The Impact of an Augmented Reality System in Teaching Machine Dynamic Course for Engineering Students

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ABSTRACT
This paper summarizes one-year research project funded by the College of Education at Sultan Qaboos University. The study aims to investigate the impact of using augmented reality system as a tool to enhance students' motivation and understanding in Machine Dynamics course and compare this new approach with traditional learning approaches. The experimental design to be used for this study for 30 students from college of engineering at Sultan Qaboos University. Students will be randomly assigned to two groups (15 students each): experimental and control group. Both groups to be taught one chapter from Machine Dynamics Course during four weeks by the same teacher. The experimental group to use the Aurasma application, so students in this group are allowed only to use iPads. On the other hand, the students in the control group are going to study the same chapter using the traditional method. Students' understanding and motivation towards the augmented reality system (Aurasma) to be measured by using observation method. More specifically, times of students' access to the augmented reality application on iPad or textbook to study and get information are to be calculated. Students' performance or understanding of the materials to be measured on weekly basis using achievement tests.

INTRODUCTION
Nowadays, technology has been integrated into many fields; education is one of the main fields. It was observed that technology made a great transition in improving the educational process. Day by day, different technologies have been involved and it was observed from the results of (M. M. Chiu, B. W.-Y. Chow, and C. Mcbride-Chang, 2007) study which shows that despite of different learning strategies, still there is a necessity to integrate complementary technologies which will help in enhancing to develop new kinds of learning environments for both teachers and learners. Augmented Reality applications are one of those new technologies that are used because of its effectiveness in the educational process. The main idea to use the augmented reality is to enhance the learner's senses by manipulating virtual objects with the real world (R. Azuma, 1997). According to (G. Chang, P. Morreale, and P. Medicherla, 2010), the augmented reality takes down shorthand the gap between the real world and the virtual world.
Further, (A. Cascales, I. Laguna, D. Pérez-López, P. Perona, and M. Control, 2013) found that augmented reality applications play a good role in providing a real motivation and stimulus for the children and teachers observed a very positive impact on them. Also, it promotes active behavior in the student, communication skills, and all kinds of interactions in the classroom. Moreover, the augmented reality helps the students to learn more as there was a positive impact in achieving the learning goals with those who used the augmented reality more than those who didn't use it. Also, (M. Billinghurst and A. Dünser, 2012) indicates that augmented reality applications motivate students to explore their surroundings and collaboratively develop their problem solving skills. On the other hand, it was detected Some obstacles that remain in making AR experiences part of the average classroom. One is the lack of content-creation tools. Many educational content developers, such as teachers, do not have the highly developed programming and 3D modeling skills currently required to design AR experiences. Unless tools become usable without such skills, AR interfaces most likely will not catch on in the mainstream curriculum (M. Billinghurst and A. Dünser, 2012).

- **Augmented Reality and understanding**

Some innovations of Augmented Reality have been developed and are being used to enhance the learning and training efficiency of the students. Several studies suggest that AR contributes to improve student's comprehension and the understanding of the content. (Shelton, 2004) indicates the significant role of augmented reality in enhancing students understanding in astronomy class. His study described the following:

The virtual sun and earth are manipulated on a small hand-held platform that changes its orientation in coordination with the viewing perspective of the student. The student controls the angle of viewing in order to understand how unseen elements work in conjunction with those that were previously seen. As another example for the employment of AR in astronomy, (Johnson, et. Al, 2010) described Google's SkyMap as an application

using AR technology. SkyMap overlays information about the stars and the constellations as users browse the sky with the see-through view from the camera on their smart phones. However, it is important to mention that the different features of AR play a significant role in improving student's comprehension. According to (Chang, Morreale, and Medicherla, 2010) study, students and trainees can strengthen their motivation for learning and enhance their educational realism-based practices with virtual and augmented reality.

(Freitas, R., & Campos, P. (2008) indicated that SMART (System of augmented reality for teaching) helps in increasing motivation among students, and it has a positive impact on the learning experiences of these students, especially among the less academically successful students.

This research will investigate the impact of using the Augmented Reality system (Aurasma) in teaching Machine Dynamics course on engineering students' motivation and understanding compared to the traditional way of teaching. We hypothesized that students' who use AR will show better performance in comprehension test and more motivation for learning.

- **Augmented Reality and motivation:**

Most of the researchers pointed out that students' motivation increase with the use of effective learning strategies. Therefore, the effective learning strategies complement with proper computer technology can seriously increase learning motivation. (Chu, Hwang, & Tsai, 2010; Hwang, Tsai, Chu, Kinshuk, & Chen, 2012). The use of Augmented Reality (AR) on learning process helps students to effectively gain understanding of the learning material afterward increasing their learning motivation. Such an approach enables students absorbing learning concepts that are not directly understood by their human senses (e.g., sight, sound, and touch). Therefore, AR offers opportunities for students to be engaged in a meaningful learning environment and interact effectually with it. (Azuma, 1997). Moreover, (Chiang, Yang & Hwang, 2014) found that AR approach helps in obtaining significant learning as it helps in improving students' attention while they focus on exploring the learning material. In addition, it aids to provide relevant information to the students based on their context, so AR bing a good tool in developing students' interests and experiences. Moreover, AR promotes their confidence regarding the learning activities while they face the challenges of the learning tasks at the same time AR helps in increasing the students' feeling of satisfaction after completing those learning tasks.

THE STUDY

The experimental design will be used for this study. Students will be randomly assigned to two groups: experimental and control group. Both groups will be taught one chapter from Machine Dynamics course during four weeks. The same teacher will teach both groups. The experimental group will be using the Aurasma Augmented Reality System(Aurasma) as an application. The content in the application will be designed or collected by the researchers as they will specify the pictures from the chapter that will be used for the application, so students in this group will be allowed only to use iPad. On the other hand, the students in the control group will study the same chapter and will be in a traditional way. Students' understanding and motivation on an augmented reality system (Aurasma) will be measured by using:

1. **Comprehension Test**

To measure students' understanding of the Machine Dynamic course, the researchers designed a comprehension test for one chapter of the book. The test contained four different questions. The test is designed according to the chapter content, the students are exposed to this test two times, one time before using the Aurasma and the other after using the Aurasma to compare the results.

2. **Motivation Scale**

The motivation scale is designed to measure students' motivation toward Augmented Reality System(Aurasma). The scale contains 20 questions; each question has three choices (happy face, normal face, sad face; see below figure). The student chooses the answer that represents his/her opinion. The researchers applies the scale before the experiment to measure the children's motivation towards Augmented Reality System(Aurasma), and will apply it again after completing it to compare the results and find if any differences exist.

		
Applies to me	Not sure	Dose not apply to me

CONCLUSIONS

This study aims to investigate the impact of an augmented reality system(Aurasma) on students' motivation and understanding. The study is in progress and its results will be concluded in the coming few months.

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