End User configuration of game elements: Game construction as learning activity

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Abstract: End user configuration of game elements is analyzed here from two different perspectives a) as a type of end user involvement in computer game development and b) as a tool for learning. We describe the treasure hunt template as computer environment that supports students to construct their own computer based treasure hunt games by manipulating the basic elements of the game. An indicative analysis of the learning process during game construction suggested that game element configuration shaped a rich learning activity that challenged students not only to engage in spatial concept negotiation but also to consider issues related to game design.

Keywords: computer game development, learning, game elements

1. Introduction

In our attempt to understand and describe end user involvement in computer game development we begin by posing a set of indicative -but not exhaustive- questions that can help us outline the issue. Why involve end users in computer game development? What kind of involvement is desirable/ possible? Which tools can be considered appropriate? Are all end-users the same or there are special groups of end users? What is the context where game design is supposed to be integrated? As soon as we try to answer these questions we realize that there is more than one answer for each of them. This multi dimensional setting seems to be complicating the issue. But then again, close observation indicates that a set of responses to the above questions comprises a different facet of end user involvement in computer game development. Therefore, we will describe our contribution by attempting to respond to the above questions.

The work reported here focuses on computer game design and development as a learning activity thus the purpose of end user involvement is related to the learning dimensions of this activity (i.e. what kind of learning skills are required, what kind of learning can be supported etc). The end users are students and the context of integration of game design is formal education. Students' involvement with game development in our study is to do with configuring and manipulating game elements in order to produce different games of the same genre. This type of user involvement

is designed to support negotiation of specific concepts and is assumed to require a set of metacognitive skills. In our example the tools students used to construct their games were drop down menus, text editors and sliders. The tools were selected so they would be close to student experience with computers and easy to use.

2. Background

Many pedagogical studies, from early on, have stressed the importance of employing games to support the learning process (see for example [5]). The introduction of digital technologies in education triggered new studies on the use of computer games, this time, as learning tools. Interestingly, research in this area highlighted the learning potential not only of game play but also of game design and development [3] identifying in the latter the potential of supporting students to build a new relationship with knowledge [4].

Computer game construction as a learning activity has been analyzed from two perspectives. The first one focuses on studying learning related to programming or specific skills and concepts (see for example [2] for a discussion on children's causal reasoning and rule understanding during game construction). The second perspective acknowledges game design and development as a learning goal in itself [1]. In the same vein, an analysis of what is called "Design thinking" shows that it requires important learning and metacognitive skills such as system based thinking, self regulation, social, technical, technological, artistic and linguistic skills (for a detailed analysis see [6]).

3. End user configuration of game elements

In this section we present an approach to end user involvement in game construction and design through providing tools for what we call "configuration of game elements". The idea is to provide a game template (e.g. the basic structure of treasure hunt games) and functionalities that will allow end-users to manipulate basic elements (define values of parameters, select tools or views available to players, etc.) in order to design their own games. We describe here an example that was developed to engage secondary school students in negotiating concepts of navigation in space and orientation through game design and game construction.

The game template of our example is based on the structure of classic treasure hunt games, and consists of the terrain where the treasure hunt is supposed to take place, and of the elements of the game which are: a) the goal of the game, b) allocation of treasures in space, c) the directions to the players in order to find the treasures, d) the conditions of the game (what happens if…) and e) the tools (functionalities) that will be made available for game play. Next we will briefly present the main components of the game template in order to show how users are involved in game creation.

3.1. The terrain

The terrain consists of a 2D map, dynamically linked to the 3D representation of the area. The dynamic link between the map and the 3D representation means that objects (treasures and landmarks) placed on the map are also visible in the 3D representation (see the red and the yellow spot in fig .1). This is an important feature because game design takes place on the map whereas game play takes place on the 3D representation of space with the choice of using the map as an aid.

The terrain is a non modifiable part of the template. This was a choice related to technical issues rather than to design decisions, as it was difficult at the time to provide tools to the end users for changing the background of the map, building a corresponding 3D representation and establishing a dynamic link between the two representations.

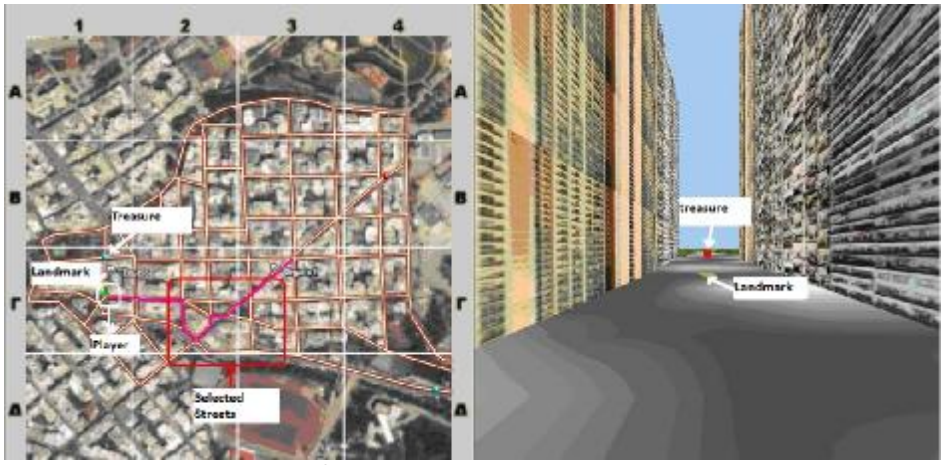

Fig. 1 The terrain of the treasure hunt template (2D map and 3D view)

3.2 Game elements

The treasure hunt template was designed in a way so that the elements of a treasure hunt game would be open for the users to manipulate using simple interaction components like drop down menus, sliders, setting of number values, direct manipulation and free text. The *goal of the game* is also set by the end user: they can play a game where the players would look for the hidden treasures, or a game where a the player is going after a thief or a game where the player is looking for the treasures and is trying to avoid or arrest a thief. After defining the goal of the game the designers should determine the *number of treasures* that will be placed on the map and what happens if the player meets the thief (see fig. 2). Three choices are available for the *player- thief encounter*: a) the player arrests the thief b) the thief takes the treasures the player has collected until then and c) the player takes the treasures that the thief may possess at the time of the encounter.

Each of the above choices for the player-thief encounter results in a different game.

In the first case the player is after the thief. In the second case the player should try to collect the treasures before the thief who moves randomly in the area and at the same time the player should try to avoid the thief. In the third case the player should be after the treasures but can also look for the thief who may also be in possession of treasures. So a complex script of action is defined through simple interaction elements. In addition, the user can define the speed of the thief's motion in relation to the player's speed by using a slider with values varying from 0 to 200% (i.e. if the cursor of the slider is in 50% then the thief moves with half the speed of the player).

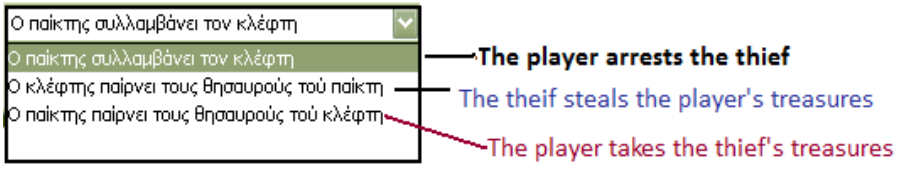

Fig. 2. The available actions for the player – thief encounter

The *treasures* are initially placed randomly on the map and the designer can move them with the mouse anywhere on the map. On each treasure the user can add, in the form of free text, directions – hints for finding the next treasure. This information is presented to the player on a free text area next to the terrain only when the player finds the treasure (i.e. info for finding treasure 3 is displayed only after the player finds treasure 2 etc).

Another game element is the definition of *dangerous streets*. The designer selects the streets he/she wants to mark as dangerous with the mouse (see fig. 1 the overlaid polygon lines) and then selects from a drop down menu the action that will be activated if the player enters the specific street. Three possible actions are available for the dangerous areas: a) the player looses half of the treasures collected, b) the player looses all the treasures collected and c) the speed of the motion of the player is reduced for a specific amount of time whereas the thief's speed remains the same. The user can define the possibility of the event activation using a slider with values ranging from 0 to 100%, (e.g. 73% chance for an event to be activated). Dangerous areas can be created around the treasures in order to make the game more difficult and spatial information about them can be provided through the treasure hints.

Finally the designers can decide which *navigation tool* will be available to the users as there is one tool based on absolute reference system (north, south etc) and a tool based on relative reference system (right-left, up-down). The users can make available one or both tools according to the directions they have included in the hints and the difficulty level of the game. They can also decide if they will make available during game play the 2D map along with the 3D view of the area.

To sum up, in this section we showed that end users (in our case students and teachers) can create a wide range of different treasure hunt games (varying in levels of difficulty, content, goals and tools for game play) through game templates that support the configuration of game elements. In the example we analyzed earlier, the configuration involved a) defining the variables of the game (i.e. number of treasures, goal of the game) b) defining the condition-action relationship between game elements (speed of thief in relation to speed of player, events in marked streets) and c)

defining the content of the game (hints for the treasures and the marked areas, landmarks on the map).

4. Learning Dimensions of end user involvement in game development

In this section we will refer to aspects of the learning process during student engagement in game construction through configuration of game elements. We will present and analyze two extracts of data that were collected during a case study with two groups of two fourteen year old students who worked with the treasure hunt template for two hours. The students created the game for the other group to play. Students S1- S2 and S3-S4 belong to group 1 and group 2 respectively.

S2: Now the quiz. What should we write for the first treasure?
S1:Go south
S2: Yeah, but it is not enough. All these are south (shows the streets at the bottom of the map. She said [the Facilitator] that the directions should be precise otherwise the game is not good. They will never find it.
S1: Ok then, there is a rectangular here. It is the only south rectangular [he refers to the shapes of the street on the map. (see Fig. 1)]
S2: That's good! Let's say "go to the southmost corner of the shouthmost rectangular
S1: They will find it immediately if you are so precise.
S2:Yeah, but they move on 3D not on the map.

Extract 1: Negotiation of spatial concepts

In the above extract students work on writing the directions that will lead to the first treasure. We observe an attempt for precision on spatial direction based on the researchers' prompt. Two things are of interest in this extract a) that students in their attempt to offer more precise information combine an absolute system of reference (southmost) with the properties of the map (shapes formed by streets on the map) and b) that S2 argues in defense of their choice based on the viewpoint of the 3D representation of space which is implied to be different from the one of the map.

S3: Let's make all these streets [around treasure 3] dangerous areas
S4: Yes! Oh, we left one out. Mark that one too.
S3: Now the treasure is protected by the bad guys, ha – ha!
S4: Ok, let's say what will happen if they [they mean the player] enter the street.
S3: Loose everything they have. Ok. Define. 100% possibility… Aha, I've got an idea! Let's do it around all the treasures [they mark the streets around treasure 1, and start marking streets in treasure 2] …
S4: You know what… this way they can't win
S3: Yes! That's the point.
S4: Yeah, but it is not a game if you play and you can't win

Extract 2: Reference to game mechanics

In the second extract students from group 2 add dangerous areas around treasure 3. The initial idea is to surround treasure 3 with dangerous areas so that players loose

with 100% probability everything they have. This idea is then generated as a game design principle which indicates that group 2 in a sense “plays against the players” [see final remark of S3]. This process seems to be triggering S4’s comment on winning as a desired characteristic of the game.

5. Final Remarks

In the work reported here we tried to present a facet of end user involvement in game development focusing on configuration of game elements as learning activity. This type of user involvement is based on a game template which is based on a game structure (in this case treasure hunt games) and includes intuitive tools that allow end users to manipulate the basic parts of this structure by defining variables, player tools, condition – action rules, and adding free text. An analysis of extracts of students discussion in the process showed that this game element configuration was a rich learning activity that challenged students not only to engage in spatial concept negotiation but also to consider issues related to game design.

6. Acknowledgements

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7. References

1. Hayes, E. R., Games, I. A. (2008) Making Computer Games and Design Thinking: A Review of Current Software and Strategies. *Games and Culture*, Vol. 3. pp. 309-332.
2. Hoyles, C., Noss, R.,; Adamson, R., Lowe, S. (2001) Programming rules: what do children understand? *Proc. of the 25th Annual Conference of the International Group for the Psychology of Mathematics.* Utrecht, The Netherlands : In M. van den Heuvel-Panhuizen.
3. Kafai, Y. B. (2006) Playing and making games for Learning: Instructionist and Constructionist Perspectives for Game Studies. *Games and Culture.* 1(1), pp. 36-40.
4. Kafai, Y. B. (1995)Computer Game Design as a Context for Children's Learning. s.l. : Erlbaum
5. Piaget, J. (1951).*Play, Dreams and Imitation in Childhood*. London: Heinemann
6. Salen, K. (2007) Gaming Literacies: A Game Design Study in Action. *Journal of Educational Multimedia and Hypermedia.*, Vol. 16, 3, pp. 301-322.