

GaD-eM: An Adaptive Game Design Model for Malaysian Higher Education (HE)

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Abstract—this paper aims to identify existing issues in designing educational game and discuss the limitation of existing GBL framework or model. The outcome of this study is an educational game design framework called GaD-eM that addresses all limitations identified earlier.

Index Terms— GaD-eM, Game-based Learning (GBL), evaluation, game design, GBL framework/model, educational game design

1 INTRODUCTION

A GAME is a competitive activity whether physical or mental that has set of rules or constraints, with the aim to entertain or reward the players [1, 2]. Game continues to gain its popularity when it is no longer limited in entertainment industry but also starts to influence the advertising, analyzing, marketing, simulating and e-learning [3] and also in military [4], education [5] and healthcare [6,7]. The usage of game in education has introduced a new term. Game that being used in education is called game-based learning (GBL). GBL refers to the innovative learning approach derived from the use of computer games that posses educational value or different kinds of software applications that use games for learning and education purposes such as learning support, teaching enhancement, assesment and evaluation of learners [8]. Ref [9] further defined that in GBL, games are utilizes as medium for conveying the learning contents. It shows that the main aim of GBL is to emphasize on learning. Unfortunately there exist imbalance between maintaining level of excitement and conveying the learning content. Many GBL imparted too much excitement on the visual effect but failed to convey the learning contents [10]. Hence, it is critical to develop a GBL model that balances between these elements.

This paper is structured as follows: Section I covers the introduction, Section II discusses the background study and a literature review, Section III discusses on the proposed framework called Gad-eM, and finally in Section IV is the conclusion.

2 . LITERATURE REVIEW

2.1 Existing GBL Framework or models

The literature search is carried out using various electronic databases that is relevant. The following terms were used

("computer games" OR "video games" OR "serious games" OR "simulation games" OR "simulation systems" OR "game-based learning" OR "online games") AND ("evaluation" OR "framework" OR "model")

Table 1 listed 16 existing evaluation frameworks or models on GBL.

TABLE 1 : LIST OF GBL FRAMEWORK/MODEL

Framework / Model (s)
Game Object Model v1[11]
Game Object Model v2[12]
Four Dimensional Framework [13]
Kirkpatrick Four Level Evaluation Model[14] CRESST Learning Model[14] Affective Motivation Learning Model[14]
Framework of Heuristic Evaluation in MMORPG[15]
Framework for evaluating web based learning [16]
Adaptive Digital Game-based learning[10]
Design Framework for Edutainment Environment[17]
Adopted Interaction Cycle for Games[18]
The Engaging Multimedia Design Model for Children[19]
SIG-Glue Quality Criteria Framework[20]
Evaluation framework for GBL [21]
Educational Computer Game Design Model [22]

Framework of Heuristic Evaluation in MMORPG [15] and Framework for evaluating web based learning [16] are extended from the study done by [23]. Ref [23] introduced a heuristic evaluation that focuses on finding interface usability problems by applying Human Computer Interaction (HCI) technique.

Ref [10] reviewed four GBL frameworks including Design Framework for Edutainment Environment, Adopted Interaction Cycle for Games framework, and The Engaging Multimedia Design Model for Children and Game Object Model and create a new framework called Adaptive Digital GBL which adds the learner characteristics as a component. The learner characteristics in this framework focus on the learner psychology.

Ref [17] introduces Design Framework for Edutainment Environment. In this framework, she identified that learner is an essential focus when designing educational game. She identified 4 factors that are closely related to the learners that

is storytelling, feel challenges while playing, interactivity and interfaces.

Ref [18] focused on interactivity between learners and game when proposing the Adopted Interaction Cycle for Games framework. In this framework, they described how the interaction between a user and a computer game happens in term of cognitive and physical user actions.

Ref [19] proposed The Engaging Multimedia Design Model for Children framework which focuses on engagement level of the learner. In her model, she claimed that high engagement level will be achieved if these features are presents such as simulation interaction, construct interaction, immediacy, feedback and goals.

Ref[11] introduced Game Object Model that significantly addressed pedagogy and game design. The Game Object Model has been further developed using theoretical constructs and developments to become Game Object Model II. Game Object Model II is far richer model that includes social elements in designing educational game.

Ref[14] reviewed three evaluation framework related to GBL including Kirkpatrick Four Level Evaluation, CRESST Learning Model and Affective Motivation Learning Model. These three frameworks are designed to evaluate learning outcome.

Ref [22] introduced Educational Computer Game Design Model. In this framework they described the process, issues and challenges in designing educational computer game for Malaysian classrooms.

Ref [20] proposed a framework called SIG-Glue Quality Criteria Framework that covers both pedagogical and technical criteria. The outcomes of this framework are the classification of games by learning purposes and an evaluation framework for assessing games.

Ref [21] proposed a general framework for evaluating GBL called Evaluation Framework for Games-based Learning. In this framework, they identified all potential attributes that to be considered when evaluating a GBL application.

Ref [13] developed a framework that addressed pedagogy which called Four Dimensional Framework (FDF). FDF described representation, pedagogy used, context and learner specification as four vital aspects in order to assist tutor's selection and use of games in their practices.

2.2 Limitation of existing GBL frameworks or models

When designing an educational game it seems logical to design it from the pedagogical perspective because the main aim of using GBL is to motivate and engage learner with the

intention that effective learning may occur [21]. Designing an educational game based on pedagogy is essential because unlike COTS, the main objective of educational game is to teach and reinforce learned concept rather than entertainment [10, 24]. Ref [25] and [21] reiterates that, creating an educational game should start from formalizing the relationship between learning theory, game design, play and development. Ref [25] and [21] argued that educational game have not been designed using any coherent theory of learning. Majority of educational games were designed based on the entertainment game which depends on the effective usage of multimedia elements to create the learning experience [8]. Despite the importance of pedagogical elements, the existing frameworks or models is still has insufficient pedagogical support in educational game design.

Furthermore, as to date very few models or frameworks address the learner characteristics or learner background in designing educational game particularly their customs, languages, culture, ethnicity and learning styles. Information about learners' background helps to refine the game design so that it can provides more effective learning experiences. Ref [26] claimed that cultural context influences comprehension regardless of an individual background. Ref [27] suggests that it is important to know the characteristics of the target audience when intending to use a game in learning. Presenting the learning materials in familiar concepts and situations from the learners' own cultures allow to increase the knowledge acquisition of learners [28]. Ref [29] stress that using topic that closely related to students lives could draw them into depth and complexity of a subject therefore it is important to present to students material which they can relate to in order to engage them in the learning process. Success of educational game is due to an emotional link established between the game and learner [30].

Ref [22] failed to identify available educational game in the market that is suitable to be used in Malaysian context due to our multicultural and multiethnic background.

Therefore, the aim of this work is to propose a framework that addresses those limitations.

3 Proposed game design model

Figure 1 illustrated the proposed game design model called GaD-eM. GaD-eM is derived from the Educational Computer Design Model [22]) and Game Object Model [11]

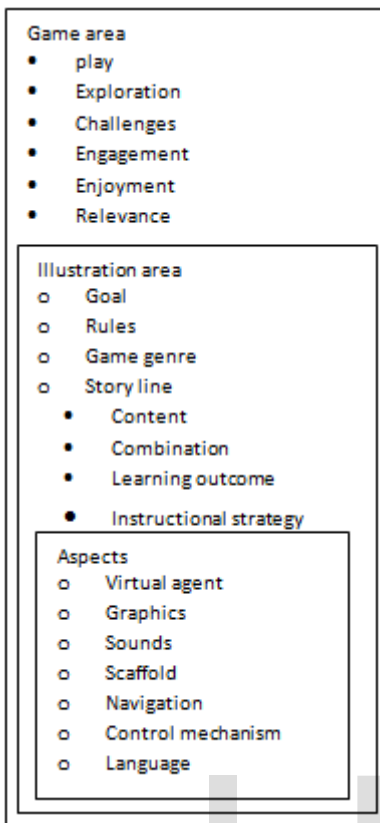


Figure 1 : GaD-eM

GaD-eM is basically harmonizing pedagogy dimensions and game design components. Educational games need to contain different aspects; those that promote educational objectives and those that allow for realization of these educational objectives. Hence, an educational game area consists of different components that contain distinct interfaces. Game aspects that promote the educational objectives are called as 'abstract interfaces' and represented by black circles while game aspects that support educational objectives are called as 'concrete interfaces' and represented by white circles. The game area embodies all components (each with their own interfaces) and interfaces that define the interactive learning environment. In GaD-eM model, the components are represented by squares.

The game area component consists of seven motivational interfaces namely play, exploration, challenges, fun, engagement, relevance and illustration. The illustration component contains story line, game genre, rules, goal, content, combination, learning outcome and instructional strategy interfaces with the aspects components embedded within it. The virtual agent, graphics, sounds, scaffold, navigation, control mechanism and language interfaces make up the story line, appearance and playability of the game. The game genre interface represents the content of the game. The goal interface represents the learning outcome of the game; while the rules interface depict the instructional strategy. The abstract interfaces therefore represent the pedagogical elements while concrete interfaces represent game elements.

3.1 Theoretical constructs of GaD-eM

Game is "a physical or mental contest that has specific rules, with the aim to amuse or reward the gamers" [1,2]. Ref [2] provides the following definition of a game or computer

game: "A game is an artificially constructed, competitive activity with a specific goal, a set of rules and constraints that is located in a specific context." As a result, an educational game should present play, fun, explorative, and challenge in an engaging environment. It is also must governed by specific rules with a specific goal that is located in a specific context.

Games provide situated experiences in which players are immerse in complex problem solving task [5]. Ref [2] and [13] defined instructional games as games that have been specifically designed or modified to meet learning objectives. As a result, an educational game should allow learner to apply their prior knowledge into the current knowledge in order to achieve a goal. This type of skill is called combination

Ref [31] defines game as "an activity that is voluntary and enjoyable, separate from the real world, uncertain, unproductive (in that activity does not produce any goods of external value) and governed by rules. Ref [32] said that computer games have the following characteristics rules, goals & objectives, outcomes and feedback, conflict/competition/challenge/opposition, interaction and representation or story.

CONCLUSION

As a conclusion, a GBL framework is proposed to address those limitations that have been identified in the existing frameworks or models. Thorough study has identified lack of pedadogy components in game design, failure to consider learner background and game genre as components that has potential to influence learning in Higher Education. This study hopes to implement the identified components in the game development and investigate the game effectiveness in imparting learning in Higher Education in Malaysia.

REFERENCES

- [1] M. Zyda. "From visual simulation to virtual reality to games". IEEE Computer, 2005
- [2] R.T. Hays,. "The Effectiveness of Instructional Games : A Literature Review and Discussion. Orlando" : Technical Report 2005-004 Naval Air Warfare Center Learning Systems Division.2005
- [3] A. Frank. and N. Lundblad. "The New Role Of Gaming: How games move outside Computing: Technologies entertainment".*Entertainment and Applications, Artificial IFIP First International Workshop on Entertainment Computing (IWEC 2002)*, 2002.
- [4] M. Schneider, K Carley, and I.Moon, . "Detailed Comparison of America's Army Game and Unit of Action Experiments". Technical Report CMU-ISRI-05-139, Carnegie Mellon University, School of Computer Science, Institute for Software Research International,2007
- [5] K Squire., L.Giovenetto., B Devane, & D Shree., "From users to Designers : Building a self-organizing game-based learning environment". *Techtrends* , vol 49 no 5, p 34-42.
- [6] J.L Lennon., "Debriefings of web-based malaria games", *Simulation & Gaming*. Vol 37(3), pp 350-356. 2006
- [7] S. Conrad,. "Effective Digital game Design for Multi-Generational Learning".
https://files.pbworks.com/download/PenGOGps0d/immersionfall09/26075333/Digital_Games_For_Learning.pdf 2010
- [8] S Tang, M Hanneghan and A El Rhalibi . "Introduction to Games-Based Learning", *Games-based Learning Advancement for Multisensory Human Computer Interfaces: Techniques and Effective Practices* . T.M. Connolly, M.H. Stansfield and E. Boyle eds. Idea-Group Publishing:

- Hershey. ISBN: 978-1- 60566-360-9. 2009
- [9] C Conati, "Probabilistic Assessment of User's Emotions in Educational Games". *Journal of Applied Intelligence*, 2002.
- [10] P. Tan, S. Ling, and C. Ting, "Adaptive digital game-based learning framework," *The 2nd international conference on Digital*, pp. 142-146, 2007.
- [11] A Amory, "Building an educational adventure game: theory, design, and lessons." *Journal of Interactive Learning Research*. Vol 12 2/3 , p. 249-263.2001
- [12] A Amory. and R. Seagram. "Educational Game Models: Conceptualization and Evaluation." *South African Journal of Higher Education*. Vol 17 no 2, p. 206-217. 2003
- [13] S de Freitas & M Oliver. "How can exploratory learning with games and simulations within the curriculum be most effectively evaluated?" *Computers & Education* , Vol 46, p 249-269.2006
- [14] H F O'Neil, R Wainess, and E L Baker. "Classification of learning outcomes: evidence from the computer games literature". *The Curriculum Journal*, vol 16 no 4, December 2005.
- [15] S Song, and J Lee,. "Key factors of heuristic evaluation for game design: Towards massively multi-player online role-playing game". *International Journal of Human-Computer Studies*, vol 65,p 709-723. 2007
- [16] S Ssemugabi,& R de Villiers. "A comparative study of two usability evaluation methods using a web-based e-learning application". *Proceedings of the 2007 annual research conference of the South African institute of computer scientists and information technologists on IT research in developing countries*, 2007.
- [17] Z C Embi, "A Case Study on the Implementation of Framework for Edutainment Environment", PhD dissertation, Faculty of Creative Multimedia, Multimedia Univ, Malaysia, 2005 .
- [18] W Barendregt and M.M. Bekker. "Towards a Framework for Design Guidelines for Young Children's Computer Games". *Proceedings of the 2004 ICEC*, 2004.
- [19] N S Said. "An engaging multimedia design model". *Proceeding of the 2004 conference on Interaction design and children: building a community 2004*.
- [20] C Dondi, and M Moretti,. "A methodological proposal for learning games selection and quality assessment". *British Journal of Educational Technology*, vol 38 no 3 p 502-512.2007
- [21] T. Hainey, "Using games-based learning to teach requirements collection and analysis at tertiary education level," PhD dissertation, Univ of West Scotland, 2010
- [22] K. Osman and N. Aini Bakar, "Educational Computer Games for Malaysian Classrooms: Issues and Challenges," *Asian Social Science*, vol. 8, no. 11, pp. 75-84, Aug. 2012.
- [23] J Nielsen and R Molich. "Heuristic evaluation of user interfaces". *Proceedings of the ACM HI'90* pp 249-256.1990
- [24] R E Pedersen,. *Game Design Foundations*. First ed., Texas: Wordware Publishing 2003.
- [25] D W Shaffer, K T Squire, R Halverson, and J P Gee, . "Video Games and the Future of Learning". <http://www.academicolab.org/resources/gappspaper1.pdf>. 2008
- [26] M Steffensen, C Joag-Deve., & R Anderson, "A Cross-Cultural Perspective on Reading Comprehension". *Reading Research Quarterly*, vol 15 (1), pp 10-29, 1979.
- [27] E Bae. "The Effects of Trainee Characteristic on Learning Effectiveness in Improving Organizational Performance". *Performance Improvement Quarterly*, vol 15 (2), pp 234-245. 2002
- [28] J Haynes. "SIOP: Making Content Comprehensible for ELLs". www.EverythingESL.Net .
- [29] V Perrone,. "How to engage students in learning". *Educational Leadership*, vol 51(5), pp 4-7, 1994
- [30] H Leemkuil, T Jong, R Hoog & N Christoph. "KM QUEST: A collaborative Internet-based simulation game". *Simulation and Gaming* vol 34 No 1, 2003
- [31] R Caillois, "Man, Play, and Games". New York: Schocken Books.1961
- [32] I S Mayer, S. Bockstael-Blok, W. and Valentin, C. "A Building Block Approach to Simulation: An Evaluation Using Containers Adrift", *Simulation & Gaming*, vol 35, pp 29-52. 2004

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