A Hierarchical Interface Design of a Puzzle Game for Elementary Education

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Abstract

A basic instinct of humans for perfect completion usually drives us happy. Basically, humans purchase a certain complete match for scattered facts. The satisfaction of completing the scattered pieces gives us great pleasure. Thus many people put in their time and effort in the puzzle, and they gain strong satisfaction. The paper solves the importance of the general effects of a puzzle in building the edu-game design. Legacy online education has following problems. First, educational effects became weaker than original text education since the physical guide for the study is absent. Second, students can lose interests in study since there are no interactions or dynamics like the real education atmosphere. An on-line game is growing up very fast through characters of the interactive computing and internet environment. In addition, an edu-game combining the advantages of the game and the education increase gradually. The paper proposes an edu-game system for providing knowledge through the hierarchical structure. The system differs from existing ones that combine a game and an on-line education. There are three different goals as follows. First, the paper proposes three levels of knowledge hierarchies. The method enables users to understand more easy and systematic and interesting education. Second, the graphic interface of a puzzle type is able to contact more conveniently and it provides beauties and functionalities. Third, among them, specifically the knowledge hierarchy is not forced to users and the method also can study in detail and users can enjoy systematically e-education by using the general type of a puzzle game.

Keywords: *Edu Game, Interface Design, Puzzle Game.*

1. Introduction

The paper concentrates on the effects of a puzzle in building the edu-game design. Legacy education has some problems. First, educational effects became weaker than the one of original text education since the directed teaching for the study is absent. Second, students can lose interests in study since there are no interactions or dynamics like the real education atmosphere.

To overcome the above problem, an edu-game formation has been popularly used in general[2]. The edu-game harmonically combines the 'fun' effect of a game and the 'learning' effect of education.

However, the edu-game typically puts weight on only combining the two formations of the game and the education. Simply combining two areas indicates a problem which does not focus on real educational effects since the balance of the weight is biased to the interest and

formation of the game whereas education focuses on logical consequences and knowledge acquisition for the given problems. Thus the paper presents the educational effects as main issues.

Especially, the online game lacks systematic consistency. The paper solves the problems in above and presents a new method. We call the method as "Stepwise edu-game". The game follows general learning phases, which guide users the top-down steps for understanding any target knowledge. The paper proposes a new educational mechanism and web interface design method to gain improved educational effects for specific knowledge.

The paper shows the following significant ideas. The paper proposes a new edu-game structured as three-hierarchical- steps, which are similar to the human thinking process. Thus, the method can enforce the knowledge to the user gracely with interests of games. The human interface of the method is organized as a form of a puzzle, which has various pieces. These can be easily accessed and arranged as a component among the puzzle pieces of scattered pictures. Besides, the paper applies human's desire purchasing perfectness to the edu-game in borrowing the game formation. The method expects a good result improving delivery effects for specific knowledge.

The structure of the paper is as follows in section 2, the paper explains the edu-game through a comparative analysis. In section 3, the paper explains the hierarchies of edu-game, in section 4, presents the design of the puzzled game interface. Lastly, in section 5, the effect of the paper and in section 6, the conclusive future direction for the research is thought upon respectively.

2. Related Work

The first phase deals with related researches that are similar with the one we propose and through the comparison we explain the distinct features of edu-game.

We describe edu-game resembles as follows. Feature of games that could be applied to address the increasing demand for high quality education are already identified[3]. Edu-game is a new term made from combining education and game. The word literally means that the user can enjoy the online game while acquiring various kinds of knowledge.

Edu-game is different from other online games in that it draws interest by making the contents of the game experience more detailed and fun[4]. Moreover, it creates the notion that education is a kind of a play which enforces the educational effects[5][6] and offers desires of accomplishment by setting goals for oneself[7][8].

Besides, originally puzzle games are made without computers. At present, digital puzzle games can be found on the web[1].

Puzzle games divides largely into the Jigsaw puzzle and Magic square. The gigsaw puzzle is a tiling puzzles in which players need to put discrete pieces together on a board to form a complete picture where each piece is interlocking with others[9]. The Magic square is a number square in which the sums in each row, column and diagonal line must be equal, and at the same time the number of each entry cannot be repeated[10].

The existing online games make users, normally among the range of elementary and middle school students, solve problems online through appropriate puzzle games offered by site managers. When the user completes puzzle games the scores are presented in interesting ways, thus providing an interesting learning method that enforces effective learning through fun learning. The paper covers each related research as well as the one on new systematic paradigm.

3. Stepwise Edu-game

The first phase explains the definition of the three levels Knowledge hierarchy and the second phase explains the control methods of the puzzle edu-game proposed in the paper.

3.1. Architecture of the Edu-game

The core proposal of the paper is the three-level knowledge hierarchy that is divided according to encyclopedia levels. The reason of this division is that it corresponds to the human thought process which understands the upper structure and then the next. This kind of knowledge acquisition process can inspire interest and enable systematic knowledge transmission.

There are three levels in the proposed architecture. The first level is a schema level. Schema, which is already defined in various studies, refers to the process that sorts or organizes general contents according to a certain format. Also, schema comprises a big portion of knowledge as it is based upon perceptions on human life experience.

The crown of this kind of knowledge is called the Skeleton level or the Schema level. In this game, schema level can be taken as the skeleton level which makes up the whole knowledge structure.

The second level is a instance level. Instance refers to the objects that belong to the same class among many. Instance level in this study means the level where all selectable objects are gathered. In Figure 1, there are many species of butterflies that are under the group insects and the attempt of gaming happens in order to explain these objects selectively.

The third level is a atomic level. Atomic level refers to the level where each atom is understood well enough to be combined into a new object. Atomic level in this game denotes a collection of games that have broken down the above instance level and have specifically and realistically realized it.

Here, we have defined the levels that comprise each hierarchy. In order to systematically deliver this hierarchical knowledge, the new notion of puzzle has been imported. Through the puzzle, attempts to acquire partial knowledge tend to shape into a holistic picture and at the same time detailed and systematic learning is possible through the introduction of an external factor, game, which is emphasized more than mere education.

3.2. Control Methods of the Game

The puzzle game proposed in the paper follows the form of an encyclopedia. While the existing educational games are ineffective in depth education due to unhelpful interface and focus on the mere combination of the game and the education, the puzzle game proposed in the paper has a hierarchical structure based on the encyclopedia and thus enables broad and systematic learning regardless of the age group.

The contents of the puzzle game suggested in the paper are consisted of a hierarchical structure as in Figure 1. The user can select the contents to be learnt at the beginning stage and this selection can be made in step approaches with down grade movements. Factors of same Instance level are positioned horizontally and each factor is comprised of sub Atomic level structures so that detailed and in-depth learning of each factor is feasible.

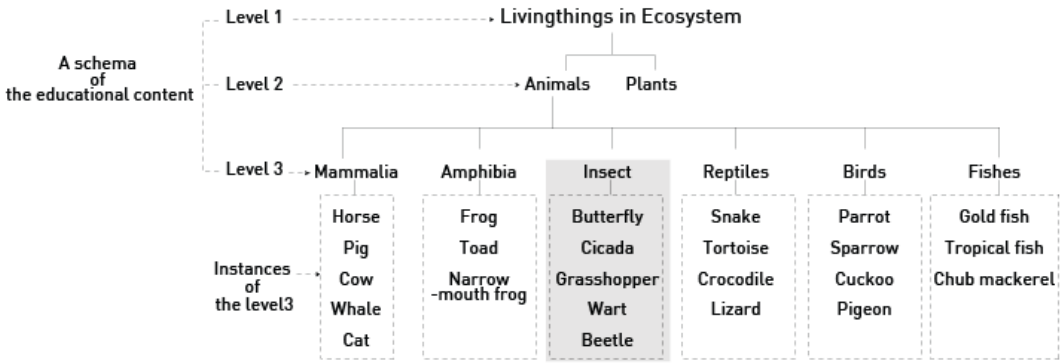

Figure 1. Selection of the Interface Layout

The selection of learning method is follows. The learning method can be described into two methods in our presentation and these are pre-learning after-game and pre-game after-learning. The former is a method where knowledge regarding the contents is acquired beforehand and the comprehension level is test and the contents are revised through quizzes, while the latter is a method where the user first plays a game to arouse interest in the parts that he does not know of and then studies those particular parts intensively. Users can select whichever method before starting the game.

3.3. Control Flow of the Game

This phase explains the method to start the game in order of precedence after logging in. The game is subject to changes in plan, thus the general structure of core contents is presented instead of the whole system.

The first goal of the game is to change the black and white puzzle board located in the center into a colorful board using the pieces around the board. Upon drag-and-drop of a piece in a specific location on the puzzle board, a transparent box appears asking a question about an object that belongs to the Atomic level chosen when opening the game room. When given the correct answer, the piece will turn colorful but when the wrong answer is given, the piece will bounce off the board, returning a different question each time of selection.

After completing the first goal, a screen appears and allows selection for another category depending on the option of the room. Moreover, the option of the room can be set so that there is a time limit for completing the puzzle and so when time is up, the game automatically ends and the user who has completed the most puzzles gets the highest points.

The layout moving between categories shows in Figure 2. Figure 2 indicates the interface screen where the moving steps between categories can be fixed. While the first game allows learning through objects that have been set by the captain of the room, games after that offer puzzles at atomic levels that suit personal standards of upper, lower and same levels, according to the options of the room.

There are two ways to complete the puzzle: explicit class display and implicit class display. Explicit class display as shown in Figure 2 is a way where users click the wanted level on the screen and implicit class display is a way that utilizes Tab keys and direction keys to move and select.

Figure 2. Layout Moving between Categories

4. Web Interface Design

This phase presents the interface design of the puzzle edu-game proposed in the paper. Figure 3 is the puzzle game interface. Center left part of the interface shows the avatars of users who are participating in the game by selecting the same factors and offers detailed information on participants and respective game process status of all users. This provokes competition for the user just like in a real learning environment.

Figure 3. Puzzle Game Interface

Shortcut icons are placed in the upper left corner and a mini map that contains the hierarchical structure of the educational contents comprising the whole game is located below to allow users convenient navigation. Below the mini map is brief information on personal information, learning levels, levels and scores of all participants in the game.

Figure 4. An Example of Solving a Problem

Figure 4 shows the process of solving the problem in a puzzle game interface. The user drag-and-drops a small piece from the edge of the screen to a particular spot on the board. Then quizzes enable learning of the particular contents. When the correct answer is given, the piece turns colorful. The learning and game of the particular contents is completed when the whole puzzle image turns from black and white into colors.

The chatting box situated in center bottom enables information exchange and boosts educational and communicational effects through conversations between users. Lastly, there is an 'invite' button in the bottom right corner to invite users in the waiting room into the learning space and the 'exit' button in the right closes the game.

5. Analysis

The first effect of the online puzzle interface is that it is a multiple game that allows simultaneous use of game and quiz. The feature attracts users who are only familiar with only one of the two.

The second effect is that the game is constructed according to the human thought process based on the 3-step architecture proposed in the paper. This enables systematic knowledge delivery mechanism through the hierarchy structure.

The third effect is that the proposed puzzle interface makes use of the strong points of existing puzzle games whose effects have been proved, in order to develop intelligence, prevent dementia, improve concentration and arouse interest.

The fourth effect is important in that by giving the impression that learning is another kind of play educational effect is enforced and users gain desires of accomplishment, in accordance to the intention of educational games.

This effect of the puzzle game fulfills the contents proposed in the paper. Along with these effects, the paper proposes the three-step game hierarchy structure adapted from the thought process and comprehension format of humans. The interface that emphasizes the aesthetics of the puzzle game is expected to offer various kinds of interesting educational effects.

6. Conclusion

The paper proposes a game that significantly enforces educational effects by grafting the existing puzzle game to online education. The proposed education method is comprised of a hierarchical knowledge transmission system in a three-level-architecture and is novel in that acquiring knowledge supposedly happens naturally through puzzle games.

This kind of education has merits as it supports detailed and systematic learning through a free and interesting environment under the basic human desire of accomplishment. In addition, an easy-to-use interface has been suggested to offer not only educational effects but functionality and beauty.

This research currently divides the contents of learning in the game according to Creatures and inanimate objects. But this composition will be able to expand systematic learning of various fields including geography, history, astrology, medicine, etc. Besides, combinations of different kinds of puzzles are expected to make edu-game even more interesting. Future of edu-game should focus on development that can be quantitatively proved.

References

[1] Owen W.S.Huang, Hercy N.H.Cheng, Tak-Wai Chan, "Number Jigsaw Puzzle: A Mathematical Puzzle Game for Facilitating Players's Problem-Solving Strategies," DIGITEL'07, 2007

[2] Mladjan Jovanovic, Dusan Starcevic, Velimir Stavlijanin, and Miroslav Minovic, "Surviving the Design of Educational Games:Borrowing from Motivation and Multimodal Interaction," HSI, 2008

[3] Federation of American Scientists, "R&D Challenges in Games for Learning," Tech. Rep., Washington D.C., 2006

[4] Saul D. Rodriguez, Irene Cheng and Anup Basu, "MULTIMEDIA GAMES FOR LEARNING AND TESTING PHYSICSI," ICME2007, pp1838,2007

[5] Fasli, M., Michalakopoulos, M., "Supporting Active Learning through Game-Like Exercises," pp.730-734, Fifth IEEE International Conference on Advanced LearningTechnologies (ICALT'05), 2005

[6] Gee, J. P.: Learning by design, "Good Video games as Learning machines," E–Learning, Vol.2, Number 1, 2005

[7] In-Kyu Choi, Eun-Jung Kim, "In the Study of Theoretical Formation Process of Edutainment," Proceedings of the Korea Multimedia Society, Vol.5, No.2, pp.1-8, 2002.

[8] Gómez-Martín, M. A., Gómez-Martín, P. P., González-Calero, "Game-Driven Intelligent Tutoring Systems," M. Rauterberg (ed.) ICEC 2004, LNCS 3166, pp. 108–113, 2004

[9] Jigsaw Puzzle. (n. d.). Retrieved October 1, 2006, from http://en.wikipedia.org/wiki/Jigsaw_puzzle

[10] Magic Square. (n. d.). Retrieved October 1, 2006 from http://en.wikipedia.org/wiki/Magic_square

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