

Collaborative Learning about Augmented Reality from Technology and Business Perspectives

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Abstract— Augmented reality technologies are becoming widely used in educational and business contexts. This paper shares results of the TalkTech project, in which first-year introductory technology students from a university in the United States and fourth-year multimedia students from a university in Romania research applications of augmented reality in various industries, develop original augmented reality artifacts, and share their findings with international partners. Based on a project-based and collaborative learning approach, students communicate, research, develop together with the main goal to improve their digital literacy skills. By creating augmented reality artifacts, students better understand the impact of this technology and its business applications, and express their technological creativity in an innovative way.

Keywords: *augmented reality, mobile technologies, project-based learning, collaborative learning, online communication*

I. INTRODUCTION

This paper describes the results of TalkTech, an on-going project, since 2008, teaming students enrolled in a first-year introductory technology course at Bentley University in the United States with fourth-year multimedia students from Politehnica University of Timisoara (UPT) in Romania. The students work together during one semester to study and discuss emerging technology trends with the main goal of developing their digital literacy skills [1].

The TalkTech 2016 project, conducted during the Fall 2016 semester, studied how collaborative learning can improve students understanding and abilities to develop applications using augmented reality (AR) and virtual reality (VR). The project targets learning about AR as a means to develop technology literacy skills and demonstrate creativity.

In this project, AR acts as the subject matter of a collaborative learning experience. The authors were interested in seeing how collaboratively creating and sharing AR artifacts enables students to gain an appreciation of the breadth of applications of AR across industries and cultures, and acquire a better understanding of the related underlying technologies.

The main research questions are:

- Does working in groups influence student understanding of AR and their applications?
- How do students express innovation and creativity using AR?

II. AUGMENTED REALITY IN EDUCATION

Both AR and VR have brought about new forms of engagement in a variety of industries and education, as the ubiquity of mobile devices has raised awareness and usage of these technologies. Several studies have demonstrated the ability to use augmented reality in higher education setting. The use of AR in education to create collaborative learning experiences has progressively increased in recent years, as researchers explore its features, advantages, and limitations [2] [3] [4]. Most are related to science (40.6%), humanities and arts (21.9%), and, surprisingly, engineering (only 15.6%), and social sciences (12.5%) [2].

Users generally experience AR using a smartphone or mobile device, by scanning a target image with an AR app. When the app recognizes the target image, the app then overlays pre-programmed multimedia content on top of the target image on the mobile device's display. The ubiquity of the smartphone increases the popularity of AR, and the number of consumer apps for experiencing AR on such a device is growing.

“AR applications are user-friendly, open-access, and can be used by teachers to create daily teaching activities.” [5, p. 428]. AR apps are just beginning to take their place in educational contexts, and students studied examples of existing AR artifacts before creating their own original ones to demonstrate their understanding of possible uses of AR in a variety of industries.

III. TALKTECH PROJECT SUMMARY

The authors have offered the TalkTech project since 2008 to students enrolled in courses they teach (IT 101 and TMM) at their respective universities each fall semester. Previous work in the TalkTech project [6] researched the students' improvement in adapting to computational thinking [1] and the impact of using real-time collaborative tools and creating short video artifacts to demonstrate students' digital literacy skills [7].

37 honors students in a first-year introductory Information Technology course (IT 101) at Bentley University in the United States, and 70 students enrolled in a Technologies of Multimedia (TMM) course, in their fourth year at Politehnica University of Timisoara in Romania participated in the TalkTech 2016 project, in self-selected groups of four or five (two or three Romanians/Americans). Students were mostly

between 21-23 years old (56.3%), and between 18-20 years old (34%) with a gender representation of 32% as females, 68% males. The Romanian students were, on average, about 3 years older than their American partners. The authors acknowledge that differences in age, number of students, and programs of study are present. For the purposes of this research, the authors considered these differences as strengths, and designed the project based on their students' experience and their technology skills. All students had some previous experience using the web, collaboration tools, and mobile devices. The project's common language is English.

This study implements a project-based learning approach [8] to introduce AR concepts by engaging students to create AR artifacts related to a particular industry. In a project-based learning activity, students work in small collaborative groups to investigate, explain, resolve and develop their project topic. Participants researched applications of AR and VR in one of the following industries: advertising / promotion, architecture / interior design, education / training, fashion, gaming, health care, mapping, museums, sports, travel / tourism. They self-selected their group members and their preferred industry, and with their group members, created original AR experiences for their international partners, they presented their results to each other in online video chats, as shown in Figure 1 (a). They also presented their group's findings in an original interactive infographic created with ThingLink [9], a web-based tool for annotating images with text, images, and video. A more detailed project description and analysis appears in [10].

During the project students met by video conference to share their findings and digital media, and demonstrate their AR artifacts to their international partners. Figure 1(a) shows two groups meeting by Skype during the project, and Figure 1 (b) shows students at both universities presenting their work to each other's classes and instructors by Skype.

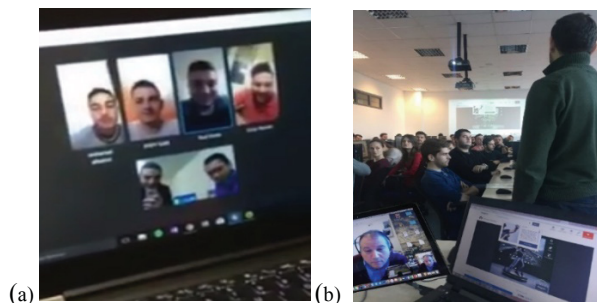


Figure 1. (a) Students sharing AR Artifacts by Skype , and (b) Classroom Demonstrations

IV. TALKTECH 2016 EVALUATION

To better ascertain students' learning about AR and creating AR artifacts, this study relies on the results of interviews, usage data, and an online questionnaire, which the students answered anonymously after the project. The questionnaire was based on experience gathered from questionnaires in previous work [1] [11] and the ZEF online tool [12] for assessment management.

A focus group discussion took place independently in Romania and America, with a pre-determined set of questions, as to identify better what the impact of AR artifacts development on student perspectives. The results are presented in this paper and in [10].

Students' prior-project use of technology was also identified in the survey, as they indicated that they mostly use (1) search engines for information gathering, (2) online chat as their communication tool, and (3) mobile phones are very important for accessing the Internet, apps, and sending text messages, and (4) YouTube also is important for their learning. The students said that before the project, augmented reality was not very important to them and they did not use it very much. [10]

All students claimed proficiency in using AR apps after the project. The American and Romanian students had different prior experiences in using some of the tools and technologies required for TalkTech 2016 as shown in Figure 2. Green squares represent American students; red squares show responses from Romanian students. Blue ovals represent averaged responses from both groups (considering that there were nearly twice as many Romanian students than American students participating).

- 2 Google+
- 3 Google Docs/Drive
- 4 ThingLink
- 5 Vine
- 6 Any AR / VR apps



Figure 2. Prior Use of TalkTech 2016 Tools.

The Romanian students claimed to use AR / VR applications (#6) a lot more than their American counterparts. Follow-up discussion suggested that the only previous exposure that many students had to AR was through playing the popular Pokemon Go! mobile game, introduced during the summer of 2016. Pokemon Go! was more popular among the Romanian students than the American students who participated in this project.

For this project, students had to research an AR creation tool to complete the project. Their instructors did not provide training on the use of any of these tools. As creators of AR artifacts, students made use of a variety of tools. Aurasma was the most popular with students with 74.7%, followed by Layar at 11.4%. Students justified these selections during follow-up interviews, citing the free, open and more user-friendly interfaces of these apps. Only two students used Blippar.

Survey results also showed that while 59% of students were able to create an AR application successfully, 22% found the process of doing so to be more difficult than they had anticipated. 83% of students surveyed recognized the potential of AR in education and learning. Of all the tools used in this project, students said that AR creation tools (82%), and Vine (72%) were the two tools that allowed them to be the most creative.

V. STUDENT-CREATED AR ARTIFACTS

The artifacts that students created demonstrated their understanding of applications of AR in their assigned industries. Figure 3(a) shows an AR artifact relevant to the advertising industry. Scanning a Snapple iced tea bottle with the Blippar app displays links to the Snapple website, social media pages, and nutrition information. Figure 3(b) shows an educational application: scanning a figure of the heart displays additional information about its organs. Figure 3(c) shows an animation that appears when scanning a beach scene in a gaming app.

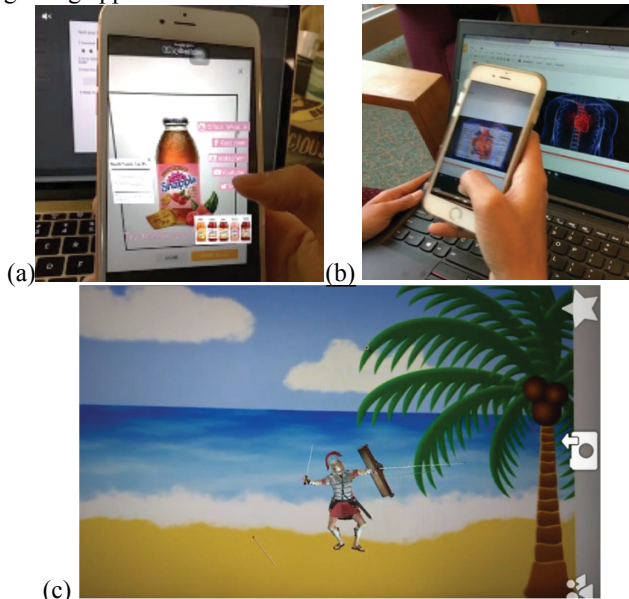


Figure 3. AR used in (a) Advertising, (b) Education, (c) Gaming

The student who created the advertising artifact remarked: “Businesses can use sites like Blippar.com to build their own augmented reality advertisements. AR is useful in advertising because it can provide additional information about the product, like nutritional info, and it can provide links to the company's website or social media pages. All the user needs to do is scan an ad or product in real life, and then they instantly will gain access to other resources concerning the product.”

VI. SUMMARY

The primary goal of the TalkTech 2016 project was to implement a project-based learning approach to study the AR and Internet-based communication tools (ICTs) and technologies that students used when working together to create their own AR artifacts. A secondary goal was to have students create their own original artifacts in order to give them a better understanding of AR from technology and business perspectives.

The instructors did not provide training on any of the ICTs needed to accomplish this assignment's tasks, because most students had indicated in a survey that they had previous experience with using ICTs. Those who had not used some of

these tools beforehand learned to do so from their group members.

This study demonstrates that creating AR artifacts helps students understand the impact of this technology and its business applications, and encourages an innovative way to express technological creativity.

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