Describing Games for Learning: Terms, Scope and Learning Approaches

Stephen Tang
Kolej Tunku Abdul Rahman
Jalan Genting Kelang, Setapak,
53300 Kuala Lumpur, Malaysia
+60162935691

mr.stephentang@gmail.com

Dr. Martin Hanneghan
Liverpool John Moores University
School of Computing and
Mathematical Sciences,
Byrom Street, Liverpool, UK.
+441512312577

m.b.hanneghan@ljmu.ac.uk

Dr. Abdennour El Rhalibi
Liverpool John Moores University
School of Computing and
Mathematical Sciences,
Byrom Street, Liverpool, UK
+441512312106

a.elrhalibi@ljmu.ac.uk

ABSTRACT
Digital games are no longer used solely as a form of entertainment. Such forms of interactive content have extended their application to areas such as advertising, simulation, training and even education. In this paper we present our description of games for learning and explain the various terminology used in the literature. We also discuss the learning approaches that a learner may opt for in such an interactive medium.

Categories and Subject Descriptors
K.8.0 [**Personal Computing**]: General - *Games*

General Terms
Theory.

Keywords
Games for learning, Edutainment, Educational Games, Digital Game-based Learning, Serious Games.

1. INTRODUCTION
Digital games are no longer a lucrative, new media industry that serves merely entertainment to the public but rather its presence is becoming a culture and it is certainly a vehicle for spreading information and influences in a rich and interactive environment. In the recent years the application of digital games and related technologies in learning has gained the interest of many researchers to promote deep learning through such an interactive medium.

At present, there is a myriad of game-like applications being used in various fields to serve different purposes. Various terms have been used to distinctively characterise these game-like applications. Narayanasamy *et al.* in [14] describes games and other forms of game-like software such as simulators, simulation games and serious games based on observable design characteristics. The work of Stoop and Turner [34] provides a description of games and simulation that explains the abstraction of reality representation based on five building blocks; *Content*, *Purpose*, *Game*, *Simulation* and *Media Technology*. However, we believe such descriptions are still lacks in defining the scope of some terms being used in the context of games for learning.

In this paper we present our descriptions of these various terminologies that are used to represent games for learning based on the interpretation of the existing descriptions. In Section 2 we describe games for learning and distinguish this from digital games. In Section 3 we describe the terms relating to games for learning such as edutainment, educational games, simulation and serious games with the aim to relate these terms and define their scope. In Section 4 we describe the types of learning approaches that can be taken by learners and their characteristics and draw conclusions on this subject in Section 5.

2. GAMES FOR LEARNING
The works of Prensky [1-2], Gee [3] and Aldrich [4] present great insights on the potential of digital games for learning and our preliminary research on games for learning through literature reviews has also uncovered that digital games have great potential for education and training [5-6]. Many suggest that the motivation of game play and the experiential learning opportunity via interactivity are two core advantages that digital games have to offer to education [4-8]. Although there are plenty of findings published on digital games, there are very few of those publications that relate the features of digital games to games for learning. The remainder of this section summarises games for learning from a digital games standpoint by means of providing greater understanding toward this new medium of educational technology.

2.1 Describing Digital Games
Digital games are software applications created merely for entertainment purpose. Game software takes advantage of multimedia technologies and other computing technologies such as networking to enable its user (or *game player*) to experience goal-directed play in a rich virtual environment. Game software can be represented in three primary design schemas defined by Salen and Zimmerman in their conceptual framework as *rules*, *play* and *culture* [9]. *Rules* formally represent the 'mechanics' or operational constraints within the game construct which in turn governs the level of interactivity within the game. *Play* represents the experiential aspect of the game which is communicated to the game player through some activity which some authors distinctively categorise as *interactivity*, *challenge* and *conflict* [10]. *Culture* then interprets the beliefs and norms represented in the game world which is often portrayed to game players though artificial characters, objects and settings via aural and visual representation of the game world and through storytelling. In summary, *rules* and *culture* define the technical and intrinsic representation of "playground" to support the activity of *play*. The conceptual framework defined by Salen and Zimmerman will

serve as the basis for us to describe games for learning in the following sections.

2.2 Distinguishing Games for Learning from Digital Games

A game in general is composed from a set of 'interesting' rules within a defined cultural context to support the activity of play. Play itself has always been perceived as an activity of enjoyment or recreation rather than a serious or practical purpose although the activity itself has potential to be used as a form of experiential learning in a fun and relaxing environment. In fact, the real purpose of the game is hidden within the activity of play defined by the designer and the perception of the game player.

Many well-designed digital games are indeed educational although they are lacking in integration of knowledge and training in skills which are considered academic. Such educational potential can be explained through Gee's '36 learning principles' that is found in many digital games [11-12]. Based on a report published by BECTa, off-the-shelf digital games such as The Sims, SimCity, Championship Manager, Age of Empires, City Traders and Brain Teasing were used in schools with specific learning outcomes and have produced evidence of positive learning experience [13]. However, games for learning should be designed and developed based on a sound pedagogical grounding to accentuate the educational elements defined rather than the entertaining aspects that are often fictitious [5-6].

The distinction between digital games and games for learning lies within the definition of *play* which translates as learning activities in pedagogical context. The game designer's primary role is to ensure game players experience fun through the entertaining act of play by solving the challenges presented to them. Storytelling and artistic visual representation are used as 'tools' to immerse and promote repeated play. However, *play* in the context of games for learning would have to focus on meaningful learning activities [5-6] although the learner might experience the activity as fun and engaging [14]. These meaningful learning activities are interactions designed with purpose to educate learners through the principle of cause and effect. *Rules* and *culture* will have to accommodate the direction of play defined for either purpose; entertainment or learning.

Rules in games for learning can range from the simplistic to extremely detailed (for example on par with a true simulator) depending on the subject matter. Similar to *rules*, the details of *culture* in games for learning depends on the subject matter, but should exhibit beliefs and norms from some real world scenario. Although storytelling in digital games is used as a vehicle for play, it does not necessarily mean that game for learning requires a compelling storyline to engage learners for individual learning. However, dialogue via artificial characters may serve a better purpose in providing information to the learner more naturally in comparison to engaging narratives that may not entail truth of the scenario presented. Other forms of content beside narrative, such as the visual element, need not be ultra-realistic although it is desirable and yet costly to include such a requirement in games for learning. Visual elements in the form of avatars and objects are sufficient for the purpose of learning.

	Digital Games	Games for Learning
Rules	Rules are designed to accommodate the activity of play which are often be tuned for playability rather than reflecting the real happening.	Rules are designed for specific learning outcomes that can be used to measure the interactions during the "serious play". Rules can be simplified or made complex to support the activity of play.
Play	Interactions designed primary for entertainment purposes with directed objectives which can be driven by storytelling. Interactions resemble the real world interaction in a simplified or abstract approach.	Interaction designed for learning purpose with meaningful responses and measurable outcomes. Knowledge is disseminated through events triggered by optimised interactions and dialogues.
Culture	Beliefs, norms and world setting presented visually and via narrative are often set in an imaginary world which is represented artistically and exaggeratedly.	Beliefs, norms and world setting presented visually and via narratives should be set in a real setting to reflect truthfulness and have direct and explicit relation to the real world events.

Table 1: Differences between digital games and games for learning in *rules*, *play* and *culture*.

Digital games provide the freedom for game players to interact within the virtual environment and as such are not an exception for games for learning. Although some male students might just exploit this as a virtual playground as observed in MIT's Games-to-teach project [15] and BECTa's Computer Games in Education Project [13], such environments are an excellent foundation for experimentation of various solutions to the problems presented. Such initiative should be encouraged and yet be supervised to maximise knowledge construction during "serious play".

3. TERMS AND SCOPE

At present there are various terms used in the field to describe games for learning such as edutainment, educational games, digital game based learning, simulators and most recently serious games. We believe that by clarifying these terms, it can help the understanding of context and scope of games for learning defined by each term.

3.1 Edutainment

Edutainment is a research area pertaining to education technology which often relates to multimedia based educational software distributed via CD-ROM but in general represents use of entertainment elements in education context. Edutainment represents the integrative use of various media such as television programs, video games, films, music, multimedia, websites and computer software to promote learning in a fun and engaging approach [16]. Sesame Street is an example of edutainment content in the form of television programme that aims at educating children through entertainment media [17].

3.2 Educational Games

Educational games (also known as *instructional games*) is a subset of edutainment which refers to software application that exploit games technologies in creating educational content though game playing and storytelling. Examples include Disney's Toontown Online, Disney's Hot Shot Business, Nickelodeon Online's The Wild Thornberrys Wildlife Rescue and Rugrats Go Wild Wildlife Rescue described in [5-6]. However most educational games are developed for children who have lower expectation of the interactive content as compared to teenagers and adults who have higher expectations. Most teenagers and adults would favour digital games for the entertainment experience in comparison to educational games ignoring the embedded educational content in the process. Educational games are commonly used at home as learning aids to encourage children. Educational games can possibly be extended from software to the scale of system which integrates other common features from e-learning suite such as discussion and assessment envisioned by Crocker [19] and described in the UNIgames project [20-21] as an integrated approach to modern learning.

3.3 Digital Game-Based Learning

Digital game-based learning is used to describe the adoption of educational games in a formal learning environment but is mostly used in the context of higher education and adult learning environments [1, 18]. Digital game-based learning is an active e-learning medium which promotes experiential learning. The learning environment described in UNIgames project [20-21] and MIT's Games-to-teach project [35] are some examples projects that encourages students to learn in using such interactive content.

3.4 Simulators

Simulators are software developed to model behaviour of some object, machine or system in reality based on precise mathematical modelling and highly accurate visualisation of the state of the subject over a period of time. Initially developed for investigations in the field of science and engineering, simulation technology has also been used in training simulators and simulation games for training and entertainment purposes [14].

3.5 Serious Games

The term serious games, made known through the *"Serious Games Initiative"* is indeed synonymous to educational games to represent digital games for non-entertainment purposes. However, serious games extend the use of digital games beyond education and training to include health and public policy [22-23]. It may also extend itself to include simulation technology for the defined purpose. Serious games are notable for being applicable to learners of all age groups. Some serious games featured at the *Serious Games Initiative* website described below are great examples that demonstrate the diverse and creative application of games technology in training and creating awareness.

- *Food Force* educates learners between the ages of 8 – 13 about the fight against world hunger in a fictitious island through six different missions with specific learning objectives; *Air Surveillance* - The causes of hunger and malnutrition; *Energy Pacs* - Nutrition and the cost of feeding the hungry; *Airdrop* - WFP's emergency response; *Locate and Dispatch* - Global food procurement; *The Food Run* - Land-based logistics; and *Future Farming* - Long-term food aid projects. This serious game is commissioned by the United Nations World Food Programme (WPF) and available for free download from www.food-force.com [24].

- *Stone City* simulates the operation of a mix-your-own ice cream franchise whereby learners take the role of an employee to serve customers ice cream. Learners are evaluated through the various aspects such as speed of service, accuracy of the portion sizes and correctness of recipe which affects the customer satisfaction [25-26].

- *Second Life* is a 3D massively multi-user virtual world created as an alternative to reality where user defined world can be used as a space for various interactions including play, business and education [27]. It has been used as a technology platform to deliver lessons in virtual classrooms and as a learning tool for students [28-29].

- *America's Army* is a tactical squad-based multi-user first person shooter developed and published by the US Army primarily as a recruitment tool to raise the interest of those who wish to join the force. It also has single-user option that serves mandatory training sessions for the user to obtain skills and knowledge before engaging in the battle in the multi-user mode. It reflects a true representation and expectation from the US Army. Besides being an advertising game to promote the US Army, different version of America's Army also serve as a training and experimental tool [30-31]. America's Army is available for free download from www.americasarmy.com [31].

- *VR Therapy for Spider Phobia* takes advantage tactile augmentation to treat patients suffering from persistent fear of spiders in overcoming it through sessions of virtual reality (VR) therapy. The patient wears a head mounted display that projects 3-dimensional visuals of a virtual environment and interacts with a virtual spider that is linked to the VR system through a positioning sensor and has been shown to significantly reduce the patient's fear of spiders [32].

3.6 Relating Terms and Scope

Educational games, simulators and serious games are indeed interactive software contents that exploit games technology for non-entertainment purpose with a different reach in the context of education. These interactive software systems can be integrated with the existing curriculum and existing e-learning facilities to form a digital game-based learning environment that promotes experiential learning. Educational games, simulators, serious games and digital game-based learning are a relatively new generation of educational technology that promotes active learning. We will adopt the term serious games in favour to the term educational games in the remaining section of the paper due to the scope serious games have to offer in comparison to educational games. However we believe that educational games still plays an important role to serve children at younger age.
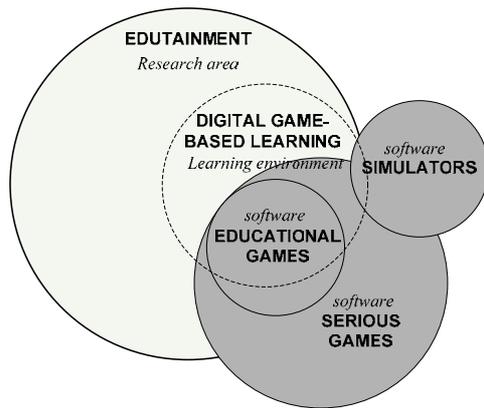
Figure 1: Relationships between and scope of *Edutainment*, *Digital game-based learning*, *Educational games*, *Simulators* and *Serious Games*.

4. LEARNING APPROACHES

Learning is an activity of knowledge construction. Generally learners can opt for surface or deep approaches towards learning. Learners who practice the surface approach accept new ideas and facts uncritically and store this knowledge in isolation. Contrarily learners who experience deep learning tend to examine new ideas and facts critically with the intention to integrate such newly formed knowledge into existing knowledge structures. Learning is optimal when learners take on the deep learning approach. Such positive attitude towards learning encourages learners to actively pursue new ideas and facts on the given subject matter and expand his or her knowledge base, and subsequently become an active learner.

The approach towards learning is determined by learners but affected by personal factors and the nature of the lesson being delivered. In reality learners may adopt surface learning due to personal factors such as lack of interest, prerequisite knowledge and time in understanding necessary concepts or learning materials. Likewise learners are primed to make such a decision due to uninteresting, passive and poor lesson delivery. Learners with a positive attitude towards learning are most likely to experience deep learning in lessons that are interesting, active and well delivered [33].

In the digital games context, learners are more likely to experience deep learning than surface learning. Digital games encourage learners to derive meaning from the interactions defined through observation of cause and effect and often require them to apply the knowledge gained in solving problems. Such experience can be replicated in games for learning by incorporating facts and concepts into the storytelling and interactive components. Our proposals in [5-6] provides useful insights in designing games for learning are encourage learners to adopt a deep approach and continues to pursue knowledge in the domain presented in reality. In fact well-designed digital games not only immerse but engage learners in solving the problems. Learners who intend to adopt surface learning in a digital games environment may choose to use cheat codes to gain competitive advantage and continue to pursue the game story while others may choose to abandon the game and claim that the game is not interesting or difficult to play.

5. CONCLUSIONS

In this paper, we had presented our description of games for learning and distinguish this from digital games based on the primary design schemas presented by Salen and Zimmerman. It is obvious that games for learning differentiate themselves from other games through the design of play while the rules and culture schemas are meant to complement the play schema. Our review on the terms used to represent the use of games in learning provides a definitive relationship and scope that complements the work of Narayanasamy [14], and Stoop and Turner [34] which has misled others who are not in the field. Finally our discussions on learning approaches that can be adopted by learners enlighten us on the importance of designing meaningful play-activity in such games for learning to foster knowledge constructions. These reviews are useful in providing a richer understanding toward the role of games in learning.

6. REFERENCES

[1] Prensky, M., *Digital Game-Based learning*, Paragon House Publishers, 2007.

[2] Prensky, M., *Don't Bother Me Mom--I'm Learning!* Paragon House Publisher, 2006.

[3] Gee, J. P., *What Video Games Have to Teach Us About Learning and Literacy*, Palgrave Macmillan; New Ed edition, 2004.

[4] Aldrich, C., *Learning by Doing: A Comprehensive Guide to Simulations, Computer Games, and Pedagogy in e-Learning and Other Educational Experiences*, Jossey-Bass, 2005.

[5] Tang, S. and Hanneghan, M., *Educational Games Design: Model and Guidelines*, in Proceedings of the 3rd International Game Design and Technology Workshop (GDTW'05), Liverpool, UK, November 8-9, pp. 84-91, 2005.

[6] Tang, S. and Hanneghan, M., *Theories of Game Design: A Pedagogical Approach*, in Proceedings of KDU Symposium on Information Technology in Education (KDUSITE05), Petaling Jaya, Malaysia, 31 May - 1 June, pp. 48-58, 2005.

[7] Prensky, M., *The Motivation of Gameplay or the REAL 21st Century Learning Revolution*, On the Horizon, Volume 10 Issue 1, 2002. (Online) http://www.marcprensky.com/ writing/Prensky%20-%20The%20Motivation%20of%20 Gameplay-OTH%2010-1.pdf (Accessed 8 May 2007)

[8] Roussou, M., *Learning by Doing and Learning through Play: An Exploration of Interactivity in Virtual Environments for Children*. ACM Computers in Entertainment, Vol. 2, No. 1, pp. 10 - 10, 2004.

[9] Salen, K., Zimmerman, E., *Rules of Play – Game Design Fundamental*, The MIT Press, 2004.

[10] Crawford,C., *Chris Crawford on Game Design*, New Riders, 2003.

[11] Gee, J. P., *What Video Games Have to Teach Us About Learning and Literacy*, ACM Computers in Entertainment vol. 1 no. 1, pp. 20, 2002.

[12] Prensky, M., *Escape from Planet Jar-Gon Or, What Video Games Have to Teach Academics About Teaching And Writing, A Review of What Video Games Have To Teach Us About Learning and Literacy by James Paul Gee*, On The Horizon, Vol. 11 issue 3, 2003. (Online) http://www.marcprensky .com/writing/Prensky%20-%20Review%20of%20James%20Paul%20Gee%20Book.pdf (Accessed 22 August 2007)

[13] BECTa, *Computer Games in Education: What aspects of computer games may offer to education?*, 2001. (Online) http:// www.becta.orc.uk/page_documents/research/cge/aspects.pdf (Accessed 15 January 2005).

[14] V. Narayanasamy, Wong K. W., Fung C. C., *Distinguishing Games and Simulation Games from Simulators*, ACM Computers in Entertainment vol. 4 no.2, Article no. 9, 2006.

[15] Jenkins, H., Klopfer, K., Squire, K., Tan, P., *Entering The Education Arcade*. ACM Computers in Entertainment vol. 1 no. 1, pp. 17, 2003.

[16] Rapeepisarn, K., Wong, K. K., Fung, C. C. and Cole, P., *Edutainment" is a form of "learn through doing"?*, in Proceedings of the 4th International Game Design and Technology Workshop (GDTW'06), Liverpool, UK, November 15-16, pp. 116-120, 2006.

[17] Revelle, G. L., *Educating via entertainment media: the Sesame Workshop approach*, Computers in Entertainment vol. 1 no. 1, pp. 16, 2003.

[18] Joint Information System Committee (JISC), *Game Based Learning*, 2007. (Online) http://www.jisc.ac.uk/publications/publications/pub_gamebasedlearningBP/pub_gamebasedlearningBP_content.aspx (Accessed 10 May 2007).

[19] Crocker, A., *Active Learning Systems*, ACM Computers in Entertainment vol. 1 no. 1, pp. 14, 2003.

[20] Dziabenko, O., et. al., *A Web-based Game for Supporting Game-Based Learning.* In proceedings of 4th annual European GAME-ON Conference (GAME-ON 2003), London, United Kingdom, November 19-21, pp. 111-118, 2003.

[21] Bouras, C., et. al, *Game-Based Learning Using Web Technologies*, International Journal of Intelligent Games & Simulation, Vol. 3 no. 2, pp. 70 - 87, (Online) http://www.unigame.net/html/unigame_journal.pdf (Accessed 24 August 2007)

[22] Serious Game Initiative, 2007. (Online) http://www.seriousgames.org/index2.html (Accessed 9 May 2007).

[23] Serious Game Source, 2007. (Online) http://www.seriousgamessource.com/ (Accessed 9 May 2007).

[24] WFP Food Force, 2007. (Online) http://www.food-force.com/ (Accessed 25 August 2007).

[25] Persuasive Games, 2007. (Online) http://www.persuasivegames.com/games/game.aspx?game=coldstone (Accessed 25 August 2007).

[26] Bogost, I, *Persuasive Games: How I Stopped Worrying About Gamers And Started Loving People Who Play Games*, Gamasutra, 2nd August 2007. (Online) http://www.gamasutra.com/view/feature/1543/persuasive_games_how_i_stopped_.php (Accessed 25 August 2007).

[27] Second life, 2007. (Online) http://secondlife.com (Accessed 25 August 2007)

[28] Education Guardian, *A second look at school life - Quin Parker on the 3D computer game that's offering teenagers a new way of learning*, 6 April 2007, http://education.guardian.co.uk/elearning/story/0,,2051195,00.html (Accessed 25 August 2007)

[29] Conklin, M. S., 101 *Uses for Second Life in the College Classroom, 2007*. (Online) http://facstaff.elon.edu/mconklin/pubs/glshandout.pdf (Accessed 25 August 07)

[30] America's Army, 2007. (Online) http://www.americasarmy.com (Accessed 25 August 2007)

[31] Nieborg, D. *America's Army: More than a game?*, In the Proceedings of 35th Annual Conference of the International Simulation And Gaming Association (ISAGA) and Conjoint Conference of SAGSAGA, September 6 – 10, 2004. (Online) http://www.gamespace.nl/content/ISAGA_Nieborg.PDF (Accessed 25 August 2007).

[32] Hoffman, H. G., Garcia-Palacios, A., Carlin, C.., Furness, T.A. III and Botella-Arbona, C. *Interfaces that heal: Coupling real and virtual objects to cure spider phobia.* International Journal of Human-Computer Interaction, 15, pp. 469-486, 2003. (Online) http://www.hitl.washington.edu/publications/m-90-4/siggraph.ps.prn (Accessed 24 August 2007).

[33] The Higher Education Academy, *Deep and Surface Approaches to Learning*, 2007. (Online) http://www.engsc.ac.uk/er/theory/learning.asp (Accessed 20 September 2007).

[34] Stoop, S., Turner, A. *Games and Simulation: DS Online's Newest Topic Area,* IEEE Distributed Systems Online, vol. 8, no. 10, 2007, art. no. 0710-ox001.

[35] Jenkins, H. et. al. *Entering The Education Arcade*. ACM Computers in Entertainment vol. 1 no. 1, 2003. pp. 17-17.