ISSN 2278-3091
Volume 8, No.1.2, 2019
International Journal of Advanced Trends in Computer Science and Engineering
Available Online at http://www.warse.org/IJATCSE/static/pdf/file/ijatcse1881.22019.pdf
https://doi.org/10.30534/ijatcse/2019/1881.22019

AUGMENTED REALITY BASED EDUCATION FOR THE IMPROVEMENT OF SUSTAINABLE LEARNING ABILITY IN OMAN EDUCATIONAL SYSTEM

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ABSTRACT
Essentially the idea of Augmented Reality is to superimpose digitally generated media onto the real world and therefore allow a composite view of what is virtual and real. While this enabled us to explore our wildest imaginations, some have the right to speculate that it has isolated us from the very real reality which for small intervals is acceptable, but may have serious percussions. So the next reel of thought would naturally be, to find some middle ground, a compromise of sorts to meet each other halfway which will enable us to harness the helpful potential of virtual capabilities in real world situations, and this has led us here, to Augmented Reality. The position of augmented reality in the tech world at this moment is such that it provides a ripe opportunity to nurture the idea of creating an application which will superimpose a video onto a surface. Augmented Reality brings our much loved virtual needs into the real world and merges the two in complete harmony. This enables us to not only be self-aware of our real surroundings, but also incorporates the key elements of our virtual worlds in a way that we are not isolated and wholly dependent on technology, but rather manipulating it in a way that it may prove useful to us. This piece of work attempts to bring an improvement in the educational and learning system such that boards and books altogether will no longer be required in classrooms making the world of education, not only more inclusive and inductive but also much more ecofriendly as the usage of paper will be minimized.

Key words: About four key words or phrases in alphabetical order, separated by commas.

1. INTRODUCTION
The benefits of AR had been increasingly receiving interest from the researchers and the corporates of Oman. AR was first used in the late Nineties, to train the pilots in the simulated cabins [1]. According to the 2011 Horizon Report, the blend of 3D imaging over a 3D space will introduce a new agenda in the teaching and learning process. Also, they have recommended using AR in the educational sector for an adaptive and efficient learning process. It takes the advantage of the physical target image and the augmented 3D model in the sample space of the handheld device to give the new definition of learning methodology [2][3].

There is a large number of published studies that document the limitations, and effectiveness of demanding situations. However, for the reason that AR is an emergent generation, it is crucial to get an overview of the advances and the actual effect of its uses in academic settings, describing how AR has been used for generating extended support to gain knowledge in the educational sector. The evaluation of empirical research that has employed the augmented reality in academic, may assist in reassembling a framework to reveal the power of augmented reality in teaching learning process [29]. Augmented Reality is a step ahead of Reality and Virtuality. Reality defines all the object in the real world, Virtuality defines all the objects in the imaginary world, whereas the augmented reality is the combination of real-world object and the imaginary world object. The definition of visualization can be amplified to the rate of understanding and cognition [10]. The visualization depends on the context of the intended learning [11]. The opportunity of high cognitive awareness in coming into existence [11], [12], [13], [14]. AR works by scanning a pattern which brings a 3D model between the real object and the display screen [4]. AR will be treated as the additional digital info or media that illustrates more details about the objects [5]. The AR application may be static or dynamic based on the needs [6], [7], [8], [9], [28].

2. AR IN EDUCATION – LITERATURE SURVEY
The research reveals that the use of AR is rapidly increasing in mobile and handheld devices. The advancement in the hardware and the software gives way to define the new era of learning. This is possible due to the advanced sensors and the image processing algorithms which work together for the common cause to realize the AR, which has been optimized for the computational ability of cellular devices. The AR development involves extensive set of programs. The basic AR application contains few hundred lines of coding, which are linked to each other for image capturing, the image recognizing, pattern matching, pattern recognizing, etc to push the education to edutainment [15]. In the literature, we can find numerous AR and m-learning targeting a particular domain, such as in the view of business and promotion of the products and real-estate modeling. Some authors have cited

most of the advanced theories and studies in the various educational games found in the literature [16]. In 2003, Ketamo observed the effect of gamed based learning scenario has a significant effect in the m-learning strategies [17]. Ketamo organized a voluntaries of 88 students to participate in the game event. The students were given with some task in the PC and the mobile device. Some group of students confirmed the below average students have improved their performance equal to the average students. Finally Ketamo concluded that the PC based teaching improves the performance, while the mobile based learning increases the learning ability of the below average skilled groups. In 2010, Huang, Lin, and Chen created a Mobile Plant Learning System (MPLS) for a PDA with a digital camera to help botany learning among standard college students [17]. An analysis is performed with 32 individuals with an average age of eleven years old. They were divided into two pools in order to find the effectiveness of the system as compared to the conventional guidebook. The outcomes confirmed that more college students inside the MPLS group pronounced having high-quality perceptions. The evaluation also found that there had been a wide differences in the students' attitudes in favor of the MPLS groups. The participants additionally noted some problems with the user interface. They had to spend an excessive amount of time keying and using the UI with the intention to document their views. User interfaces are critical while designing the application or software considering that a badly designed UI ought to make the application too tedious to play. Similarly, in 2011, Juan et al. [18] developed an AR game. They observed the result of AR games with the traditional video games with thirty-eight children. They found that large difference in the interest of playing the AR game over the traditional video game. The questionnaires reveals that the kids who played the AR game have more fun than the kids who played traditional video games. There are also numerous other m-gaming research conducted over the student of different level to improve the learning skills. In 2009, Uzunboylu, Cavus, and Ercag conducted a study of 41 participants. The participant was given a task for environmental awareness. This study shows that there is an increase in the attitude of the students towards maintaining of the environment [19]. A similar study was conducted in 2005 by Schwabe and Göth by distributing a dedicated handheld device to the student on the orientation day of the college. In 2007, Balog, Pribeanu, and Iordache came up with a new idea to evaluate the effect of AR in the learning process. He gathered a group of students and gave them a dedicated PDA with the 3D model of an object and the real object is placed before them. The majority of the group were interested to use the AR object rather than using the real object in front of them [20]. In 2010, Hsiao provided a brand new method for the analysis the AR application in the field of chemistry. He employed few hundreds of students in the domain of chemistry. He developed a curriculum for this AR to study the significant difference in the performance of the student with this new approach over the traditional methods. He found the result is astonishingly better compared to the traditional approach [21].

2.1 Governments Investing in AR for Education

Estimated that over $108 billion worth industry will be established in the next four years. Due to the business and the marketing bottleneck they may be implementing the AR for the demonstration of their products and the process to promote the business [22]. Also, the Facebook and Snapchat are planned to add AR in their platform. Another impacted area is the academic industry. The ability of the AR is the mix of the real world object with the imaginary world object to give the realistic illustration of the intended concepts, which will bring the learners and the teacher to the new world of experience. Several major governments have realized the benefits of AR and they are focusing to develop AR based application to be imposed on the educational sector.

- **U.S.A.**

On November 2015, the U.S. Department of Education called the developers and the education technology communities to seek the new possibilities for the next generation learning process with the help of AR. This call is named as EDSim Challenge. The objective of the EDSim Challenge is to strengthen the learning ability and employability skills [23].

- **France**

The French government had made a step forward than the USA to incorporate the AR technology in the next curriculum development and commencement starts from the middle school onwards. The aim of this curriculum revision with the inclusion of AR is to give the hands on practice, increase the problem-solving ability, collaborate, cooperate, design, innovation, and communication. Many schools signed to incorporate the AR in the academia before the arrival of the revised curriculum. 17 academic regions of France have signed up for Augmented Reality to be used in their classroom [24].

- **South Korea**

The ministry of Science has decided to invest $363 million in the AR technology by next 5 years. The South Korean government has started implementing this plan by having a workplace called the Korean Virtual Reality – Augmented Reality Complex (KoVAC). The objectives of the workplace are to provide the resources for the AR development and maintenance for over 2200 students [25].

- **U.A.E.**

The UAE government started a pilot project in several schools in the region to introduce AR teaching methods to the students. The first stage is to view the 3D model of the famous architecture and the International Space Station, which is impossible for those students to visit those places [26].

- **China**

China is one of the largest investors in AR with the partnership of 170 corporates and the research institutes. The collaboration includes Beijing University of Aeronautics and Astronautics, Beijing Institute of Technology, Columbia University, and Stanford University. HTC Corporation has the major role in developing China VR Research Institute [27].

3. RESEARCH METHODOLOGY AND IMPLEMENTATION

The use of Augmented Reality (AR) in educational system is a novice approach considering it being used for the first time in Oman. Earlier there were some thoughts regarding the repercussions that would follow upon implementation of AR in coursework; but they all died down after bringing the plan to fruition. Students gave an overwhelming response to the AR technology merged with their coursework. AR was implemented for the first time in Mazoon College (Muscat, Oman) for a course named IST50/IST1750 (Introduction to Information Systems). This is a basic course which has to be completed by all students regardless of their majors. The students studying this course are General Foundation Program (GFP) graduates having limited knowledge of information systems. The teachers teaching this course often face challenges with low grades and declining CGPA's. Therefore, the authors came up with the idea of bringing some innovation to this course so that the students' interests are captured and performance is improved. The authors first collected the required teaching materials and prescribed books for this course. In a course of multiple meetings and discussions with the teachers, the important topics were selected and finalized for implementation. After coding the apps were tested and approved. Three apps were designed: one covering chapter 1, 2 and 3, second one for chapter 4 and the third for chapter 5. The apps were made available in the Google Play Store as well as iPhone App Store. The coding was done such that the app would run on both Android as well as iOS platforms so as to cater to the needs of every student. Then the orientations were planned for each class where the authors and the teachers explained the students about the use of this application in their courses. The sessions were interactive wherein the students were involved in asking questions and giving suggestions for improvement. The entire procedure starting from downloading the app to installing and using it was informed and practically demonstrated to the students. The app is able to detect and capture a picture in the book and play a video related to it. This led to better understanding of the concepts as a picture or video captivates the senses of individuals much better than words. This feature had one more advantage for students who were irregular to classes. This helped them understand the topics they had missed. The analysis of AR in Mazoon College for the course IST50/IST1750 shows a tremendous rise in the grades of the students. The following tables and graphs show a comparative analysis of the performance of students across three semesters viz. Fall 2016, Fall 2017 and Fall 2018. The results of Fall 2016 and Fall 2017 are without the use of AR whereas Fall 2018 used AR for performance improvement. The comparison has been done on 6 sections of Fall 2016, 4 sections of Fall 2017 and 5 sections of Fall 2018. The tables 1, 2 and 3 depict the average marks for each section in the Quiz I, Mid Term, Quiz II, Class Participation (Class Part.) and Final examinations where the maximum marks of each examination is shown in parenthesis in the table. The tables also show the number of students who secured Grades A, B, C, D and F where A = 90 – 100 marks, B = 80 – 89 marks, C = 70 – 79 marks, D = 60 – 69 marks and F = Below 60 marks. The results of Fall 2016 (Without AR) for IST50 across 6 sections and their average is shown in Table 1. The results of Fall 2017 (Without AR) for IST50 across 4 sections and their average is shown in Table 2. The results of Fall 2018 (With AR) for IST50 across 5 sections and their average is shown in Table 3.

Further, on comparison of the Quiz I marks for the three semesters (figure 1) it was found that the Fall 2018 semester which used AR technology showed an increase in the average marks as compared to Fall 2016 and Fall 2017.

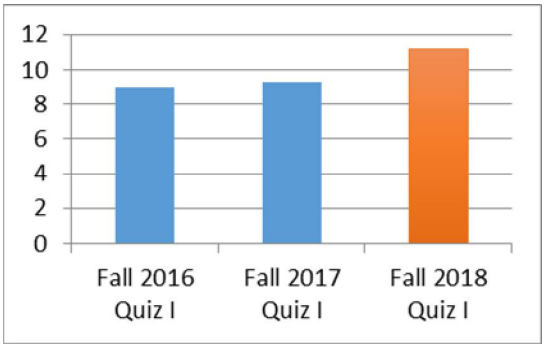

Figure 1: Comparison of Quiz I marks for Fall 2016, Fall 2017 and Fall 2018

Similarly, on comparing the Mid Term (figure 2), Quiz II (figure 3), Class Participation (figure 4) as well as the Final marks (figure 5)of the three semesters we can see an overall increase in the average marks in the Fall 2018 semester which used the AR technology whereas the Fall 2016 and Fall 2017 semesters showed a decreased trend.

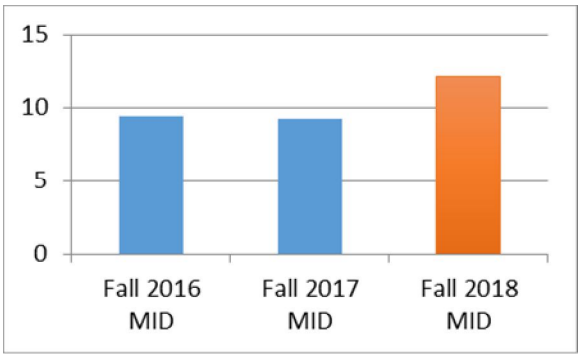

Figure 2: Comparison of Mid Term marks for Fall 2016, Fall 2017 and Fall 2018

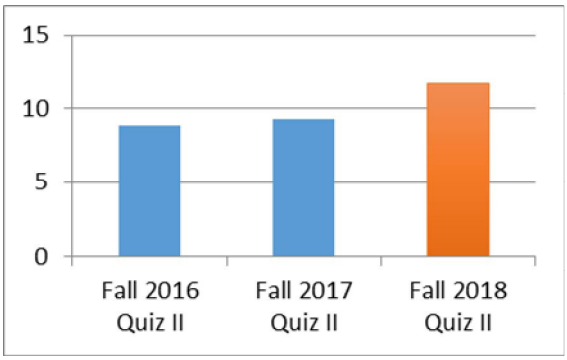

Figure 3: Comparison of Quiz II marks of Fall 2016, Fall 2017 and Fall 2018

Table 1: Results of IST50 (Fall 2016) Without AR

Fall 2016												
Section	No. of Students	Quiz I (15)	Mid Term (20)	Quiz II (15)	Class Part. (10)	Final (40)	Mark Average (100)	Number of				
								A	B	C	D	F
S1	36	9.3	9.19	8.67	7.94	23.78	58.88	6	5	5	8	7
S2	35	10.25	9.6	7.8	8.65	23.48	59.78	3	3	9	7	10
S3	35	9.35	10.97	9.94	9.08	24.79	64.13	9	2	7	5	8
S4	34	9.71	9.62	9.51	8.28	23.94	61.06	5	9	4	4	10
S5	34	8.97	9.76	9.79	8.92	22.82	60.26	3	6	3	8	12
S6	11	6.54	7.36	7.45	7.72	20.44	49.51	2	0	1	4	2
Average	30.83	9.02	9.416	8.86	8.43	23.20	58.93	4.67	4.17	4.83	6	8.17

Table 2: Results of IST50 (Fall 2017) Without AR

Fall 2017												
Section	No. of Students	Quiz I (15)	Mid Term (20)	Quiz II (15)	Class Part. (10)	Final (40)	Mark Average (100)	Number of				
								A	B	C	D	F
S1	35	8.58	9.39	9.9	8.52	25.33	61.72	2	5	4	14	6
S2	39	8.89	8.31	8.71	8.49	25.63	60.03	2	4	7	13	9
S3	34	9.9	8.77	8.03	8.73	26.53	61.96	3	3	6	13	5
S4	30	9.85	10.41	10.44	8.37	27.33	66.4	5	4	7	6	5
Average	34.5	9.30	9.22	9.27	8.52	26.20	62.52	3	4	6	11.5	6.25

Table 3: Results of IST50 (Fall 2018) With AR

Fall 2018												
Section	No. of Students	Quiz I (15)	Mid Term (20)	Quiz II (15)	Class Part. (10)	Final (40)	Mark Average (100)	Number of				
								A	B	C	D	F
S1	31	11.59	12.52	12.21	9.93	28.69	74.94	8	5	9	4	3
S2	31	10.59	11.89	11.19	9.85	26.37	69.89	3	5	9	7	3
S3	32	11.81	11.81	12.03	9.84	28.44	73.93	7	11	3	7	4
S4	31	10.74	12.35	12.39	9.81	28.33	73.62	7	7	11	2	4
S5	30	10.96	12.36	11	9.71	25.79	69.82	7	9	4	1	7
Average	31	11.138	12.186	11.76	9.828	27.524	72.44	6.4	7.4	7.2	4.2	4.2

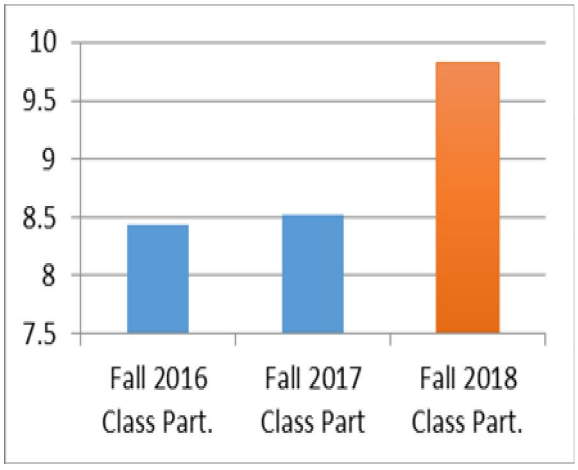

Figure 4: Comparison of Class Participation marks for Fall 2016, Fall 2017 and Fall 2018

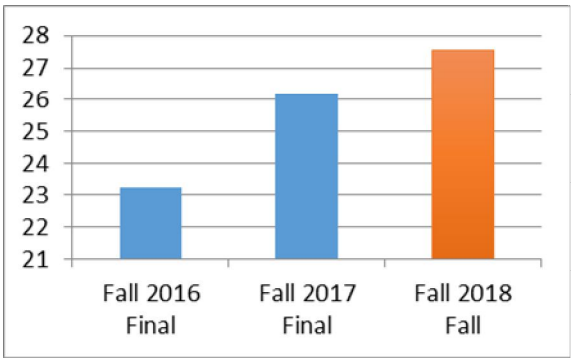

Figure 5: Comparison of Final marks for Fall 2016, Fall 2017 and Fall 2018

A significant increase in the mark average can been seen in figure 6 where Fall 2018 (with AR) shows the highest level of marks.

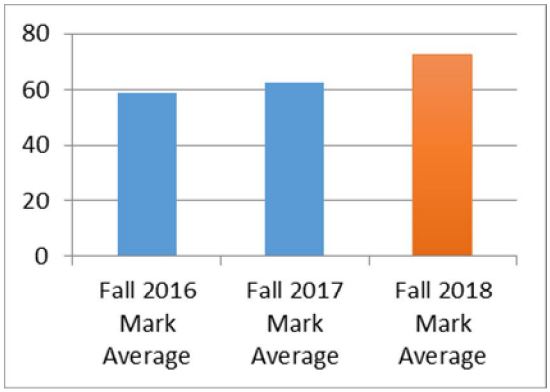

Figure 6: Comparison of Mark Average for Fall 2016, Fall 2017 and Fall 2018

4. CONCLUSION

AR technology has revolutionized the educational and learning experience in a way that has benefitted the students as well as the teaching fraternity. The study of the AR based education for the improvement of sustainable learning ability in Oman educational system infers that AR has been instrumental in boosting the teaching methodology as well as upgrading the performance of the students. Further, we can also presume that AR can be expanded to diversified territories which can lead to an enhancement in the said areas.

APPENDIX

Certificate of Appreciation from Mazoon College

News in News Paper (4th Dec. 2018)


كلية مزون تنفذ تطبيق «الواقع المعزز»

ACKNOWLEDGMENT

We thank and acknowledge the management and department of Mazoon College for the support and facilities provided for successful completion of implementing AR based Education.

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