classrooms will distract students.	4 6%	15 23%	24 36%	20 30%	3 5%	2.9	.98
7	I believe that using Augmented Reality in education will increase health risks because of the use of digital devices	7 11%	19 29%	28 42%	11 17%	1 1%	3.3	.92
8	I believe that it is difficult to find quality learning content to be used in Augmented Reality	5 8%	15 23%	23 35%	21 32%	2 3%	3	.99
9	Lack of training programs hinders the use of Augmented Reality in education	13 20%	30 46%	22 33%	0	1 1%	3.8	.80
10	Lack of awareness of programs hinders the use of Augmented Reality in education	15 23%	28 42%	21 32%	2 3%	0	3.8	.80

(64%) ranged their familiarity between average and high. The mean of this item was 1.8 and SD = 0.72 which means faculty at Saudi Electronic University are familiar with AR. The distribution of females and males on the three levels of the item was identical, indicating that gender had no impact on faculty familiarity with AR.

The second question asked about faculty usage of AR applications. The majority of participants (64%) had never used any of the applications. The data did not indicate any difference between males and females in regard to their usage of AR. Table 3 shows the responses to these two questions.

The second and third questions of the study – What is the faculty attitude toward the use of AR in their teaching? and What are the obstacles that may hinder faculty from using AR from the faculty point of view? – were designed to include two scales. The first contained 14 items to gather information about faculty attitudes. Table 4 shows the frequencies, percentages, means and standard deviation of the responses to these items which were measured on a five-point Likert scale, ranging from "strongly agree" (5 points) to strongly disagree (1 point). The mean values represented a high positive response to the items which ranged from 3.7 to 4.1 and standard deviations which ranged from 0.7 to .9. The items with the largest means were "The use of Augmented Reality in education enhances student-content interaction " and " The use of Augmented Reality in education enhances students' engagement" (M = 4.1). However, all items

had means larger than 3.7, indicating that the faculty believed AR had the potential to improve the learning environment.

The second part of the survey contained 10 items devised to gather information about the obstacles that can, from the faculty's point of view, hinder the use of AR in education. Table 5 shows the frequencies, percentages, means and standard deviation of the responses to these items. The responses were also measured on a five-point Likert scale that ranged from "strongly agree" (5 points) to strongly disagree (1 point). Results showed that the faculty agreed some obstacles could hinder implementing AR in education. Some had more agreement than others, such as "Lack of IT infrastructure will hinder the use of Augmented Reality in education" and "Lack of technical support will hinder the use of Augmented Reality in education". On the other hand, some obstacles had less agreement from faculty such as "AR does not support some subjects or distracts students" and they did not believe the quality learning content to be used in AR is difficult to find.

6 Discussions

The research aimed to investigate faculty familiarity with AR as well as their attitude toward its use in education at Saudi Electronic University. Intrestingly, even though results show the faculty were familiar with AR, they did not use it in education.

Results show that faculty hold positive attitudes toward the use of AR in education. This finding agrees with previous studies that found educators hold positive attitudes towards AR (Alkhattabi 2017). This result is assumed to be connected to the advantages of AR in education. Previous studies found that AR provides high-quality visuals and pictures that faciliate (Morrison et al. 2011), increase students' engagement tools (DeLucia et al. 2012), attract student to the lessons, help students develop positive attitudes toward learning (Sirakaya and Kiliç Çakmak 2018) and provide active and meanngful learning (Alkhattabi 2017).

Moreover, results showed the important obstacles that might hinder implementing AR in education were lack of technical support, lack of IT infrastructure, and cost of devices and applications. These results were supported by the findings of other studies (Alkhattabi 2017; Serio et al. 2013). They also revealed other obstacles, such as lack of training and awareness programs. These obstacles were consistent with the findings of other studies Wang (2012).

7 Conclusion and recommendation

It can be concluded that the faculty at Saudi Electronic University are willing to use AR in education since they have positive attitudes toward the application. Considering the obstacles which hinder implemting AR, it can be clearly stated that AR is an impressive tool but needs to be assessed in terms of challenges before implementation. There is a need to generate awareness along with modifying and improving the software to deal with the queries of students. There is also a need for better infrastructure and improved technologies to make AR more impactful and widely acceptable in the educational industry worldwide.

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