EGameDesign: Guidelines for Enjoyment and Knowledge Enhancement

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Abstract. We believe that an effective e-learning game can encourage the learners' enjoyment and catalyst their learning initiative, so as to cumulate their learning experience, and to improve their knowledge. However, challenges remain in terms of what tasks included and arranged in a "complexity'' game design for the knowledge level enhancement. Thus, this study presents the design guidelines based on the Freitas and Oliver four dimensions game-design evaluation framework and stressed the Bloom six levels of knowledge within the cognitive domain to interpret game tasks arrangement. These guidelines was applied to design a e-learning games VIEW (Virtual Investment Education World) which includes the investment tasks of virtual stock market, financial news, investment course, forum, and so on. By employed financial textbooks, the VIEW knowledge pool was built. In order to increase the complexity of the game, the embedded levels of knowledge were testified by some faculty iteratively.

Keywords: Web-based game, educational game design, Knowledge level.

1 Introduction

Web-based learning provides a new environment of learner-centred learning where has attracted instructors and developers to create and design electronic games for educational purposes [3]. However, there are two challenges in developing game-based learning materials for education. Firstly, the challenge of game needs to provide incentives for learners to accumulate their learning experience. The knowledge level enhancement has to be embedded in game task design. Secondly, compared to the leisured-based computer games, the development of skill-based educational gaming has one more challenge. In order to achieve the goal of knowledge enhancement, it must be a "complex" game [11]. Thus, the design of an educational game that is interesting enough for these "e-generation" of learners who have grown up with computer games to immerse themselves in [14] and frequently reflect upon is the main challenges in the field of e-learning [8].

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According to experience theory, game-based learning provides an enjoyment learning surrounding and is considered to be a possible solution to keep the learners' intension, so as to promote their knowledge level. Therefore, to develop game-based courseware, one must not only consider the process of how the teachers' constructed their curriculum, but also the learners' viewpoint on learning motives and flows. The main purpose of this study is to prompt useful guidelines of an effective educational game design, including the goal, style, task, and interface of the game that provides comprehensive considerations on design processes of Web-based educational games to motive the players' flows to enhance their knowledge.

2 Perspectives on a Web-Based "Complex" Educational Game

In the knowledge creation process, knowledge is accumulated through the learner's exposure to societal contexts. The learner internalizes the knowledge he or she obtained in the classroom through integrating the knowledge with his or her life experiences. Continuous stimulation from the learning environment will encourage knowledge growth. This results in a knowledge spiral shown in Figure 1 [10]. A Spiral curriculum is iterative revising and successive increasing the level of knowledge of the course material [7].

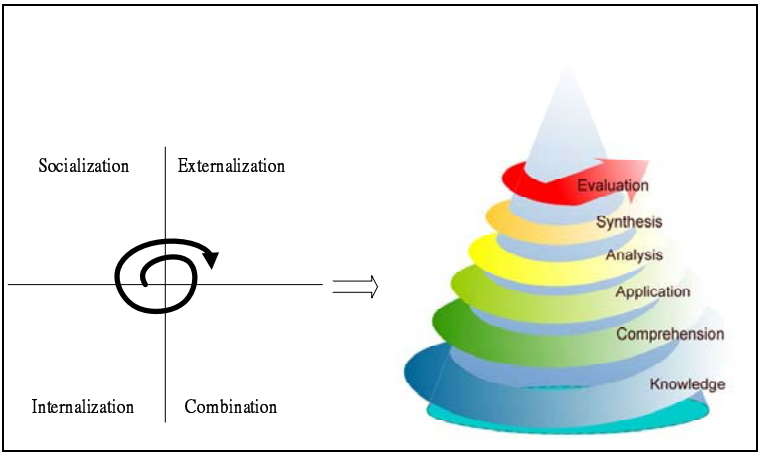

Fig. 1. Knowledge spiral and evolution

Games are deeply engaging, visually dynamic, rapidly paced, effective tools for exposing students to knowledge [11]. They more efficiently increase the players' experience than any other type of material because the interactive immersion component has already been strongly developed for the players [6]. However, a good game-based educational material design is very complicated work; it should take into account the interactions from three perspectives: (1) the Game goal and game style considerations in the particular context in which learning takes place; (2) the Game interface considerations for the characteristics of learners, (3) the internal representational task arrangement of the game [4]. We discuss these perspectives below:

2.1 Game Goal and Style Considerations in Web-Based Educational Games Design

Pedagogic considerations include curricula objectives, pedagogic approach, learning activities, and the corresponding learning outcomes [4]. Computer games should not only provide a learning-centered environment but also should have the correspondent goals to the curriculum [11]. According to experiential theory on game-based learning, learners construct the knowledge themselves by interacting with the environment. Any new Learning is a process of knowledge transfer from the previous learning. By the alternative game style designed, the learning process takes place naturally in the virtual world where players engage in the games. [12].

Table 1. The Knowledge level, knowledge content and the correspondent game styles

level	Knowledge taxonomy	Knowledge acquisition motion	Possible game styles
Low	Knowledge: Recall of specifics and universals.	Defines, describes, identifies, knows, labels, recalls, etc.	Game show competition, Flashcard type game, etc.
	Comprehension: Understand the meaning, translation, interpolation	Comprehends, converts, defends, distinguishes, estimates, etc.	Simulation game
	Application: Use of abstractions in particular and concrete situations.	Applies, changes, computes, constructs, demonstrates, discovers, etc.	Adventure games
	Analysis: Breakdown the breakdown of a communication into its constituent elements.	Analyzes, breaks down, compares, contrasts, deconstructs, differentiates, etc.	Role playing games, Detective games
	Synthesis: Put together of elements so as to form a whole	Categorizes, combines, compiles, composes, creates, devises, etc.	Strategy games
High	Evaluation: Make judgments about the value of ideas or materials.	concludes, contrasts, criticizes, critiques, defends, describes, iscriminates, etc.	No games suitable

Bloom identified six levels of knowledge within the cognitive domain, from the simple recall or recognition of facts, at the lowest level, to increasingly more complex and abstract mental levels, with the highest order classified as evaluation. The taxonomy provided a useful structure that the teachers would be able to apply appropriate strategies in their test questions [2]. In Table 1 we try to combine the possible games styles suggested by Prensky [11] with Bloom's taxonomy of knowledge.

The new learning style of young people today demands a quick and enjoyable approach to learning [11]. The "new vs. old" tensions are: twitch speed vs. conventional speed, parallel processing vs. linear, graphics first vs. text first, random access vs. step by step, connected vs. stand alone, active vs. passive, play vs. work, payoff vs. patience, fantasy vs. reality, and technology as friend vs. technology as foe [9]. Therefore, game

style design should match the preference of the e-generation of university students. They are considered to have sufficient skills and background to use the Internet as well as play digital games.

2.2 Game Interface Considerations for the Characteristics of Learners

Educational Games interface needs to provide an efficient and effective means for the learners to interact with the program just like other types of software. But, how to keep them"in play' as long and as deeply as possible is the main concern of the interface design. In another study, researchers used self-made online e learning game as an instrument along with 120 college students in an experiment. The study has shown that e-learning games help students to devote longer periods of time to their studies and to perceive more interesting [5].

Game players in Web-based learning can easily obtain physiological pleasure through animations, sounds and other stimuli provided by the multimedia. A framework of pleasure by the anthropologist Lionel Tiger consists of four types of pleasure that motivate usage: physiological, social, psychological and ideological [1]. Physiological pleasure is derived from the sensory organs. It consists of pleasure connected with touch, taste, and smell as well as feelings of sexual and sensual pleasure. Social pleasure is derived from the company of others, such as having a conversation or being part of a group. Psychological pleasure is gained from accomplishing a task. Ideological pleasure is derived from the user's perception of the importance of the task itself. Ideological pleasure is only experienced by students taking important courses that are perceived to be highly difficult [5]. The criterion of concentration implies that games should provide stimuli that quickly grab the players' attention and maintain their focus throughout the game [13]. Interfaces such as tutorials, online support, and feedback are important to a game's usability [13]. Players should be able to start playing the game without reading the user's manual. They should receive feedback on their progress toward their goals. Multimedia presentations encourage learners to engage in active learning by making mental connections between the story and structure of the problems. In accordance with the complexity of the game's storyline, the game can be labelled as well-structured or ill-structured. The importance of the storyline depends on the complexity of the game. Generally, the more complex the game is, the more important the storyline tends to be [8].

The main purpose of educational game is to enhance players' skills or knowledge. There are multiple paths in which to achieve the game goal and different learners have vary determination of what path is accurate in obtaining the goal. Therefore, in order to create immersion in an interactive environment we must make the user actually forget they are participating through a medium. Thus, the instructors who design the game with pedagogy should consider the players pleasure and their development community interfaces which are satisfied by the context of the online multimedia learning platform.

2.3 Internal Representational Task Arrangement of the Game

Fun relates to more than just the user interface of a game; it also relates directly to game play. Siang & Rao [12] suggested seven levels in a hierarchy needs that game players demonstrate. At the bottom level, players are seeking information to understand the

rules of game. Then they need to know how to gain control over the game. After that, they will expect more challenges (to meet esteem needs). The subsequent aesthetic need involves players demand for good graphics and visual effects, appropriate music, sound effects, and so forth. In game-playing, the aesthetic need is a higher ranking need than esteem needs. Therefore, a good game should be sufficiently challenging and match the player's skill levels [13]. Game players experience flow, or addiction to the game, only when the challenges offered match his/her skill [8]. The player performs the learning activities required by the games and focuses on playing in order to achieve the required learning outcomes [4].

In order to support knowledge enhancement, increase communication, and help the community development, the game tasks should enable to apply the Swan's interactions factors to enhance students' performance in the e-learning environment [12]. The key features on task arrangement based on the design instruction should include the functions are listed as follows:

(1) Database-driven materials: The knowledge-centred design indicated that the curriculum is only partially fixed and result from a negotiation process between the learners and instructional agents. The learners can store all their history records, so as they could browse, search and download them easily. They can start a new game based on their previous experience. Learners could share their task with others or interact with each other through online messages.

(2) Fully modularized user customerization management: The learners could choose and arrange the modules, such as to set criteria for group members, to send e-mails or messages, and to facilitate their learning.

(3) WWW supported: User-centred design meant that students controlled more of his/her learning process. Extracurricular resources on the internet could be easily linked into the teaching materials or text communications among colleagues.

(4) Flexible discussions forum arrangement: Community-centred design shows that technology can drastically alter the social structure of schools. The functions on the forums not only supported team collaboration, but also could secure team workspaces and private discussion.

(5) Multimedia supported: For sharing ideas or information efficiently amongst members, every tasks provide multimedia document views, such as graphical or video.

3 The Guidelines of the EGame Design

Since the steps of designing a useful educational game are too complicated to be explicated through a cognitive process, we listed the guidelines from these perspectives: (1) the Game goal and game style considerations in the particular context in which learning takes place; (2) the Game interface considerations for the characteristics of learners, (3) the internal representational task arrangement of the game, and are as follows:

(1) Game goal and game style considerations: The different knowledge level should have different game style design (Table1). For example, at the knowledge application level, the game style such as an adventure games could allow learners to acquisition knowledge by the action of applying, changing, computing, constructing, demonstrating,

and discovering, etc. At the knowledge analysis level, the detective games could provide learners an environment to analyze, break down, compare, contrast, so as to find the results progressively.

(2) Game interface considerations for the characteristics of learners: Tiger suggests four types of pleasure that motivate usage: physiological, social, psychological and ideological. All these elements of pleasure should be considered to the usability of interface, including the tutorials, online support, and feedback are important to learners' involvement.

(3) Game task arrangement: Database-driven materials, fully modularized user customerization management, WWW supported, flexible discussions forum arrangement, and multimedia supported are all the important components to arrange the game tasks.

4 Validating the Model: VIEW

In order to explain how the above guidelines is useful in developing of educational games, an prototype investment games VIEW(Virtual Investment Education World) which includes the investment tasks of virtual stock market, financial news, investment course, forum, and so on, were built. We illustrated the design detail parts and discuss its perspectives below:

4.1 Game Goal of VIEW

VIEW is a virtual stock investment simulation game. The novice learners get started to play investment, set their own goal progressively, and enhance their investment knowledge through "learning by doing". The goals of the game are:

(1) To acquisition knowledge progressively from previous learning experience.
(2) To have pleasure and immerse by the interactive game tasks arrangement.
(3) To control the game and improve the learning flow

4.2 Game Style, Task and Interface Design

VIEW provides a spiral investment game play. Learners could revise their learning topics, and their new investments are related to previous learning experience. As the level of difficulty increases, the learners can easily obtain eextracurricular resources, go to forum, or browse online information to enhance their knowledge and make the decisions. The logical design concept of VIEW knowledge level is shown as fig2.

At the knowledge level, learners could define, describe, identify from VIEW basic investment knowledge. At the comprehension level, the learner can go father study by system provided some cases study to let them comprehend, convert, and estimate. At application level, based on previous learning experience and knowledge accumulation, they can surf the Internet stock market information to change, to compute, and to construct their discoveries. At analysis level, official news and announcement can give learners to analyze, to break down, and compare more detail financial information of their portfolios. At synthesis level, they can change, combine, compile, or compose their knowledge form the experts in the professional forum. At evaluation level, learners make their invest strategy from all their alternatives.

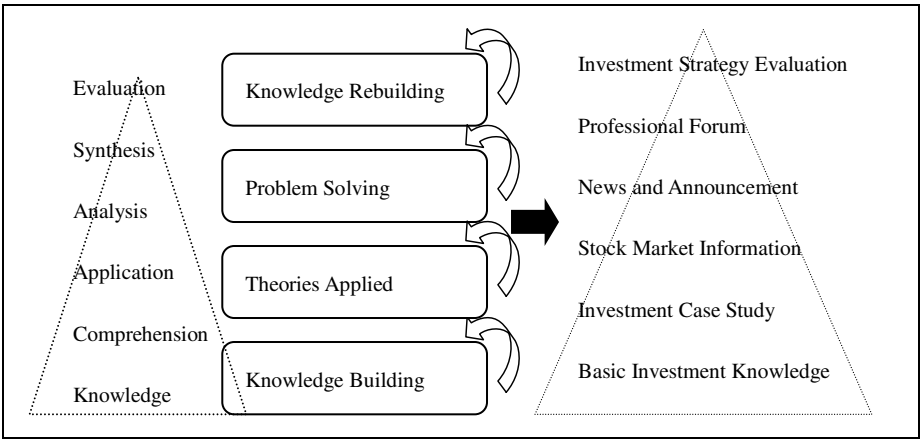

Fig. 2. Knowledge level of VIEW

4.3 Skill Enhancement Design

Pedagogic considerations focus on whether the curriculum goals are attainable by means of game goals, and whether the game style matches the Bloom's knowledge taxonomy level. The pedagogic method in the game designs in this study was the experiential theory mentioned in [4]. The earliest, initial learning process in computer games is behavioral learning. Players learn by trial and error as well as stimulus associations. When the basic knowledge are understood, learners start to think cognitively about how they should respond to a new situation and actively update existing knowledge to fit the new things they are confronted with in the game environment [12].

4.4 Challenge Design

The games create scenarios and provide challenges to invoke the learners' curiosity and keep them involved. Players immerse themselves in the game when the challenge provided by the game matches the skills they have [8]. VIEW simulates real stock market trade and provides different structured problems. The different levels of challenge are given to the players progressively. The players become anxious to search new knowledge for enhancing their skill to overcome the challenge.

4.5 Pleasure Design

The physiological pleasure comes from the graphics, sound, as well as the interaction with the systems. The psychological pleasure comes from positive feedback, such as score and/or applause. VIEW has included all the elements of satisfactions to encourage the player's engagement in playing.

4.6 Concentration Design

The context factors of VIEW involved in the design of educational games included the physical environment, equipment, technical support personnel, and so forth. The

level of concentration is determined by the stimuli and the workload the game provided. Storylines and activities are considered as the stimuli while heavy demands on the player's memory capacity are regarded as a high workload [13]. VIEW is considered to have the factors hampering players' concentration.

5 Conclusions

Designing a "complex" Web-based educational game is a complicated task. In order to enhance learner's knowledge level, the spiral curriculum must be included in game design. One must consider numerous factors such as "reinforcement" to remind the learners continuingly; the task arrangement should be "from simple to complex"; the "integration" of different knowledge and approaches is required; all the task arrangement has to be in "logical sequence"; allocating "higher level objectives" to enhance learners' knowledge progressively, and so on. Much effort exerted in the designing of educational games should also be targeted at achieving the curriculum goal through relevant learning theories, contexts and learners' characteristics.

The primary intention of this paper is to present design guidelines that make designing and evaluating Web-based educational games less complicated and more effective. These guidelines based on Bloom knowledge taxonomy stresses the importance of focusing on the purposes in each game design perspectives and their relationships to achieve of skill enhancement, challenge, concentration and pleasure.

An empirical study- VIEW (virtual investment Educational World) was conducted to validate these design guidelines. Curriculum goals can be reached using different game styles, game tasks and interfaces that produce separate results in terms of the players' perceived challenge, concentration, pleasure and developed skills. Empirical results of the guideline contribute to the "complex" game design could have easily solutions and detail suggestions. The players' levels of engagement are consistent with the expectation of their enhancing knowledge level to overcome the increasing challenge.

Due to the constraints imposed by the budget and the learning platform, there still remain some ambiguous phases on "complex" educational game design. Currently, leisure, social games are very popular online and could have multi-users play together. We expect that in the future, this paper's guidelines can be further illustrated into operational procedures to help instructors apply their EGame design.

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Appendix: VIEW System Structure