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Exploring the use of digital gaming to improve student engagement at a resource poor institution in South Africa.

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Abstract

Although student engagement has potential to enhance learning and student retention, the use of digital games to achieve this learning outcome remains a challenge in higher education. While the role of gamification is highly predicated in Horizon Reports to enter mainstream education, the popularity of game-based learning has remained marginal. In this paper we report on the use of game-based learning at a higher education institution where students are pre-disposed to play games outside formal educational settings. This is further compounded by the challenging nature of designing learning activities that fully exploits students' capacity to engage. This paper reports on a case study using game based learning as a tool to mediate engagement for students enrolled in health science education at a resource poor higher education institution in South Africa. The aim of this study was to examine the role of a digital game to enhance student engagement within the classroom. By means of mixed methods, this study utilised a design-based enquiry using a case study of sport science curricula. Design-based research was used as part of the design and implementation of an interactive learning environment using a technology (gaming) innovation within an education setting. Sixty-four students from a sport science department volunteered to participate in this study. Quantitative and qualitative data was collected. Results indicate that even though 89% of participants indicated that they have played digital games, only 46 % indicated that they have engaged with a digital game for the purpose of learning. Baseline data prior to intervention suggested that students did not learn well in groups (70.3%, $M=1.91$; $SD=0.938$). However, in post-intervention focus group interviews students expressed that the introduction of a digital game for learning in the classroom aided co-construction of knowledge in a fun and meaningful way.

This study concludes that the use of digital games is a valuable mediating tool in sport science education as it strengthens collaborative learning and improves engagement. This paper recommends a strategy to improve engagement and ultimately student retention. This study offers new insight into understanding student engagement within a game based learning environment.

1. Introduction

In South Africa, student engagement has been identified as an important indicator of student success and is useful in understanding students' perspective of their learning experiences in higher education settings. (Council for Higher Education, 2010). Among other reasons, the poor throughput and unsatisfactory graduation rates at tertiary

institutions remain a serious concern in higher education (Scott, Yeld & Hendry, 2007) and can be attributed to lack of student engagement. Student engagement is defined as the 'time and energy students devote to educationally purposive activities and the extent institutions employ effective education practices to induce students to do the right thing' (Strydom, Basson, & Mentz, 2010:10). By increasing student engagement, there is a likelihood of minimizing apathy in the classroom and thereby improving learning and academic performance (Aronson, Janke, & Traynor, 2012). Furthermore, engagement is an aspect of teaching, learning and discovery in a way that enhances learning through its focus on knowledge enterprise. Engagement is of utmost importance as it, amongst other things, enriches students' learning experiences; broadens academic thinking and improves student development (Fitzgerald, Bruns, Sonka, Furco, & Swanson, 2012). In addition Angelino and Natvig (2009) indicated that engagement may be one strategy that could be used to address retention in higher education institutions. Although strategies to improve retention, academic thinking, student development and student learning create a good learning environment, it does not guarantee success and throughput. Since student engagement is central to the success of students in higher education settings, an integrated pedagogical approach that offers students the opportunity to participate in activities that allow for collaborative engagement may create a space that is more conducive for the improvement of throughput rates. Due to the instability and on-going change in South African universities, student engagement continues to remain a cause for concern (Strydom & Mentz, 2010). Although the definitions of engagement will be adopted from Strydom, Mentz, et al., (2010), within this context, student engagement will also observe as students' interaction between peers, coursework the lecturer and a gaming tool in a way that enriches scholarship and sharing of knowledge.

1.1 Game-based learning

Game based learning has recently become a significant focus of attention in the field of education (Wu, Hsiao, Wu, Lin, & Huang, 2012). Game-based learning is regarded as an innovative tool for facilitating students' active participation and engaged learning and it embodies powerful principles of learning which educators might do well to emulate (Chen, Liao, Cheng, Yeh, & Chan, 2012; Bransford, Brown & Cocking, 1999; Gee, 2003; Squire, 2003 as cited in Squire, Giovanetto, Devane and Durga, 2005). Whilst the focus shifts to game based learning, a focus on student engagement is still lagging behind. Game based learning may therefore be a valuable tool to foster student engagement within the classroom. Games may be used to teach new generation students in a medium that they are used to interacting with during their childhood years (Prensky, 2007). In this way it could be used to support learning as well as establish dialogue and break cultural barriers. To date, there is a paucity of evidence within the South African education system with regard to games and its impact on student engagement. Researchers have done a significant amount of work on game-based, learning theories and ICT based instructional design in South Africa (Amory, 1999; 2003; 2012). For effective learning to take place [using games], knowledge should be uniquely constructed through social interaction with others, through play as well as exploration (Amory, 2012).

Although there are various affordances of game based learning as shown by Wu, Hsiao, Wu, Lin and Huang (2011), for the purpose of this study it will be defined as game exercises that are seen as instructional strategies to support learning as adopted [and adapted] by (Prensky, 2007). Hence, the use of digital games as a tool to support learning through enhancement of student engagement is well worth academic scrutiny as it may inform our teaching and learning practices within sport science education.

International research shows that a focus on student engagement can enhance student learning and other learning outcomes (Strydom, Mentz & Kuh, 2010). In light of this, Prensky (2001) is of the view that if we are to improve education, then we need to “*invent radically new ways of learning*” that complements the students’ world, style and capabilities. He believes that digital game-based learning is one important way of doing so. Prensky (2001:5) suggested that games are about “fun and engagement, and the coming together of serious learning and interactive entertainment into a newly emerging and highly exciting medium”. Similarly, a digital game is a favourable tool for engaged learning and active participation in education and it offers opportunities for students to engage in a non-traditional environment (Chen, Liao, Cheng, Yen & Chan, 2012). Interacting with emerging technologies therefore has the potential to foster student engagement and provides a useful interface with game based learning. The purpose of this study is to explore student engagement in in sport science education in South Africa through the use of game based learning.

Anecdotal evidence shows that students enrolled in health science education at a higher education institution in South Africa tend to group themselves in social-cultural clusters hence limiting their overall interaction in the class. Thus, the introduction of games has the potential to create neutral, openly accessible spaces which all students can occupy to share knowledge and engage with content and one another. The issue around engagement and interaction is complex as it previously focused on dialogue between the students and the teacher (Anderson, 2009). Furthermore, since sport is seen as a vehicle for social change, the creation of a neutral online space where cross cultural interactions can take place within the classroom setting could further promote social change and cohesion. McMullen, van der Mars and Jahn (2013) acknowledged that many educators are following a social-constructivist framework as there has been a shift from teacher-centered to a learner centered approach to delivering education. For the purposes of this study, it could be used to examine how student engagement is fostered within a game based learning environment (GBLE).

This study took place in a sport science department located in a health sciences faculty at a university in South Africa. Sport science is a niche area at this institution. During the 1970’s this institution was seen as ‘the struggle university’ and has since repositioned itself in the post-apartheid democracy. However, its academic identity still reflects traces of multiple identities in its historical narrative (Ravjee, Hames, Ludwig & Barnes, 2009).

It is therefore important to explore the pedagogical value of gamification and its impact on student engagement in the South African higher education context. This paper documents exploratory mixed method educational exercise on the use of games in sport science education in South Africa. Therefore, the aim of this paper is to report on the extent to which gaming can mediate or improve student engagement in sport science education in South Africa.

2. Methodology

This study was evaluated using an advanced intervention mixed method approach. A mixed method is a research design with philosophical assumptions i.e. the researcher's world view on a subject, as well as methods of inquiry (Creswell, 2009). As a method, it focuses on collecting, analyzing and mixing both quantitative and qualitative data in a single study or a series of studies.

2.1 Study Design

A cross sectional, descriptive design was used to obtain quantitative and qualitative data by means of a survey as well two focus group interviews. Baseline data was collected with the purpose of exploring students' experience to and identifying exposure to digital games and examine their levels of engagement within a classroom. These questions were designed to ascertain students' learning preferences, prior exposure to gaming, level of engagement and use of other online tools. The survey was designed from various instruments that have already been tested within the South African Higher Education setting (Strydom & Mentz, 2010, Rowe, 2009).

2.2 Research Setting and sample

Participants for this study were conveniently selected. A sample of eighty-eight (88) students in their second year of study towards a sport science degree at a higher education institution in the Western Cape, South Africa was invited to participate. The university is considered a resource poor institution. All students were verbally invited to participate in the study. Sixty-four (64) students agreed to participate in the survey. After which, students were purposefully selected to participate in focus group discussions. To this end 16 students participated in two separate focus group discussions. With respect to ethical considerations, permission to conduct this research was obtained from the Senate Research Grants Committee and the Ethics Committee at the University of the Western Cape and the University of Cape Town. All information was treated with the strictest confidentiality in so far as pseudonyms were used to protect the anonymity of the participants.

2.3 Procedure

After survey data was collected, students were randomly placed into groups of five. Randomising the class-list allowed for integration within the classroom. Students were meeting students who they would not ordinarily interact with on a regular basis. The game intervention was conducted in four iterations. These iterations were done for

various reasons, including continuous development of the game prototype in line with design based research methodology.

Iteration 1: The first iteration was conducted four weeks after the first class. Game 1 included multiple choice questions from chapters 1-3 of the course reader. The primary aim of this iteration was as a socialization exercise. Since many of the students did not know their fellow classmates in their group, the iteration with the game, as a group, allowed them to get to know one another. The secondary aim of this iteration was to engage with the content of Chapters 1-3 through collaborative learning whilst playing the game in a group. All scores were logged into the leaderboard on the game interface

Iteration 2: In line with the research design of developing and redesigning a prototype, iteration two included a new game, Game 2 that consisted of multiple choice questions from chapters 4-6. This game was played 4 weeks after Game 1 was played. The primary aim of this iteration was allow students an opportunity to engage with the content and collaboratively construct knowledge. Since they were more familiar with their teammates, they felt more comfortable. In addition, students could access the game from anywhere, even in their homes. An incentive voucher was made available for the group who landed at the top of the leaderboard.

Iteration 3 and 4: The prototype of the game was continuously re-designed to add two more games. This was to allow for meaningful engagement with the content as well as collaboratively construct knowledge within a group environment. Game 3 was used to prepare for last test, whilst Games 1-4 was used for the final examination. An incentive was offered to the leaders of Game 3.

2.4 Research Instrument: Digital Game

The game is designed as a quiz game where content from any other social sciences discipline could be applied, as long as the content of the module is programmed into the game. Students learn the content by collaboratively playing the game. The game is designed to be played in groups of five players per team. The game can be played mobile devices such as an iPad, tablet, laptop or an android enabled smartphone. The game requires teams to answer as many questions correctly as possible within 45 seconds. For each game round, there will be a leader in the group who controls the game and reads the questions. Group members will assist in answering the questions. Groups who answer the most questions correctly will score the highest points. Each gaming session would last approximately 7 minutes, after which a new leader will be selected until each member has had a leadership opportunity. Although this did not always happen, an effort was made to ensure that each person had a leadership opportunity in the various iterations. There are no penalties in the game, however failure to answer questions correctly will result in failure to move forward in the game, or accrue more points. A leaderboard was displayed on the game interface each week.

Student could also access the game off campus using their team login details. This was used to prepare for tests and exams. All the login details are erased before the group gaming sessions.

2.5 Data Collection and Analysis

Baseline Survey: The survey instrument data was be coded, cleaned (using a ‘match-formula’) and captured on Microsoft Excel 2010 after which it was imported into the Statistical Package for Social Sciences v21 (SPSS) to provide the descriptive and inferential statistics.

Focus Group data: Focus group data was transcribed verbatim in English. The researcher did a thematic analysis from the focus group discussion. Here, similar information was grouped together into narrative clusters and analysed using Atlas TI. Data was collected until the research achieved theoretical saturation and was reviewed until certainty was achieved.

3. Results and Discussion

This section represents the findings which emanated from the baseline (pre-test) as well as the focus group data. Eighty eight questionnaires were distributed to the entire class population of which sixty four were returned (n=64), indicating a response rate of 72%. Sixty-nine percent of the respondents were male and 25% were female as illustrated in Table 1.

Table 1: Student responses by gender (n=64)

Gender	
Male	44 (69%)
Female	16 (25%)

Note: 4(6%) respondents did not record their gender

3.1 Learning preferences of students

Pre-intervention data show that 45 (70%) respondents claim that they are unable to learn in formal group sessions, yet 35 (55%) respondents indicated that they enjoy working in groups. Forty –eight (75%) responded that they learn best by memorizing (Table 2)

Table 2: Learning preferences (n=64)

Activity	Yes (n%)	No (n%)
Learning in formal study group sessions	19 (30%)	45 (70%)
Enjoy working in groups	35 (55%)	29 (45%)
Memorizing	48 (75%)	16 (25%)

3.2 Prior digital gaming experiences

Fifty –seven (89%) respondents indicated that they had already played some form of digital games before. Seven (11%) of the respondents indicated that they had played a

digital game that day, whilst 19 (30%) indicated that they've played a game in that particular week. Seven respondents (11%) indicated that they have never played a digital game before. Even though 89% of respondents indicated that they have played digital games, more than half of the respondents (53%) indicated that they have never played games for educational purposes (Table3).

Table 3: Prior digital gaming experiences (n=64)

Activity	Yes (n%)	No (n%)
Played a digital game	57 (89%)	7 (11%)
Played a digital game for education purposes	30 (47%)	34 (53%)
Played digital games outside of the classroom	53 (83%)	11 (17%)

3.3 Participation and understanding of digital games

Students were of the opinion that digital games could improve learning because it is a medium that is fun and interactive. Some of their responses are highlighted below;

'It can help because you are having fun while learning, you are likely to remember better...'

'It associates imaging with your work'

'Might make learning more fun'

'I feel it is a good way idea to combine something our generation enjoys with learning purposes as it could potentially make it easier and enjoyable'

Furthermore, respondents indicated that engaging in a game assisted with integration of theory and asserted that the visual aspects of the game improved retention of course information. This is highlighted in the quotes below;

'It has improved my knowledge in this module and increased my interest in sport psych.'

'The games give a virtual reality experience to the theory.'

'They help you visualise things you don't usually see. It helps in remembering.'

'They knowledge obtained stays longer in memory.'

'Interaction with people leads to better answers'

3.4 Level of engagement

Twenty-eight (44%) respondents indicated that they did not revise their work on their own while twenty-two indicated that it was important. Forty-two (66%) respondents indicated that they prepare for examinations with peers. Fifty (78%) respondents either agreed or strongly agreed that interaction with peers was of importance as illustrated in Table 4.

Table 4: Level of engagement (n=64)

	Strongly agree (n%)	Agree (n%)	Uncertain (n%)	Disagree (n%)	Strongly disagree (n%)
Examination prep	9 (14%)	33 (52%)	9 (14%)	8 (13%)	4 (6%)
Revision	4 (6%)	18 (28%)	13 (20%)	21 (33%)	7 (11%)
Memorizing	28 (44%)	27 (42%)	26 (9%)	1 (2)	1 (2)
Interaction	22 (34%)	28 (44%)	9 (14%)	3 (5%)	1 (2%)
Academic Consultation	3 (5%)	14 (22%)	10 (16%)	27 (42%)	9 (14%)

As is evident in the post gaming focus groups below, participants reported that even though it was a new concept, it assisted with motivation to work. Students reported that it was uncomfortable at first; however, as they became more comfortable it became enjoyable and allowed for more focused attention.

'It was work based. It's a new concept and I think it gives people more focused attention because people enjoy playing games as opposed to sitting in lectures listening to someone talk'(Marvin)

'...you wanted to work, because when you're with friends you tend to snap off a bit and just make fun and stuff all the time. But when you with other people, you actually want to work ...' (Joseph)

'... if you in a new group you will also want to, not be smart, and in their eyes you are going to look smart and going to put that extra effort in' (Karin)

'I am repeating the subject so uhm first time wasn't well and we never played any games back then. But now, when we played this game, my marks have improved and I am enjoying it. Meeting new friends so it's going well' (Matt)

4. Discussion

The purpose of this paper was to explore the use of digital gaming and its impact on student engagement at a resource poor institution.

Game-based learning is regarded as a promising vehicle for facilitating students' active participation and engaged learning and it embodies powerful principles of learning which educators might do well to emulate (Chen, Liao, Cheng, Yeh and Chan, 2012; Bransford, Brown & Cocking, 1999; Gee, 2003; Squire, 2003 as cited in Squire, Giovanetto, Devane and Durga, 2005). In this study, whilst most of the students (89%) reported that they had previously played a digital game, less than half of them played a game for educational purposes. This is in line with Pivec (2007) who suggested that games have a high presence in non-formal and informal segments of our learning. Unfortunately, in formal education, games are still often seen as an unserious activity. However, the use of games in higher education spheres in South Africa is gaining some attention (Amory, 2012).

With regard to engagement, the pre-intervention survey suggested that most students (66%) prepared for examinations with other peers. Thus, it is not surprising to note that 78% of students reported that they enjoyed interacting with their classmates. Further to this, the post intervention data reveals that students were receptive to the game because it fostered interaction and engagement with classmates whilst still having fun. It appears that the students felt motivated when placed in groups to play a game together. Pivec (2007) proposes that games are played in the first place to have fun, to immerse into an imaginary world, to take the challenge and outsmart the opponents and/or win. Amory (2010) suggests that collaboration is one of the 'cornerstones of contemporary education practices' and that the activities embedded within collaboration in complex virtual worlds are not fully understood. Although students reported that they enjoyed working in groups (55%), they did however report that they are unable to learn in formal group study sessions (70%). Despite the majority of students reporting that they prepared for examinations with other peers, it still appeared that learning occurred in isolation. This could be as a result of the complex nature of collaboration through group work as highlighted by Amory (2010).

This study did well to bridge the gap between students' enjoyment working in groups (55%) and their inability to learn when studying in formal group sessions. Focus group data shows that students learnt while playing a game as it gave them 'focused attention'. The students also reported that they 'put that extra effort in' while playing the game in a group. Although there is no evidence that learning had occurred, while playing in groups, but it gives insight into the affordances a game of this nature could have on learning in groups for this population of students in order to make their experience of group work more meaningful.

Students' claim that they had fun while learning and it appears that the fun aspect of games assisted in the retention of information in this module. In addition, the visual effects of a game for learning content also appear to have been valuable. The affordances of games have number of characteristics to engage students in games that offer the potentials such as imaginary, challenges, competition, fantasy, curiosity, uncertainty, goal decisions, discussion and emotional connection (Lo, Ji, Syi, You, & Chen, 2008; Prensky, 2008 as cited in Chen, Liao, Cheng, Yeh and Chan, (2012). This playing process therefore supports the learning process by allowing players an opportunity to gain learning experiences in games, encouraging interactions between learners and the game system, and situating learners in complex learning environments (Huang & Johnson, 2009; Pannese & Carlese, 2007 as cited in Huang, 2011). This provides a rich opportunity to explore how games can be used as a mediating tool to support student learning.

5. Conclusion

This study was limited to one of the twenty-four higher education institutions in South Africa. The fact that 69% of the participants in this study were male could indicate that there is a gender bias present in the findings of this study. Although only reporting on one

case, finding from this contextual data shows how the use of gaming transformed students' learning experiences and levels of engagement within the classroom. Thus, the outcome of this study has offered new insights into our approach to game-based learning in sport science education. Despite there being a tension between their enjoyment of working in groups and interacting with peers with their inability to learn in groups, the implementation of a game appeared to have mediated engagement and provided a space conducive for learning within a sport science classroom. This study concludes that the use of digital games is a valuable mediating tool in sport science education as it strengthens collaborative learning and improves engagement. Further research should be conducted to determine whether group randomization for gaming situations is useful.

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