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Introducing pre-service education students to university experiences through an augmented reality game

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Augmented reality has come into its own recently due to the advent of Pokémon Go. However, this technology has been around for several years and there is an increasing body of knowledge available. This study reports on an augmented reality game (ARG), called the UQ Amazing Race, that was developed for a first year education course for students studying to be teachers. Students had the opportunity to complete the UQ Amazing Race in class tutorials and then report on their experiences by completing a survey a week later. Students' experiences were investigated particularly regarding how the experience is different by gender and comfort with technology. Results suggest the game was engaging for all students but particularly positive for female students. Students with more comfort with technology reported significantly higher participation in the ARG.

Keywords: Augmented reality game; ARG; pre-service teachers; educational technology

Introduction

Due to increased access to fast Internet and mobile devices, augmented reality games (ARGs) are becoming more common, particularly those used in education. This was increasing prior to the release of Pokémon Go in July, 2016. However, now there is much talk in educational circles about how augmented reality can be used for educational purposes (Vercelletto, 2016; Yoder, 2016). This talk is occurring by teachers of the younger years through to high school and also in tertiary education. Students increasingly have their own devices that they can use in their studies and students in schools also often have access to various types of devices. This means that ARGs can readily be used by academics to enhance student learning and engage them.

The augmented reality game (ARG), called the UQ Amazing Race, described in this paper was developed by one of the authors in order to enhance the learning experience of the large first year course and to expose future teachers to the possibilities of using ARGs in teaching. This paper reports on the game development as well as the learning experiences of students playing an ARG as part of a first year School of Education course *Learning Tools for the 21st Century*. This paper also covers aspects of the ARG pedagogy as well as the experience for the students at The University of Queensland and how the ARG assisted with their course experience. The aim of the UQ Amazing Race was to introduce students to various locations and useful information about the campus. Locations included the faculty office, student services, computer lab location, the library and where to locate wireless internet assistance.

Literature Review

Augmented Reality is "an enhanced version of reality created by the use of technology to overlay digital information on an image of something being viewed through a device (as a smartphone camera)" (Merriam-Webster, Inc, 2014, p. 1). For instance, mobile phones can be used as "viewfinders" through which a user looks while textual information about various objects in the physical space are overlayed on the objects on the screen.

Educational ARGs often revolve around a central mystery that students must solve either individually or in a group. Through the process of solving this challenge, students utilise a technological medium (e.g. iPad) to gather virtual data from their environment that provides the learning upon which the event is initially based. Thus, learning on the topic is necessary to successfully solve the mystery. Research shows that playing educational ARGs generally has a positive effect on student engagement and motivation (O'Shea & Folkestad, 2010; O'Shea, Mitchell, Johnstong, & Dede, 2009; Squire & Jan, 2007). It is possible that there are differences between students in their use of the ARG based on their gender and technology level. According to Kimbrough, Guadagno, Muscanell, and Dill (2013) women use mediated communication more frequently than men. The research project reported in this paper has the following research questions:

1. What are the student levels of engagement when using an ARG game in a teacher education course?
2. Is that experience different by students' gender and comfort with technology?

Methodology

This study involved students enrolled in a first year School of Education course *EDUC1049 Learning Tools for the 21st Century* who were undertaking a Bachelor of Education (Secondary) degree. There were approximately 350 students enrolled in the course with all students who attended the tutorial class in week 1 of classes having the opportunity to complete the UQ Amazing Race in class time. In their groups, students completed the treasure hunt in any order they wished with students working in groups of approximately four students. The students were able to complete a survey on their experiences using the ARG, the UQ Amazing Race, during class the next week. The survey consisted of both closed and open-ended questions with only the closed questions are reported here.

The research sample consisted of mostly, first and second year education students. 219 students responded to the survey about their experiences in using the ARG. In some of the following analyses the total sample size may be different because missing values were treated analysis by analysis, in other words only complete data was used for each analysis depending on the available data for each variable. 69% of students who completed the survey were enrolled in first year, with 19% of students in their second year of the course, 9% in third year, 2% in fourth year and just 1% in their fourth year of the course. This distribution of students who participated in the survey is representative of the spread of the students in the course, which is mostly undertaken by first year students.

Game Development

The development of this game came about due to a researcher from the United States visiting the university with a University of Queensland travel grant. At this time professional development was conducted for school teachers and one of the researchers was involved with the workshop development and thus attended the workshops (O'Shea and Campbell, 2016).

The ARG was created using Aurasma (2014), a program to create an ARG as well as a website to have the back bone of the game. Numerous aspects of campus life were investigated and then chosen ones were included in the game. A website was set up for students to access. Videos were also created to give students information on various topics, including the game introduction, electronic course profile information and computer lab information. The game was conducted in class tutorials. Students had 30 minutes to gain as many points as possible. Students would go to the location, use Aurasma to bring up a website and information. Then points were given for successfully completing the tasks and answering questions including the opening hours of the Faculty office, the name of one person in the School of Education office, library location and how to get assistance in setting up Eduroam. For locations where the image may change regularly (for example, daily due to different bikes being racked) points were also given for students locating, taking a photo and then emailing the tutor a photo of the bicycle racks. Assistance to the researcher was given by the Faculty Educational Designer who assisted with testing of the game as well as problem solving anything that was difficult to use.

Results

Overall, on a scale from 1 (strongly disagree) to 5 (strongly agree), students reported a positive experience of participating in the UQ Amazing Race ARG game, with means equal to 3.50 or above for all the statements, as presented in Table 1. Also investigated were the differences between students according to gender and their comfort level with technology.

Table 1: Descriptive statistics of experience of using an ARG in a pre-service teacher education course.

Statements	Strongly disagree (%)	*n*	Disagree (%)	*n*	Neither disagree or agree (%)	*n*	Agree (%)	*n*	Strongly agree (%)	*n*	Mean	*sd*
1. I enjoyed participating in the ARG.	3.69	8	11.98	26	23.96	52	51.61	112	8.76	19	3.50	0.94
2. I found playing the ARG engaging.	3.23	7	10.14	22	17.97	39	55.76	121	12.90	28	3.65	0.94
3. Through the ARG I got to know some of my classmates.	0.47	1	3.72	8	6.98	15	57.21	123	31.63	68	4.16	0.74
4. Through the ARG I learned some aspects related to university services and facilities.	2.30	5	11.98	26	27.19	59	47.00	102	11.52	25	3.53	0.93
5. I actively participated in the ARG.	0.46	1	1.84	4	6.45	14	60.83	132	30.41	66	4.19	0.67
6. I feel more confident now to participate in a future ARG.	2.76	6	6.45	14	25.81	56	47.93	104	17.05	37	3.70	0.92
7. Participating in this ARG expanded my vision of technology use in education.	4.15	9	9.68	21	24.42	53	47.00	102	14.75	32	3.59	0.99
Total (N=217)											*3.76*	*0.88*

As can be seen in Table 1, students scored active participation in the game as the highest statement, with a high mean score of 4.19. They found playing the game engaging with 68.66 (n=149) responding they either agreed or strongly agreed, and enjoyable with 60.37% (n=131) of students either strongly agreed or agreed that they enjoyed participating in the ARG. Students can be anxious when first attending university and they are often in courses outside of their friendship circle. One of the advantages of students completing the game is that they got to know others in their tutorial class in an informal way (walking around the university completing the game), thus the high score for statement 3 with 88.84% (n=191) agreed or strongly agreed, with a high mean score of 4.16.

Differences according to Gender

As presented in Table 2, there were significant difference between males (mean=3.63) and females (mean=3.81) in the overall experience of using the ARG. A closer look at the item-level, significant differences only appear for items 4 (mean for males=3.33, mean for female=3.60) and 5 (mean for males=4.01, mean for female=4.28) at the alpha level .05. All of these differences mean that female students had a more favourable experience than male students.

Table 2: Independent samples t-test according to gender (N=211)

Statements	Variance	t	df	Sig. (2-tailed)
1. I enjoyed participating in the ARG	Equal variances assumed	-1.046	209	.297
	Equal variances not assumed	-1.048	144.463	.296
2. I found playing the ARG engaging.	Equal variances assumed	-1.610	209	.109
	Equal variances not assumed	-1.577	135.820	.117
3. Through the ARG I got to know some of my classmates.	Equal variances assumed	-.672	209	.503
	Equal variances not assumed	-.639	125.467	.524
4. Through the ARG I learned some aspects related to university services and facilities.	Equal variances assumed	-2.038	209	**.043**
	Equal variances not assumed	-1.972	131.289	.051
5. I actively participated in the ARG.	Equal variances assumed	-2.846	209	**.005**
	Equal variances not assumed	-2.728	128.109	.007
6. I feel more confident now to participate in a future ARG.	Equal variances assumed	-1.190	209	.235
	Equal variances not assumed	-1.154	132.086	.251
7. Participating in this ARG expanded my vision of technology use in education.	Equal variances assumed	-.973	209	.332
	Equal variances not assumed	-.916	122.144	.361
Total (Average of all statements)	Equal variances assumed	-2.047	209	**.042**
	Equal variances not assumed	-1.969	129.313	.051

Differences according to Comfort with Technology Use

We used one-way analysis of variance (ANOVA) to test if students' experiences were different based on their comfort with technology use (see Table 3). There was no significant difference according to the overall experience. The only difference based on was in statement 5 "I actively participated in the ARG".

Table 3: ANOVA Results for Differences in ARG experience according Comfort with Technology Use (N=211)

Statements		Sum of Squares	df	Mean Square	F	Sig.
1	Between Groups	3.085	4	.771	.856	.492
	Within Groups	185.664	206	.901		
	Total	188.749	210			
2	Between Groups	5.087	4	1.272	1.445	.220
	Within Groups	181.254	206	.880		
	Total	186.341	210			
3	Between Groups	2.294	4	.573	.817	.515
	Within Groups	144.503	206	.701		
	Total	146.796	210			
4	Between Groups	6.243	4	1.561	1.864	.118
	Within Groups	172.477	206	.837		
	Total	178.720	210			
5	Between Groups	5.815	4	1.454	3.540	**.008**
	Within Groups	84.602	206	.411		
	Total	90.417	210			
6	Between Groups	5.284	4	1.321	1.592	.178
	Within Groups	170.906	206	.830		
	Total	176.190	210			
7	Between Groups	4.974	4	1.243	1.278	.280
	Within Groups	200.486	206	.973		
	Total	205.460	210			
Total= Average of all statements	Between Groups	3.012	4	.753	1.994	.097
	Within Groups	77.787	206	.378		
	Total	80.800	210			

Post-hoc analysis using Fisher's least significant difference (LSD) test shows that the differences were only significant between students who reported a level 2 comfort with technology use and the three higher levels (3, 4, and 5), as can be seen in Table 4. This means that students with more comfort with technology (levels 3: mean=4.29, level 4: mean=4.15 and level 5: mean=4.24) reported significantly higher participation in the ARG, compared with the lower level (specifically level 2, mean=3.20). One limitation of this finding is the small number (*n*=7; 3.3%) in the lower levels (1 and 2) of comfort with technology compared with the higher levels.

Table 4: LSD Post hoc results for item 5 according to comfort with technology use (N=211)

Levels of comfort with technology use ((1=Least comfortable; 5=Most comfortable)		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
2	1	-.800	.536	.137	-1.86	.26
	3	**-1.089***	.302	.000	-1.68	-.49
	4	**-.949***	.295	.001	-1.53	-.37
	5	**-1.050***	.296	.000	-1.63	-.47

*. The mean difference is significant at the 0.05 level.

Discussion and Conclusion

The positive results with the ARG show agreement with the current literature that suggests motivation and student engagement are enhanced through the use of ARGs in class (O'Shea & Folkestad, 2010; O'Shea, Mitchell, Johnston, & Dede, 2009; Squire & Jan, 2007). Students were also able to get to know their classmates which may have assisted in their enjoyment of the game and activity.

The results for this study show that students enjoyed participating in the ARG and that the female students had a more favourable experience than the male students. The differences in the student's experience depending on their comfortable with technology need to be taken with caution because of the small sample size in the lower level of comfort with technology use; the majority of students are comfortable with using technology in this study. For the small minority who still feel uncomfortable with technology use, it is expected that they will struggle with playing computer games. This small minority may have been the older students who were taking the course. In addition, this factor may have also been diffused in this study as students completed the game in groups.

Future directions include having students learn the necessary skills to create their own ARGs so that they are be able to use ARGs with their future students. As ARGs are such a new teaching tool there is limited research on university students creating ARGs, investigating if the amount of time it takes to learn the design process outweighs the effort. However, with games such as Pokémon Go there is now renewed interest in using ARGs for educational purposes and thus new interest is added to game creation in educational contexts.

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