

Brain Race

An Educational Mobile Game for an Adult English Literacy Program

Nada Soudy¹, Silvia Pessoa², M. Bernardine Dias³, Swapnil Joshi¹,
Haya Thowfeek¹ and Ermine Teves⁴

¹Computer Science Department, Carnegie Mellon University in Qatar, Doha, Qatar

²English Department, Carnegie Mellon University in Qatar, Doha, Qatar

³The Robotics Institute, Carnegie Mellon University, Pittsburgh, Pennsylvania, U.S.A.

⁴Computer Science Department, Carnegie Mellon University, Pittsburgh, Pennsylvania, U.S.A.

Keywords: Mobile, Game-based Learning, Motivation, Implementation.

Abstract: This paper investigates the role and impact of Brain Race (BR), a customized mobile game-based learning tool, on the learning and teaching experiences of teachers and learners in a community adult English literacy program in Qatar. Relying on observations, formal interviews, and surveys with teachers and learners, this paper examines the implementation process of introducing BR in a classroom, the interaction of teachers and learners with BR and their opinions on BR, and BR's perceived impact on learner motivation, engagement, and learning outcomes. Results indicate that although BR motivates learners and allows them to practice English concepts, certain issues, such as equipment used, scheduling, and content relevance, must be addressed in order to make the experience more efficient and valuable to both teachers and learners. The paper argues that learners and teachers have a variety of preferences, and thus it is important that they are able to decide for themselves how they want to include game-based learning tools, such as BR, into their classrooms. We conclude with recommendations to improve the implementation process so that learners can benefit more from BR and similar games.

1 INTRODUCTION

There is no doubt that technology has become an integral part of our daily lives. Students all around the world are constantly surrounded with information and communication technology (ICT) tools (Huizenga, Admiraal, Akkerman, and Dam, 2009). As will be shown in this paper, there has been a surge in research on the impact that different technology tools, both hardware and software, can have in an educational environment. More specifically, there has been an increasing interest in investigating the use of games in the classroom. This paper is primarily interested in investigating the impact of Brain Race, a customized mobile game-based tool, on the learning and teaching experiences of teachers and learners in a community adult English literacy program in Qatar. After providing an overview of the literature and background information on the project and the target population, we discuss our methodology and our findings. We conclude with recommendations to facilitate the process of introducing games into the classroom.

2 RELATED WORK

Dempsey, Lucassen, Haynes, and Casey (1996) define games as “a set of activities involving one or more players. It has goals, constraints, payoffs, and consequences. A game is rule-guided and artificial in some respects. Finally, a game involves some aspect of competition, even if that competition is with oneself” (p.2). The literature reviewed here discusses the potential usefulness of a variety of games: computer games, online games, videogames, console games, and mobile games. The purpose of this review is to understand the benefits and challenges that come up when games are introduced into a classroom environment, and the recommendations for future work.

Several articles provide reviews of previous work done to explore the potential of technology and games in a learning environment (Huizenga et al., 2009; McClarty et al., 2012; Osman and Bakar, 2012; Papastergiou, 2009; Randel, Morris, Wetzal, and Whitehill, 1992; Rosas et al., 2003). The literature highlights the impact of computer, mobile, or

videogames on motivation, but not so much on academic development or learning achievement (Papastergiou, 2009).

Educators are interested in the relationship between games and education, because they see that games can be very beneficial. The most common benefits of introducing digital games in the classroom are that they enhance student motivation, engagement, and cognitive skills (Huizenga et al., 2009; Ke and Grabowski, 2007; McClarty et al., 2012; Mifsud, Vella, and Camilleri, 2013; Rosas et al., 2003; Tüzün, Yılmaz-Soylu, Karakuş, İnal, and Kizilkaya, 2009; Virvou, Katsionis, and Manos, 2005; Williamson and Futurelab, 2009). In their investigation of the impact of videogames on economically disadvantaged students in Chile, Rosas et al. (2003) found that because students reacted positively to the games, teachers started introducing the games more often in class (p.90).

In their review of the literature, McClarty et al. (2012) also found that games are tools students can use to constantly practice their school material. They found that games provide “immediate feedback” (p. 8-9) to students, and “can be a tool for personalized training” (p. 10). Teachers also noted that computer games help improve students’ ICT skills, “higher-order thinking skills (such as logical thinking, planning and strategizing)” (p.2), and encourage more interactions amongst the students, and between teachers and their students (p. 2-3).

Other benefits include encouraging student independence (Tüzün et al., 2009), and the ability to play anywhere (for mobile games at least), (Kam et al., 2008). Kam et al. (2008) and Rosas et al. (2003) found that mobile phones and videogames (respectively) are cheaper than other technological tools, and hence, can benefit less-economically privileged students. Research has also shown that students believe games, such as videogames, can help enhance their learning experiences (Mifsud et al., 2013). Rosas et al. (2003) noted that videogames assist teachers as well, as they offer a different teaching method, provide prompt feedback on student performances, and make class material more interesting for students (p.74).

However, despite these benefits, there are important factors that hinder or complicate the implementation of games in a classroom environment. A common factor is how teachers perceive the role of such games on the educational development of their students (Groff, Howells, Cranmer, and Futurelab, 2010; Mifsud et al., 2013; Rosas et al., 2003; Rice, 2007; Williamson and Futurelab, 2009). Some researchers found that

teachers believe introducing games into the classroom will encourage them to be less social (Mifsud et al., 2013). To address this, researchers highlight the importance of familiarizing teachers with the potential of such games on education, and/or training them on how to best utilize these tools in their classrooms, and/or ensuring that schools provide teachers the necessary technical, financial, infrastructure, and administrative support. (Groff et al., 2010; Mifsud et al., 2013; Rosas et al., 2003, Tüzün, 2007).

Another common factor is the extent to which these games relate to the curriculum taught in the classroom, specifically the content used in the games (Groff et al., 2010; Mifsud et al., 2013; Rice, 2007). Researchers found that teachers and/or school administrators resist the use of games because they do not find that the content and/or the games are context specific or customized enough for their students to benefit from them (Osman and Bakar, 2012). On a related note, teachers’ decision to introduce games into the classroom is influenced by the extent to which games measure and adapt to students’ individual performances, (Mifsud et al., 2013), something that has already been proven to be highly beneficial to students (Hwang, Sung, Hung, Huang, and Tsai, 2012; Tseng, Chu, Hwang, and Tsai, 2008; Wang and Liao, 2011).

However, even if teachers/school administrators see the value of using games in the classrooms, other factors come up that hinder them from doing so. One common factor found in the literature is the difficulty of fitting games into rigid class schedules (Groff et al., 2010; Mifsud et al., 2013; Rice, 2007).

Unsurprisingly, many technical issues come up when it comes to implementing these games in a classroom. In addition to lack of suitable infrastructure mentioned earlier, and technical difficulties (Mifsud et al., 2013; Shiratuddin and Zaibon, 2010), some schools face licensing issues that prevent games from being played on multiple technology tools (Williamson and Futurelab, 2009).

And finally, some factors that hinder the use of games in the classroom come from the students themselves. Bourgonjon, Valcke, Soetaert, and Schellens (2010) argue that one must not automatically assume that all students in today’s world enjoy video games. For example, some students find it difficult to understand how games can help with their education (Bourgonjon et al., 2010; Williamson and Futurelab, 2009). Other students might not be interested in the games because they are not appealing enough (Rice, 2007). Others find the instructions difficult or the games difficult to play

(Bourgonjon et al., 2010; Groff et al., 2010). Some students do not find games appealing in general, or are interested at the beginning but lose interest with time (Bourgonjon et al., 2010; Groff et al., 2010).

Although the literature provides many examples and case studies of introducing educational digital games to the classroom, there is still a lack of experimental and empirical research that examines the applicability of these tools in a classroom environment, and that examines their success on student motivation and learning outcomes (Huizenga et al., 2009; Mifsud et al., 2013; Williamson and Futurelab, 2009). This paper seeks to fill this gap, by investigating the role and impact of Brain Race (BR), a customized mobile game-based learning tool, on the learning and teaching experiences of students and teachers in a community adult English literacy program in Qatar. The paper examines the implementation process of introducing BR in a classroom, the interaction of teachers and learners with BR and their opinions on BR, and BR's perceived impact on learner motivation, engagement, and learning outcomes. The game was tested on South East Asian adult migrant workers participating in an English community literacy program in Qatar. Not only are we contributing to the literature by studying the impact of BR in a classroom environment, we are specifically shedding light on the impact of BR in a non-traditional non-formal classroom environment, where university students teach adult learners as part of a community program. Moreover, this paper presents a mobile game-based tool that was customized specifically to the learning needs and interests of the target adult migrant worker population.

3 BACKGROUND

3.1 Language Bridges Literacy Program Context

Qatar is a small country in the Arabian Peninsula, and is a member of the Gulf Cooperation Council. According to Qatar Statistics Authority and Qatar Information Exchange, the estimated current population is 2.2 million, of which foreign workers comprise more than 94% of the economically active population. Many of these foreign workers come from South East Asia to work mainly as construction workers or in the service industry.

Language Bridges (LB) is a student-led club that runs the Reach Out to Asia Adult English Literacy

(RAEL) Program, a community English literacy program that is sponsored by Reach Out To Asia, a key non-profit organization in Qatar. Carnegie Mellon University in Qatar (CMUQ) faculty and staff assist the LB student board in running the program. LB is mainly composed of CMUQ undergraduate students who volunteer to teach adult migrant workers English.

The student teachers come from a variety of countries, including Qatar, Pakistan, Egypt, India, and Bangladesh. Most of the teachers interviewed study Computer Science, Information Systems, Business Administration, and Biological Sciences. There are also Northwestern University in Qatar (NUQ) student teacher volunteers majoring in Journalism. Most of the teachers are not native English speakers themselves, and a few of them speak Urdu and Hindi, which are languages that the learners are familiar with.

The adult learners mostly work in the CMUQ building as janitorial staff, service attendants, contractors, security guards, and technicians. They are between eighteen to fifty years old, and come from the Philippines, Nepal, and Sri Lanka. The Filipino learners have a stronger grasp of English than Nepali and Sri Lankan learners, and thus usually work as service attendants. The native languages of the learners are mostly Tagalog, Hindi, Sinhalese, and Tamil. RAEL aims to improve learners' English literacy. However, the learners are at very different literacy levels, in both their native languages and English. As a result, a four-level English curriculum was designed to cater to the specific literacy needs of RAEL learners. The program runs in the Fall and Spring semesters for eight weeks each. The class levels are divided into Basic, False Beginner, Intermediate, and Advanced. Some classes are held once a week for two hours, while the rest are held twice a week for one hour each. Class size varies from three to eight learners, with two to three teachers per class.

3.2 Brain Race (BR) Game

BR is a result of a research project that aims to investigate the extent to which computing technology can enhance English literacy skills. The project is a joint collaboration between researchers in Carnegie Mellon University (CMU) in the U.S. and its branch campus CMUQ. RAEL participants were selected as a target population because they are learners of English. The research team conducted a needs assessment with RAEL learners in January 2013 to collect information on the English literacy needs of

this population, and the computing tools that could potentially enhance their literacy skills. Interviews were conducted with the learners before they started their literacy classes. Forty-four learners were interviewed: sixteen from Sri Lanka, eleven from the Philippines, thirteen from Nepal, and four from India. Most participants were between twenty and thirty-two years old. Only five females participated in the study.

The needs assessment interviews revealed that learners want to improve their English skills to be able to communicate better, to seek better jobs, to communicate at work, and to lead an easier life in Qatar. In general, all learners want to develop and be able to use English grammar. We found that for beginner learners, an intuitive game with few instructions would work best for them. For example, they claimed to enjoy the game Snake, where the player has to manoeuvre a snake to gobble up an object. A popular game idea that came from the learners was a car racing game, where the player can control the direction and speed of the car. More advanced English learners informed us that they enjoy playing sports games, such as basketball and volleyball, during their free time. Additionally, they enjoyed more complicated games, such as Sudoku, Text Whiz (a word game that requires you to build words with a given set of letters and also tests you on vocabulary). As shown in Figure 1, Snake and Car Racing were the most popular game choices.

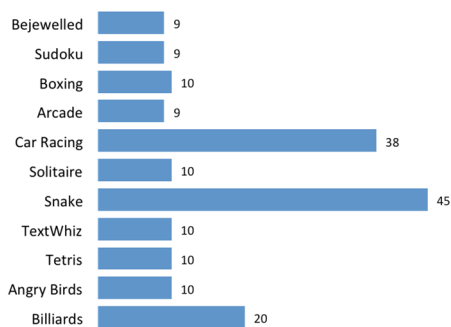


Figure 1: Game suggestions based on learner preferences.

Based on the needs assessment, the research team decided to design a car driving game (see Figure 2) so that it appeals to all learners. BR is a unique game because it is a customized teaching and learning tool. The game developers were CMU students who were part of a class taught by one of the research members. The class focuses on designing technology tools for social development purposes. The students designed BR, a car driving game where players must correctly answer grammar/vocabulary multiple choice

questions in order to collect fuel for their car. The obstacles in the game are other cars on the road that players would have to avoid. The game has power-ups, such as speed controls and coins, to help the players obtain a higher score. Every time the player drives through a fuel icon, a question pops up that they would have to answer in order to continue playing. Similar to an endless running game such as Temple Run or Subway Surfer, the game continues until the player runs out of fuel or crashes the car too often. When the game ends, players are prompted to insert their names to view their scores as well as the other players' recorded high scores.



Figure 2: Screenshots from BR game.

4 METHODOLOGY

From our needs assessment, we found that False Beginner and Intermediate students would benefit the most from this game. Basic learners would struggle with the touch screen and the language of the game, and Advanced learners would find the game to be too simple. Following this, we scheduled 10-15 minutes of game sessions in the curriculum of False Beginner and Intermediate learners. Over the course of eight weeks, we had six game sessions with the False Beginner classes, and eight game sessions with the Intermediate classes. We scheduled fewer game sessions with False Beginner learners so as not to overwhelm them.

The structure of the session included members of the research project visiting the classes on the scheduled day. The research team was composed of three of the authors: a Research Associate, and two Research Programmers, one of whom speaks Hindi while the other understands Tamil. Access to these languages helped us communicate with the learners. We had enough phones for each learner to play individually, and accessed the BR game through the

phones' web browsers. With the help of some student interns, we developed questions from each level's curriculum. To ensure that BR's educational content was relevant to what the learners were reviewing in class, which the literature highlighted was a contributing factor to the perceived usefulness of such games (Groff et al., 2010; Mifsud et al., 2013; Osman and Baker, 2012; Rice, 2007), questions were either taken directly from the curriculum, or similar examples were developed for variety. At the beginning of the game sessions, we helped the learners get started with the game, provided assistance when necessary, and then stepped back to observe the learners playing, only interacting with them if the learners were stuck with the game. Afterwards, we asked the students questions about what they thought of the game, whether or not they liked it, and why/why not. We then collected the phones and left for the classes to resume. Most of the game sessions happened at the beginning of class. However, sometimes, due to scheduling conflicts or simultaneous classes, game sessions happened towards the end of class.

We relied on qualitative research methods to examine the process of introducing BR in a classroom, the interaction of teachers and learners with BR and their opinions on BR, and BR's perceived impact on learner motivation, engagement, and learning outcomes. First, we observed the learners and teachers during each game play session. We occasionally asked the learners questions about the game after they were done playing. Our observations took place when classes were in session. We started the observations when classes commenced in September 2013. Second, we relied on one-on-one interviews with twelve out of twenty-six teachers who have interacted with BR so far. We made sure that we interviewed teachers who had various exposures to the games (e.g. some have only seen the game once, while others have seen it five to seven times). Teachers were asked to describe what they did while their learners played, what they thought about BR, the game session structure, the game being played on a phone, etc. They were also asked to give their opinion on whether we should continue including BR or other educational games in the curriculum. Third, we asked learners to complete simple anonymous surveys (see Appendix) regarding their opinion on the game, what they liked and disliked about it, and whether they felt it helped their English. The surveys were explained in the learners' native languages by research team members and student interns. Twenty four learners responded to the survey out of almost forty learners who played BR since September 2013. The teacher

interviews and learner surveys were completed between October-November 2014.

The investigation revealed that although BR motivates learners and allows them to practice English concepts, certain issues, such as equipment used, scheduling, and content relevance, must be addressed in order to make the experience more efficient and valuable to both teachers and learners. The paper argues that learners and teachers have a variety of preferences, and thus it is important that they are able to decide for themselves how they want to include game-based learning tools, such as BR, into their classrooms. After describing our results in more detail, we conclude with recommendations to improve the implementation process so that learners can benefit more from BR and similar games.

5 RESULTS

5.1 Teacher Interactions with BR

Our observations of game sessions revealed that when teachers interacted with the learners while playing, either to help them with the questions or with the game, learners were more engaged and more focused on choosing the correct answers. We found that some teachers would say encouraging comments, such as 'Good job!', or would remind learners about a particular concept in class, or would even read the questions out loud with the learners in an effort to help them. With these teachers, the learners seemed much more engaged, excited, and focused on the game.

However, a few teachers were disconnected from the process. Some would just browse through their phones, or they would seem completely uninterested in the session. In these classes, it was always very quiet and not fun for the learners. It may be that teachers reacted this way because they did not fully understand the purpose of the project, or they were intimidated by our presence, or they simply did not care. We provide recommendations later on how to address this matter.

5.2 Teacher Opinions on BR

Teachers had mixed reactions about BR itself (see Figure 3). Most teachers found that BR provided learners a different learning method to practice conjugations or to review and reinforce class material and concepts. One teacher described the game as fun, stating that he would be interested in playing it to practice Spanish, a language he is learning at CMUQ.

One teacher thought the game was useful in helping him evaluate which learner has a good grasp of the material and which learner needs more help.

Although most teachers thought positively of the game, a few teachers, some of whom study Computer Science, noted the following issues about BR: bugs, abrupt pop-up questions, slow response rate, low quality, and unattractive graphics.

A few teachers informed us that the learners requested that the game be provided on their personal phones, so that they can practice at home and during their shifts when they have free time. One teacher felt practicing English concepts using a game was easier than using their books. We were only able to accommodate the request to install BR on learners' personal phones for four learners who owned smartphones or devices with touchscreens, since they are required for the game to work properly. The learners expressed their gratitude for the research team because they were able to enjoy the game while practicing their lessons during their free time at work, particularly when they had Internet access via the public network.

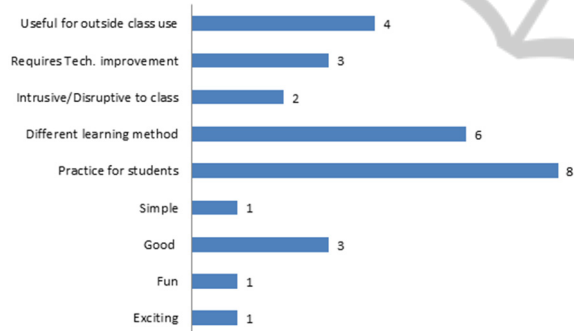


Figure 3: Teacher opinions on BR game.

5.3 Teacher Feedback on Implementation Process

5.3.1 Game Session Timing, Length, and Frequency

As shown in Figure 4, most teachers preferred that game sessions take place at the beginning of class, rather than during class, so as not to disrupt their class flow. One teacher noted that sometimes, he would forget that a game session was scheduled for a particular day, and hence would be surprised to see us coming in during class. The same teacher stated that in the future, he would like to know exactly when the team plans to come to the classroom, how long the game session will last, and what content we will be including. He stated he would need this information

to provide his class with a brief outline so that they also know what is happening. A couple of teachers preferred that game sessions be held at the end so that their teaching is not interrupted, and also for learners to practice the concepts they took in class: "I think if we have [the game session] at the end of class, as a treat. So have them play after they've done the actual work- so it's like motivation for them. Something to look forward to." One teacher said it would depend on how much material they needed to cover that particular day.

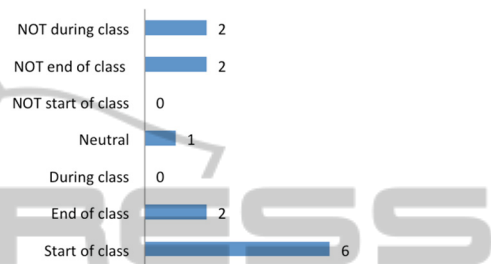


Figure 4: Game session timing preferences.

In addition to commenting on their game session timing preferences, two teachers noted that they want game sessions to be more frequent, so that learners could get the most out of the experience. However, one teacher thought that the sessions should be less frequent but longer than fifteen minutes. Two additional teachers similarly thought that the game sessions were too short and rushed. Hence, the teachers did not have time to go over the game instructions, or mistakes learners made in the game. One teacher was concerned that this made the focus more on the game rather than the questions. No teachers found the sessions to be too long.

5.3.2 Using Smartphones

We received a variety of preferences with regards to where to play the game (see Figure 5). Most teachers felt smartphones/tablets were better than laptops, mainly because they were easier to carry around. One teacher noted that phones were more controllable because learners could easily and quickly tap the screen with their fingers, particularly since BR was in portrait mode. The teacher thought an iPad screen would be too big for a car game like BR. Other teachers felt phones were more appropriate than other devices because learners were more familiar with them. One teacher specifically discussed how learners see people play games on their phones all the time, making the process more relatable than if they were playing on another device. Almost all learners have some kind of phone, even if it is not a smartphone. A

teacher explained that because very few learners have interacted with a laptop before, it would have been difficult to train them and it would have overwhelmed them. Teachers who preferred tablets/laptops felt that they could monitor learners' progress better, and that learners would have better control of the car because of the bigger screens.

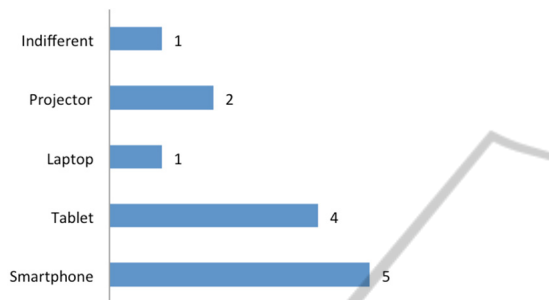


Figure 5: Game technology preferences.

Teachers who chose projector screens felt this would make the games more exciting as learners could compete against each other by shouting out the answers. They felt competition had a positive impact on class atmosphere. Moreover, this would make the presence of the research team unnecessary during the session.

5.3.3 Presence of Research Team

Most teachers found that our presence in their classroom was intrusive or made the learners feel tense and uncomfortable (see Figure 6); perhaps because they felt they were being tested. One teacher felt that we “took over the whole class,” noting that sometimes he felt that the research team was “being kind of a boss on the teachers.”

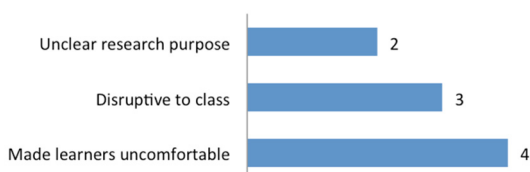


Figure 6: Teacher opinions on presence of research team.

A significant portion (89%) of the teachers stated that they would prefer to receive the equipment before class to lead the game sessions themselves so that learners are not put off by our presence, and so that teachers can schedule game sessions whenever they see fit based on what the learners are learning. The literature reviewed earlier on the use of educational games showed how the perceived usefulness of educational games on the educational

development of students was not always apparent to the teachers (Groff et al., 2010; Mifsud et al., 2013; Rosas et al., 2003; Rice, 2007; Tüzün, 2007; Williamson and Futurelab, 2009). RAEL teachers expressed similar concerns, and thus noted that before they lead the sessions themselves, the research purpose would have to be explained more clearly, and the phones would have to be collected immediately after class so that they are not misplaced. Only 11% of the teachers stated they would feel more comfortable having us handle the game session process: “The team has more authority, [which] would make the learners feel that the game is useful and that it is serious. If we do it, they’ll just think that it’s a game.” Another teacher noted that all the learners are familiar with us (the research team members) and hence, there was no negative impact on the class environment. The teacher noted that it was a “good change” to have visitors in class.

5.4 Teacher Feedback on BR Game Impact on Learner Motivation, Engagement, and Learning Outcomes

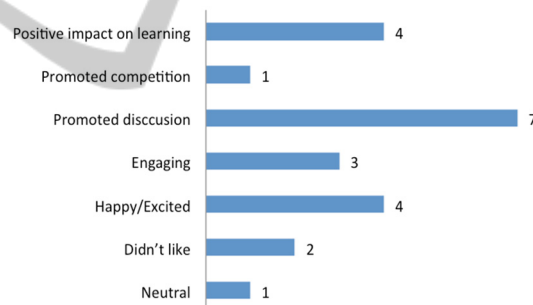


Figure 7: Learner reactions (teacher observations).

Almost all teachers felt that the game had a very positive impact on the class environment. Most of them felt that the game brought variety to the class, and that it was a good break, not from learning, but from the traditional modes of learning. The game also made the class more fun, and for some of the longer classes, teachers felt that it would have reenergized the learners and made class more exciting.

Most teachers stated that the game got learners to be excited, and enhanced their class engagement. As shown in Figure 7, many teachers noticed that learners remained excited from the moment we arrived and throughout the session:

They were all excited, would discuss the questions, their scores. There was more

engagement compared to when I was teaching something and had to call on them to answer. They wanted to play more. Some of them wanted other games- one of them said cricket. But they enjoyed it.

A couple of teachers stated that their shy learners became more talkative and engaged with their classmates and teachers after the game sessions, “We had one learner who was very shy and who wouldn’t talk much in class. He would [...] talk to us about the game because it was something he knew a lot about because he just experienced it.” Another teacher noticed that the few learners who did not have phones of their own were very excited about the game, whereas the others were more interested in the questions. One teacher recalled a time when the learners asked her at the beginning of class if they were going to play the game today.

However, a few teachers felt that the game session could have been more engaging, for example, if learners were placed in teams: “When I play a game in class, I play it on the board. We complete it together. But with BR, because of time, there is no time to make pairs/teams.”

We received a variety of responses regarding the game’s impact on the learning experiences of the learners. Four teachers explicitly discussed positive learning outcomes. Sometimes teachers went over the mistakes learners made in the game after the game session was over. Teachers found that the game helped reinforce key concepts, such as conjugations and verbs, because learners stopped repeating the mistakes after playing the game. One teacher recalled a story that demonstrates learning from the game:

Once I wrote something incorrect on the board. I wrote a word in the present tense when I should have written it in the past because I pronounced it in the past tense. One of the learners corrected me and told me he remembered this from the game. We had played the game [during] the previous class.

Some teachers did not find the game to be as beneficial as they would have liked. As shown in Figure 8, teachers found the questions to be irrelevant, repetitive, or inappropriate for learners’ English levels, which some felt discouraged the learners. For example, a few Intermediate teachers noted that the game includes mainly grammar and conjugation questions, though their curriculum focuses more on reading passages, job-related issues, writing resumes and cover letters: “I don’t find BR beneficial. In the curriculum, they write compositions, essays, but only grammar is in the

game. The curriculum is all reading. Maybe if I have more grammar activities in the curriculum, then yes, so they can relate.”

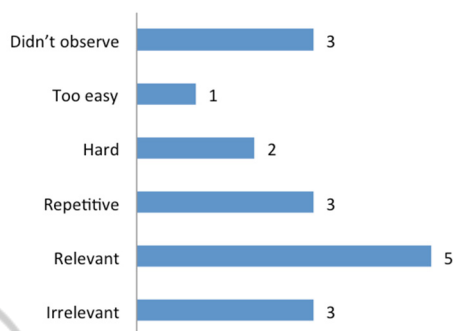


Figure 8: Teacher opinions on game content.

5.5 Learner Interactions with BR

We were able to obtain learner reactions to BR from our class observations and conversations with them immediately after playing, and from the brief survey we gave them. From our observations of game sessions since September 2013, we found that learners enjoyed practicing their lessons using BR. Some appeared to be more enthusiastic about the game than others. However, we found that even when learners reacted indifferently to our arrival with the games, they almost always chose to play.

Many learners struggled with the touch screen at first. The biggest struggle for them was figuring out how to move the car. Some learners tapped the screen, while others physically tilted the phone thinking that this movement would make the car move. Eventually, most had a good grasp of the game rules and the touch screens. Another struggle was figuring out the purpose of the power-ups. Some learners avoided all power-ups thinking they were obstacles. This was mainly the result of them not reviewing the game instructions before playing.

When we asked learners how they wanted to play, most learners chose to play individually. Some teachers anticipated this was either because they wanted to compete against each other, or they wanted to learn alone. Teachers explained that learners seemed motivated to do well because they were competing against their classmates. The learners were almost always quiet during gameplay, while they focused on answering the questions.

5.6 Learner Opinions on BR

When we would ask learners if they would like to play the game in the future, they would almost always say

yes. One learner explained that the game is good because sometimes, when he is talking to people, he does not understand what they are saying because he cannot clearly hear their use of past/present tense. He found the game useful in that sense. On the surveys, 81% of learners indicated that they wish to play the game in the future. Moreover, they all indicated that they like playing educational games. On their surveys, only one person described the game as bad, while the rest described it as “good” (ten learners) or excellent (eleven learners). Ten learners found the questions to be excellent while twelve thought they were good. No one found the questions to be “bad.” When asked to describe what they liked about the game verbally, following the game sessions, and in the survey (see Figure 9), most of them commented on the learning aspect of the game, noting that they can practice their English with the questions, “I like the most in Brain Race is when we answer. Every step question will be harder, and will be challenging to us. Fill the answer. That I liked.”

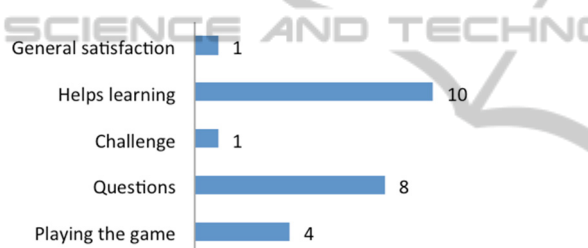


Figure 9: BR aspects learners liked.

Figure 10 demonstrates what learners disliked about the game. Four learners found the game to be too short: “The period of time is very short. That I don’t like.” One learner wrote that the game was boring, while four others commented on some of the games’ technical issues, such as when it crashes. One learner indicated that he is not used to phones or technology in general. Another learner indicated that he/she would like control keys, which were not available on the touch screen.

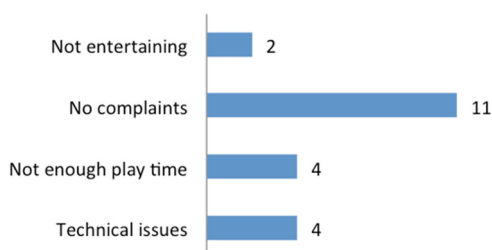


Figure 10: BR aspects learners disliked.

5.7 Learner Feedback on BR Game Impact on Learner Motivation, Engagement, and Learning Outcomes, and Implementation Process

Occasionally, learners would choose to pair up, so that one learner is playing, while his classmate helps him choose the right answer, and then they switch. One learner said he was discouraged from playing because he could not get the right answer, so he wanted to play with someone else. Others stated they did not want to play but just wanted to answer the questions. In fact, we noticed that some learners engaged differently with the games and questions when they played with a classmate. For example, there was a female learner who was extremely shy. She would never ask questions about the game and tried to figure it out alone. However, when she played with her classmate, she seemed much more interested in the game, and helped her classmate with the questions. In general, game sessions that included paired learners seemed much more exciting and collaborative for the learners, especially since they debated answers.

There were several signs that indicated that learners were interested in the game and wanted to do well. For example, sometimes we heard them read the questions out loud; other times they smiled or nodded their head in approval when they selected the correct answer. Other times, they became frustrated when they selected the wrong answer, and seemed determined to play again to obtain a higher score. Sometimes we heard them exchange answers and tips in their own language. If they obtained a high score, they smiled in satisfaction and showed off their scores to us and their teachers. Another important sign is that, despite the occasional technical issues that came up during gameplay, learners were always still interested in playing. Moreover, when we would announce that the game session was over, they would almost always continue playing.

However, on a few occasions, one or two learners from a class would choose not to play, and would continue working on their assignments. They explained that either they do not like playing games and prefer to answer questions only, or that they do not know how to play, and would therefore also prefer to answer the questions only. For example, a 50-year-old learner explained that he has never played a game before, and so does not know how to nor does he like playing games. When one of the research team members played the game in front of him, the learner

managed to get all the questions right. This supports the findings in the literature that caution that not all learners are interested in games or see their educational benefits (Bourgonjon et al., 2010; Groff et al., 2010; Rice, 2007; Williamson and Futurelab, 2009). During a different game session, two learners decided that they did not want to play, but were too shy to explain why. Their teacher predicted it was probably because they did not know how to play the game. In another game session, all the learners in the class (about three) said they did not want to play the game that day, and asked us to come back the following week. The teacher stated that we had come in the middle of class, when the learners were working on a reading assignment. The teacher knew that at least one of the learners really enjoys reading, which is why he thought the learner was not interested in playing the game that particular day. This shows that even if many learners are motivated by the game and competition, others are not, and prefer to learn the traditional way.

6 RECOMMENDATIONS

All teachers stated that they would like us to bring BR back (or any other educational game) into their classroom. They agreed that games, such as BR, enhance learner engagement and motivation, and bring excitement and variety to the class so that it is not just focused on books and assignments: “In Spanish, we listen to music, play games. If it’s all writing and talking to class, it’s so bland and boring.” Another teacher had similar reactions, and confirmed what the reviewed literature highlighted earlier with regards to the importance of introducing relevant content (Groff et al., 2010; Mifsud et al., 2013; Osman and Baker, 2012; Rice, 2007):

It makes them think about the material quickly, they are recollecting what we’ve taught them. Very helpful- it’s different, it opens their mind to answering the same questions in different ways, it helps them process things fast. It’s a fun way of learning, and should be implemented more.

Another teacher agreed that other educational tools should be explored further:

I think it’s a good idea. In a lot of educational settings, we don’t realize that we can use other sources, and that educational games can be a good gateway to have them look for themselves at other materials. It can encourage learners to look for other ways to learn.

However, a couple of teachers noted that educational games should be included but with caution. One teacher cautioned that games can be helpful only if learners enjoy and/or understand them. Another teacher explained that games other than BR can be useful to the learners:

I think they [educational games] are a good idea. I just don’t think the same game and the same content is useful, I just felt that they [the learners] said yes [to playing] so you [the research team] don’t feel bad. It’s a surprise for the first time. The game can also be better and happening less frequently, unless it’s a different game.

Hence, one must not assume that everyone will enjoy and benefit from educational games. However, there are several recommendations one can keep in mind for the future:

- Explain to the teachers and learners what the game is about, what content it will test, and why it is being introduced into the curriculum. Ensure that content developed for the game is relevant to what learners are learning.
- Make game sessions longer. Sessions are too short for learners to interact properly with the game, and learners should be able to play the game more regularly. Moreover, longer game sessions will allow teachers to explain the game properly and go over mistakes.
- Allow teachers to decide whether they want the research team to lead the game sessions, or if they want to take the lead on it themselves. If teachers decide to have the research team lead the process, schedule game sessions at the beginning or end of class. If teachers decide to lead the process themselves, ensure that they receive the equipment before class.
- Present teachers and learners with different equipment (smartphones, tablets, etc.), so that they can choose how they want to play.
- Ask teachers and learners how often they want game sessions to be, particularly since some teachers indicated that they wanted it more regularly while others preferred it to be played only a few times.

7 CONCLUSIONS

McClarty et al. (2012) argue that “research should prioritize *how* games can best be used for learning” (p.23). This paper examined the process of introducing a customized mobile game in a classroom, the interaction of teachers and learners

with the game and their opinions on it, and the game's perceived impact on learner motivation, engagement, and learning outcomes. We demonstrated the positive and negative impacts of BR on adult learners. Teachers and learners believe that educational games are motivating and help learners with their English skills when game play sessions are appropriately implemented. Although teachers welcomed the continuous inclusion of BR, or any other educational game into the class, they (and their learners) highlighted concerns regarding *how* the games are introduced in the classroom. Our main conclusion is that teacher and learner concerns should be addressed, while ensuring that they are given a variety of choices that best meet their needs and interests.

In the next phase of our project, we aim to improve BR, making it a smoother and more appealing game based on the feedback we received from those who have interacted with it. Similar to other games discussed in the literature (Mifsud et al., 2013; Shiratuddin and Zaibon, 2010), there are still technical and quality-design issues we need to address. Moreover, we are currently investigating the impact of BR and other mobile-based games on different populations in Qatar and the U.S., including postsecondary students, adult refugees, and students with special needs. Additionally, we are exploring different tools to allow teachers to see which questions or academic areas their learners are struggling with. In general, we are exploring clearer measures to help us evaluate BR's impact on learning outcomes.

ACKNOWLEDGEMENTS

Many individuals supported the work presented in this publication. This publication was made possible by the National Priorities Research Program (NPRP) grant # 4-439-1-071 from the Qatar National Research Fund (a member of Qatar Foundation). The statements made herein are solely the responsibility of the authors. We would like to thank Yomna Sabry for assisting with formatting the document. We would also like to thank the students participating in the CMU Pittsburgh class for designing the BR game. We would also like to thank the ROTA and the LB club for providing us with access to the learners. And finally, we would like to express our gratitude to all the teachers and learners who participated in the surveys and interviews.

REFERENCES

- Bourgonjon, J., Valcke, M., Soetaert, R., and Schellens, T. (2010). Students' perceptions about the use of video games in the classroom. *Computers and Education*, 54(4), 1145-1156. doi:10.1016/j.compedu.2009.10.022.
- Dempsey, J. V., Lucassen, B. A., Haynes, L. L., and Casey, M. S. (1996). Instructional applications of computer games. *Paper presented to AERA'96: The American Educational Research Association*. New York. Retrieved from <http://eric.ed.gov/?id=ED394500>.
- Groff, J., Howells, C., Cranmer, S., and Futurelab. (2010). *The impact of console games in the classroom*. Retrieved from Learning and Teaching Scotland website: http://archive.futurelab.org.uk/resources/documents/project_reports/Console_Games_report.pdf.
- Huizenga, J., Admiraal, W., Akkerman, S., and Dam, G. T. (2009). Mobile game-based learning in secondary education: Engagement, motivation and learning in a mobile city game. *Journal of Computer Assisted Learning*, 25(4), 332-344. doi:10.1111/j.1365-2729.2009.00316.x.
- Hwang, G., Sung, H., Hung, C., Huang, I., and Tsai, C. (2012). Development of a personalized educational computer game based on students' learning styles. *Educational Technology Research and Development*, 60(4), 623-638. Retrieved from DOI: 10.1007/s11423-012-9241-x.
- Kam, M., Agarwal, A., Kumar, A., Lal, S., Mathur, A., Tewari, A., and Canny, J. F. (2008). Designing e-learning games for rural children in India: A format for balancing learning with fun. *Proceedings from DIS '08: The 7th ACM conference on Designing interactive systems*, 58-67. Cape Town, South Africa. doi:10.1145/1394445.1394452.
- Ke, F., and Grabowski, B. (2007). Game playing for maths learning: Cooperative or not? *British Journal of Educational Technology*, 38(2), 249-259. doi:10.1111/j.1467-8535.2006.00593.x.
- McClarty, K. L., Orr, A., Frey, P. M., Dolan, R. P., Vassileva, V., and Mc Vay, A. (2012). *A literature review of gaming in education*. Retrieved from Pearson Assessments website: http://researchnetwork.pearson.com/wp-content/uploads/Lit_Review_of_Gaming_in_Education.pdf.
- Mifsud, C. L., Vella, R., and Camilleri, L. (2013). Attitudes towards and effects of the use of video games in classroom learning with specific reference to literacy attainment. *Research in Education*, 90(90), 32-52. doi:10.7227/RIE.90.1.3.
- Osman, K., and Bakar, N. A. (2012). Educational computer games for Malaysian classrooms: Issues and challenges. *Asian Social Sciences*, 8(11), 75-84. doi:10.5539/ass.v8n11p75.
- Papastergiou, M. (2009). Digital game-based learning in high school Computer Science education: Impact on educational effectiveness and student motivation.

Computers and Education, 52(1), 1-12. doi:10.1016/j.compedu.2008.06.004.

Qatar Information Exchange (n.d.). *Economically active population (15 years and above) by nationality, sex and occupation*. Retrieved June 17, 2014, from <http://www.qix.gov.qa/>

Qatar Statistics Authority (2014, Nov 30). *Population*. Retrieved December 5, 2014, from <http://www.qsa.gov.qa/eng/PopulationStructure.htm>.

Randel, J. M., Morris, B. A., Wetzal, C. D., and Whitehill, B. V. (1992). The effectiveness of games for educational purposes: A review of recent research. *Simulation and Gaming*, 23(3), 261-176. doi:10.1177/1046878192233001.

Rice, J. W. (2007). New media resistance: Barriers to implementation of computer video games in the classroom. *Journal of Educational Multimedia and Hypermedia*, 16(3), 249-261. Retrieved from <http://www.aace.org/pubs/jemh/>

Rosas, R., Nussbaum, M., Cumsille, P., Marianov, V., Correa, M., Flores, P., Salinas, M. (2003). Beyond Nintendo: Design and assessment of educational video games for first and second grade students. *Computers and Education*, 40(1), 71-94. doi:10.1016/S0360-1315(02)00099-4.

Shiratuddin, N., and Zaibon, S. B. (2010). Mobile game-based learning with local content and appealing characters. *International Journal of Mobile Learning and Organisation*, 4(1), 55-82. doi:10.1504/IJMLO.2010.029954.

Tseng, J. C., Chu, H., Hwang, G., and Tsai, C. (2008). Development of an adaptive learning system with two sources of personalization information. *Computers and Education*, 51(2), 776-786. doi:10.1016/j.compedu.2007.08.002.

Tüzün, H., Yilmaz-Soylu, M., Karakuş, T., İnal, Y., and Kizilkaya, G. (2009). The effects of computer games on primary school students' achievement and motivation in geography learning. *Computers and Education*, 52(1), 68-77. doi:10.1016/j.compedu.2008.06.008.

Tüzün, H. (2007). Blending video games with learning: Issues and challenges with classroom implementations in the Turkish context. *British Journal of Educational Technology*, 38(3), 465-477. doi:10.1111/j.1467-8535.2007.00710.x.

Virvou, M., Katsionis, G., and Manos, K. (2005). Combining software games with education: Evaluation of its educational effectiveness. *Educational Technology and Society*, 8(2), 54-65. Retrieved from <http://www.ifets.info/>

Wang, Y., and Liao, H. (2011). Adaptive learning for ESL based on computation. *British Journal of Educational Technology*, 42(1), 66-87. doi:10.1111/j.1467-8535.2009.00981.x.

Williamson, B., and Futurelab. (2009). *Computer games, schools, and young people*. Retrieved from Futurelab website: http://archive.futurelab.org.uk/resources/documents/project_reports/becta/Games_and_Learning_educators_report.pdf.

APPENDIX

Brain Race Learner Survey

English Level:

1. I think Brain Race is a/an _____ game:

Excellent	Good	Bad
		

2. Brain Race helped me practice my English:

	
Yes	No

3. The questions in the game were:

Excellent	Good	Bad
		

4. I want to continue playing Brain Race in the future.

	
Yes	No

5. I like playing educational games.

	
Yes	No

6. What do you like about Brain Race?

7. What don't you like about Brain Race?