

Effectively Engaging Students in Educational Games by Deploying HCI Evaluation Methods

Q.E. Looi, S.L. See

Abstract—In recent years, there has been a lot of interest and work in studying and designing games for learning. Educational games and immersive environments such as Second Life have been experimented as platforms for teaching and learning; but they have yet to effectively pervade into the teaching curriculum. The problem lies within the inability for these games to effectively engage students in the in-game learning activities. Therefore, Human Computer Interaction evaluation methods could be deployed to study and improve student engagement in order to advance the quality and effectiveness of the educational games. The video-diary method is one of the evaluation methods which could potentially improve the quality of games in education by understanding the gamers' preferences.

Index Terms— human computer interaction, game-based learning, social games, evaluation methods, education, students

I. INTRODUCTION

In recent years, many education technology researchers have speculated on the widespread use of computer games as a medium for education, or as a tool or platform for supporting new learning approaches. There has been works such as [1, 2, 3] which identified and analyzed the characteristics of specific computer games which make them suitable for educational purposes. Such works postulate that learning in a non-traditional environment enhanced the learning experience [4, 5]; when coupled with the fun and entertainment, educational games should achieve potent learning outcomes. Most game developers would agree that point-and-click adventure games are a good choice given their nature to be more content-based than action-based and entertainment-oriented [6, 7]. However, developers always face the challenge of building a successful game to engage the users.

In this study, a successful educational game is defined as “a game that can engage students over extended periods of time, motivating them to learn whilst playing simultaneously.” With this definition, it is evident that introduction of games in the educational system is hindered by obstacles such as the lack of student engagement or the repetitive nature of tasks. In order to overcome these obstacles and strive towards building

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a successful game, Human Computer Interaction (HCI) evaluation should be carried out.

By establishing proper HCI user interface studies, future educational game developers could use HCI evaluation to assess the success of their games, and improve the platforms in order to achieve maximum results from the students, and ultimately lead to the successful development of educational games that are sustainable.

In the study, we will focus on the platform of Second Life. The reason for choosing Second Life is due to the increasing number of educational institutions incorporating their educational material into Second Life's open-source platform.

II. SECOND LIFE—AN ANALYSIS OF THE GAME

Second Life is a virtual world launched by Linden Lab in 2003. It is a social game where players can interact with one another through avatars, and participate in individual and group activities [8].

Originally, it was created for entertainment purposes, allowing gamers to live their own alter ego; thus is aptly coined—Second Life. However, in recent years, it has been increasingly used as a platform for education by many institutions.

It is undoubtedly the most popular, open-source educational game, with over a hundred regions used for educational purposes, covering topics such as English, Chemistry and History.

According to an earlier study [9], over 80 percent of United Kingdom's universities use Second Life for learning activities, in varying degrees of involvement. Similarly, new educational institutions are capitalizing on this open-platform to deliver high-quality content to a worldwide audience at minimal cost [10].

It is also poignant to note that the most extensive learning that occurs in second life is language learning [11]. This is significant as learning of language usually involves interaction, and it would be more effective to learn new languages if students interacted with in-game characters which were fluent in the language, as they can progress according to their own pace.

It is evident therefore, that Second Life is indeed a successful educational game to a certain extent, given its widespread outreach and influence towards educational institutions worldwide.

However, one conundrum remains: Why isn't it pervading into the education systems of most countries? Even for countries like the United Kingdom, the universities do not focus on Second Life as a tool to complement their education; rather, it is just an experiment for most institutes.

The answer to this question lies in the educational games' abilities to capture the students' attention for extended periods of time, yet provide adequate learning opportunities. This constitutes the successful educational game, as put forth earlier in the definition.

Therefore, the following method proposed below could ultimately unravel the solution to the conundrum. Though it is not a complete, perfect solution, it still contributes to the advancement of effective engagement of students in educational games.

III. IMPLEMENTING HCI EVALUATION IN SECOND LIFE

The first step towards effective engagement of students in educational games is to examine the Human Computer Interaction facets in the game platform. In this study, user interface studies are the main facets of HCI.

User engagement is frequently determined by how close the interaction occurs between the gamer and the game. Thus, to measure this level of user engagement, the video-diary method, followed by the criteria to evaluate its results is presented below.

A. The Video-Diary Method

The video-diary method was originally introduced in 1973 to evaluate managerial work [12]. In 2008, this method was modified to evaluate HCI in social games [13]. This video-diary method was different from the past HCI evaluation methods as it focused on the user rather than the game platform, thus adopting a user-centric approach. It was then found to be extremely effective in revealing valuable insights about the HCI and user engagement in these games, from the gamers' perspectives.

Conducted on the social game—Maplestory, this video-diary method revealed that user-user communication and in-game social activities proved to be the most attractive factors, based on the studies conducted on the subjects.

Unlike other evaluation methods which focus on users' responses towards in-game activities, the diary component of the method requests users to log their rationale for carrying out certain activities, thereby revealing deeper insights towards how the gamers feel and think when engaged in game play.

A sample of the diary, in the form of a logsheet is shown in Table 1.

Table 1: Extract from Logsheets Based on Previous Study

Hour	In-Game Activity	Comments
1	Character Job:	Cleric
	Character Level:	LVL 40
	Skills Upgraded:	-
	Training Area:	Thailand
	Quest:	Welcoming Ritual (Thailand)
	Interaction with Other Players:	Asked for Maple Staff Partied at Koduckie

Similarly, this video-diary method can be adopted to evaluate the entertainment and engagement value of Second Life.

It should be emphasized that the purpose of this video-diary method implementation in Second Life is to improve the level of student engagement, encouraging them to play for extended periods of time only. It does not help to increase the educational value of the game per se, and will be discussed later in Section 4.

Applying this video-diary method, students are supposed to record down their in-game activities, as well as the rationale for carrying out these activities. Based on these recordings, teachers and game developers can accurately pinpoint the facets that win over the students; thus improving the attractiveness of the educational game by emphasizing the facets that appeal to the gamers.

Whilst the students are gaming and recording down their in-game activities, they are also under video observation. This video-observation captured down physical and verbal responses of the students based on what was happening in the game. This reveals further insights as to how the students portray the game, whether they are interested or bored by it. This video observation is very valuable as the subtle motions and exclamations made by the student will usually not be recorded down on the logsheets.

Thus, given the first-person perspective (diary logsheet) and third-person perspective (video observation), the level of user engagement can be effectively derived and determined.

B. The Criteria to Evaluate

Understandably, there is a gap between obtaining both first and third person perspectives and deriving whether user engagement has been sustained. Thus, a set of criteria needs to be established so that the video-diary results can be benchmarked and assessed for effective user engagement.

The evaluation criteria have not been tested together with the video-diary method, and are developed based on a

hypothetical situation. The criteria require the researcher, educator or game developer to ask a few questions, and derive the answers based on the video observation and logsheets:

1. Does the student show any sign of boredom or lack of interest during game play?
2. Is the student able to sustain long periods of game play (e.g. 5 hours)?
3. Does the student prefer to do non-learning related activities rather than stick to the learning tasks assigned?
4. Is the student able to complete the tasks individually, or does he/she need to work together as a group to finish the assignment?

The questions are varied; some of which are direct and the answers can clearly tell if engagement has been sustained (Questions 1 and 2), others are in-direct, whereby the engagement level has to be deduced by the researcher (Questions 3 and 4).

The researchers propose that the following questions be answered based on a scale, from 1 (a strongly positive answer) to 5 (a strongly negative answer). Based on what is observed and deduced from the video and the logsheet (diary), the results from both perspectives are combined to assess the answers based on the scale.

It is highly likely for both perspectives to correlate; if no-correlation exists; i.e. what the logsheet reads and the video observation displays contrasts starkly, the results for the specific subject should be ignored.

Based on the scale above, it is then evident whether the students have been effectively engaged in the course of game-play.

Other than the questions proposed above to be included as criteria for the researchers, similar questions will be posed to the student after the gaming experience. Questions that mirror the aforementioned include:

1. Did you feel bored at any course of the game-play? If yes, please explain which aspects. If no, please explain why.
2. Did you think that the extended period of gaming was tiring and un-enjoyable? Explain

Based on these answers, students will provide simple "Yes/No" answers followed by explanations. No rating scales are involved.

The combination of the two insights will then provide further backing for the overall results. It will then be irrefutable with regard to the success in effectively engaging students in educational games.

The feedback sought from the researchers and students are then compiled and aspects of the game, which are to be improved, are identified and improved on.

IV. PROVIDING ADEQUATE LEARNING OPPORTUNITIES

If Second Life is to be used for educational purposes, adequate learning opportunities must be available. However, with the need to achieve a balance between user engagement

and the provision of learning opportunities, educators and developers of the learning platforms in Second Life face a dilemma—to provide substantial content for learning at the risk of losing the students' interest or to increase levels of engagement but decrease the amount of content taught. Each aspect is pivotal towards building a successful game, and cannot be undermined.

Other challenges towards providing adequate learning opportunities will be inevitably faced. Second Life's original purpose was to provide entertainment, thus many facets of the game is still entertainment-oriented. As a result, there is a high possibility that students will be distracted from the learning activities and carry out non-learning related activities.

Furthermore, given the complexity of platform and the presence of many other in-game players, educators are unable to monitor the activities and learning progress of each and every student in the game. Such examples are few of the many more challenges that could possibly arise.

Thus, HCI can offer methods to alleviate the problems faced during in-game learning. It is vital to note that HCI can only lessen the severity of the problems faced, and is by no means a definite solution to the challenges posed.

An example of a solution HCI can offer is by establishing a platform where all can contribute information and knowledge, teachers and students alike. Knowledge sharing is uncommon in stand-alone educational games due to the multiplayer platforms which are much more complex to develop compared to single-player, point-and-click games.

However, given the availability of the multi-user platform Second Life is built on, the social and interactive characteristics should be capitalized on and transformed to knowledge sharing platforms.

Furthermore, the value of information sharing is its nature as a double-edged sword. Not only does it promote active learning among students during the information sharing, it also enhances user engagement levels, as students feel compelled to constantly share their knowledge and be part of the in-game community. HCI is then able to reinforce this idea of knowledge sharing, expanding the spectrum of learning opportunities students can get to enjoy. An additional plus point is that the need for educators to constantly add new information and content is lessened, as students pro-actively contribute to the knowledge available.

Thus, not only can HCI effectively help to improve learning in the games, it can also help students to understand better. Utilizing HCI as a tool to understand the students, teachers and game developers can effectively develop an educational game that complements the regular syllabus; i.e. reinforcing knowledge and ideas taught via traditional methods.

It should be noted here that one of HCI's limitations as a solution is that it is only applicable to educational games that complement traditional educational pedagogy. It is not able to drastically transform the education paradigm by allowing educational gaming to replace traditional teaching methods.

Using the video-diary method as suggested earlier, based on the logsheet (diary) and the video observation, educators and game developers can accurately pinpoint the most effective mode of teaching and knowledge building.

More of these opportunities can be explored with the wide range of abilities HCI possesses, thus making it crucial towards effectively engaging students and providing substantial learning opportunities simultaneously.

V. CONCLUSION

Although there has been extensive usage of various educational games such as Second Life in the curriculum of many institutes worldwide, educational games are still unable to effectively permeate and pervade into educational systems. As they are mostly used in experimental settings, they are unable to complement the mainstream educational pedagogies, proving that the quality of games in education is still far from desirable.

However, with the deployment of HCI methods to sustain user engagement and provide learning opportunities as suggested by this paper, it is highly possible that the quality of games in educational can be improved, and the benefits brought about from this improvement in quality will outweigh existing problems during the development of such games, such as the high costs and the time required to develop the games.

Future work with regard to implementation of HCI in education should entail further improvement of the HCI evaluation method proposed as well as conducting more detailed user-studies on games suitable for educational purposes, extending beyond the boundaries of Second Life. With a more varied spectrum of educational games, the best game can then be selected and built on, ultimately improving the outlook for implementation of games in education.

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REFERENCES

- [1] C. Aldrich. 2005. *Learning by Doing: A Comprehensive Guide to Simulations, Computer Games, and Pedagogy in e-Learning and Other Educational Experiences*. San Fransisco, CA: Pfeiffer.
- [2] A. McFarlane, A. Sparrowhawk & Y. Heald. (2002). Report on the educational use of games: TEEM: Teachers Evaluating Educational Multimedia.
- [3] A. Mitchell & C. Savill-Smith. 2004. *The Use of Computer and Videogames for Learning: A Review of the Literature* Trowbridge, Wiltshire: Learning and Skills Development Agency.
- [4] R. Garris, R. Ahlers, & J.E. Driskell. 2002. *Games, Motivation and Learning: A Research and Practice Model*, Simulation & Gaming
- [5] T.W. Malone & M,R, Lepper. 1987. Making learning fun: A taxonomy of intrinsic motivations for learning. In R. E. Snow & M.J. Farr (Eds), *Aptitude, learning and instruction III: Cognitive and affective process analysis* (pp.223-253) Hillsdale, NJ: Lawrence Erlbaum
- [6] A. Amory. 2001. *Building an Educational Adventure Game-Theory, Design and Lessons*. *Journal of Interactive Learning Research*, 12(2/3), 249-263
- [7] E. Ju, & C. Wagner. 1997. *Personal computer adventure games: Their structure, principles and applicability for training*. *The Database for Advances in Information Systems*, 28(2), 78-92.
- [8] --. 2003. *Second Life* by Linden Labs. Available: <http://secondlife.com/?v=1.1> Accessed on 31 January 2010
- [9] J. Kirriemuir. 2007. *Snapshots of Second Life use in UK HE and FE Eduseriv Foundation*. Available: <http://www.eduseriv.org.uk/foundation/studies/slsnapshots>. Accessed on 31 January 2010.
- [10] M. Cowan. 2008. The 'second wave' of Second Life. *News*. Available: <http://uk.reuters.com/news/video?videoId=92549&videoChannel=6>. Accessed on 31 January 2010
- [11] --. 2009. "8D Taps Language Learners, Bots, Microtransactions. 2009" in *Virtual World News*. Available: <http://www.virtualworldsnews.com/2009/05/out-of-stealth-8d-taps-l-anguage-learners-bots-microtransactions.html>. Accessed on 31 January 2010
- [12] H. Mintzberg. 1973. *The Nature of Managerial Work* 1.Harper Collins Publishers, New York
- [13] M. Tan, Q.E Looi, & S.L. See. 2008. "Social Gaming—What Attracts the Most Attention? An Analysis of Current Methodology and Trends" in *Proceedings of the 14th Youth Science Conference*, Singapore.