Design for Creative Activity: A Framework for Analyzing the Creative Potential of Computer Games

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Abstract. This paper describes a design framework intended to conceptually map the influence that game design has on the creative activity people engage in during gameplay. The framework builds on behavioral and verbal analysis of people playing puzzle games. The analysis was designed to better understand the extent to which gameplay activities within different games facilitate creative problem solving. We have used an expert review process to evaluate these games in terms of their game design elements and have taken a cognitive action approach to this process to investigate how particular elements produce the potential for creative activity. This paper proposes guidelines that build upon our understanding of the relationship between the creative processes that players undertake during a game and the components of the game that allow these processes to occur. These guidelines may be used in the game design process to better facilitate creative gameplay activity.

Keywords: Videogames, Creative gameplay, Behavioral analysis, Expert review,

1 Introduction

The research described in this paper examines the impact that the design of a game has on the potential for that game to engage players in creative activity. Creative thinking is an important aspect of problem solving and a valuable skill to acquire. While existing research demonstrates the effectiveness of some games in facilitating creativity [4], this study focuses on the impact that specific game elements (e.g., goals, actions) have on the creative problem solving processes that occur during gameplay. Assessing the creative potential of an experience requires a focus on how an individual responds to particular activities [9]. This research examines the activities provided within games though specific game elements and analyses how these activities may facilitate creative engagement. It identifies the key specific components of computer games that support creative activity. The outcome of the research is a set of guidelines that can aid game designers in the creation of games to facilitate people's creative thinking skills.

adfa, p. 1, 2011.

2 Background

Interactive experiences within a game environment allow people to express their creativity and intentions [15]. Research on creativity has resulted in multiple definitions, perspectives and models. For example, creativity has been defined to consist of at least four components: (1) the creative process, (2) the creative product, (3) the creative person, and (4) the creative situation [3]. It has also been grouped using four definitions: product, person, press (the "press" of the environment), and process [13]. Our research concentrates on the creative process and, more specifically, the thinking processes employed during creative activity. The creative process is the result of sustained and complex mental effort over time [13] and consists of a step-by-step sequence of mental activities.

To identify the potential of games to engage players in creative processes, criteria related to activity undertaken need to be clearly understood. While we understand that games have great potential to support creative processes [11], it is not clear how we go about designing for creative activity. We know that creative ideas result from the novel combination of ideas [14], that creativity involves a process of convergent and divergent thinking [2], and that critical thinking plays an important role [5]. To develop interactive experiences that incorporate these valuable, educative processes, we need a clearer understanding of how different game elements may be combined to produce creative potential.

3 A Creative Potential Game Design Model

The creative potential game design model is based on two distinct studies. The first study was designed to measure the creative processes that occur during gameplay [6]. The conceptual method that was employed to assess creativity examined the extent to which factors that have been identified as playing an important role in creative processes – task motivation, domain-relevant skills and creativity-relevant skills – are present within gaming experiences. A behavioral and verbal protocol method that has been used previously to measure creativity in structure building activities, collage making and poem writing [12] was employed during this research. The study involved participants being observed while playing the three selected puzzle games: Portal 2, Braid and I-Fluid (Portal 2 is played from a first-person perspective and involves solving puzzles via the placement of portals within the environment; Braid is a platform style game that involves solving puzzles by manipulating time; and I-Fluid is a game where the player controls a drop of water and attempts to solve physics based puzzles). They played each game for 15 minutes. To examine the creative process, participants were video recorded while playing the games and a video coding scheme was used to capture the type and frequency of observable behaviors and participant verbalizations.

The second study [7,8] examined specific elements of the three games used in study 1 to determine which of these elements are important in fostering creativity. A heuristic checklist forms the basis of this study and experts used the items in this

checklist to analyze each of the games. The items are structured into the categories identified as the key components of moment-to-moment gameplay. The three categories – identify goals, perform meaningful action and interpret outcome – map to a model of interaction that is based on cognitive processing. This model provides an important link between specific elements of games and creative problem solving activity. Fig. 1 provides an overview of the Creative Potential Game Design Model that links all of these concepts. To understand the interrelationship between gameplay and creative potential we have interpreted the results of the two studies that have been undertaken.

Fig. 1. Creative Potential Game Design Model

3.1 Analysis of the Play Experience

Our research has identified the extent to which each of the facilitating components of creative potential are present in each of puzzle games examined (Fig. 2). Results demonstrated that Portal 2 was best able to provide the task motivation and domain relevant skills necessary to engage in creative activity. Braid was the worst performer in both of these areas. Conversely, Braid was best able to provide the creativity relevant skills identified as important in creative processes and Portal 2 was least able to facilitate these skills. I-Fluid sat between Portal 2 and Braid for facilitating all three components.

Our more detailed analysis indicated that while the games were similar in many respects in relation to their ability to facilitate creative activity, there were areas where differences were evident (Fig. 3). Portal 2 was able to support task motivation through providing a greater number of tools to solve problems, offering more opportunities for players to use and freely manipulate a range of objects and providing options for players to playfully explore the world in their own time. Players had the time and

resources to plan their approach and refine solutions to problems. Braid and I-Fluid limited the number of actions available to players and there were fewer pathways available that would lead to success.

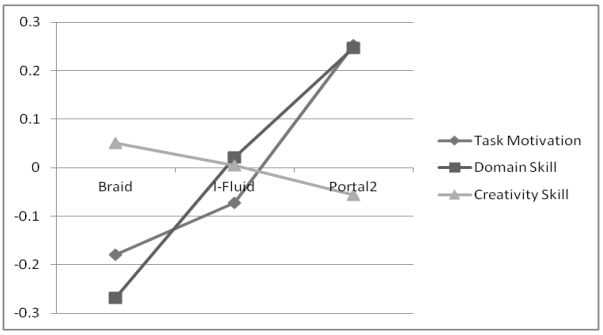

Fig. 2. Creative potential components for each game

A game's ability to facilitate domain-relevant skills centered on creating an environment that instilled confidence, providing clear pathways to complete tasks and ensuring that players understand the objectives they're trying to achieve. In the games that didn't perform as well on this component there were clearly times when players were uncertain about how the world would respond to their actions and how they could complete game objectives. Some of the challenges that arose for players related to difficulties working with objects and resources.

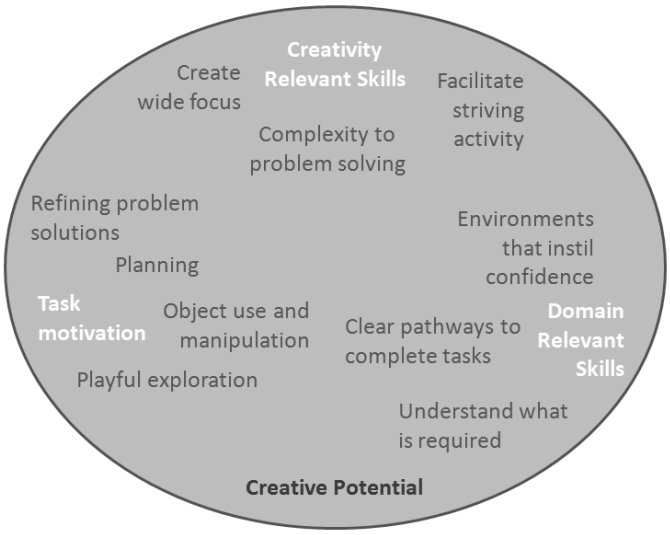

Fig. 3. Identified Means of Facilitating Creative Potential

From a creativity-relevant skills perspective our analysis indicates that overall frequency of players engaging in these types of activities were quite low. Areas identified as important in facilitating creativity-relevant skills included providing greater

opportunities for players to take a wide focus when engaging in gameplay. This may be achieved through allowing activity that is future-oriented, letting players work through problems that require more than one step and facilitating interactions that enable players to develop their own goals. Problem solving needs to involve a player striving to achieve an outcome through overcoming challenging obstacles.

A tension has been identified between providing an experience that encourages striving (creativity-relevant skills) and producing gameplay where the player finds it straight-forward to understand what they are required to do and how they might go about doing it (domain-relevant skills). It appears that the ideal conditions for creativity are achieved within challenging environments where objectives are clear and consequences for exploration are positive. Given the focus within puzzle games on logical and conceptual challenges, experiences where players are able to develop their own goals or sub-goals is limited. Design for creativity involves opening up rule-sets, broadening the ways goals might be achieved and providing opportunities for non-goal directed behavior.

3.2 Analysis of Gameplay

The player's experience of the game derives directly from their interaction with the game environment and it is this environment that we analyze to determine where differences in creative activity occur. We apply the Seven Stages of Action [10], which details the process of executing and evaluating actions to achieve a particular goal, to moment-to-moment gameplay activity. Gameplay consists of the challenges and actions that a game offers the player and central to the experience is how the player addresses these challenges to achieve game objectives [1]. The three key components of game activity – goals and challenges, action and interaction, and interpretation – can be mapped to Norman's seven stages of action. Expert analysis of Portal 2, I-Fluid and Braid provides insight into how each game provides challenges that players must address to achieve goals, the effectiveness of the actions and interactivity available, and the quality the feedback presented so that players can assess their progress [8].

To determine how the components of game activity influence creative potential we firstly examined the expert review of Portal 2. Given that Portal 2 performed well in the task motivation and domain-relevant skills categories for creative potential, it is useful to identify the game activity components in which it performed better than Braid and I-Fluid. Analysis demonstrated that Portal 2 most effectively provided mechanisms that allow the player to succeed at particular challenges. Expert review found that the game challenges effectively allowed for cognitive and logical thinking and strategic planning, that there were multiple types of challenges available that players could approach in their own way and at their own pace, the level of challenge was well matched to player skill level, and that narrative mechanisms guided challenges and supported progress towards goals. Portal 2 did well at offering players interesting options and choices, allowing the player to perform a range of actions to address a challenge and the story was particularly well integrated with the gameplay. The game actions provide a good sense of control over interactions and they allow

players to feel that they have a significant impact on the game world. The review found that the interface to Portal 2 was easiest to learn, use and master and that the game had good input control. In terms of feedback, analysis of results demonstrated that Portal 2 performed well at providing output that allowed the player to assess the state of gameplay at any given time. The feedback mechanisms provided positive reinforcement which enhanced free-choice and self-awareness.

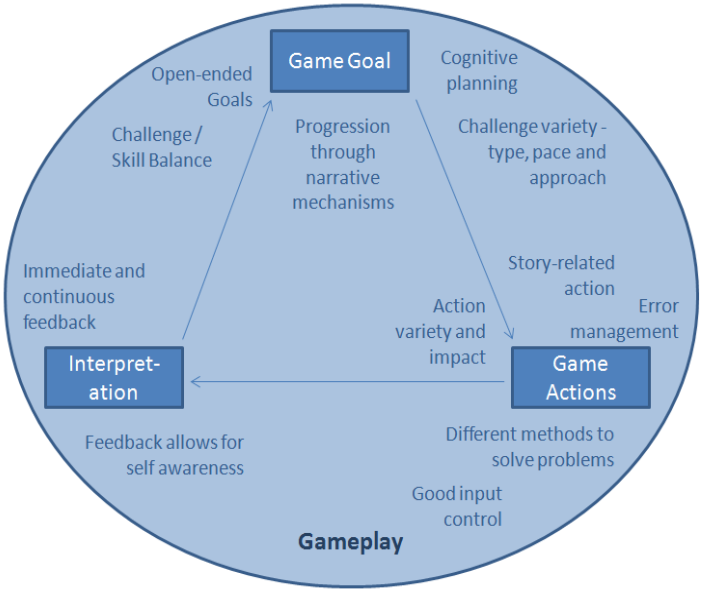

Fig. 4. Analysis of Game Activity Components for Creative Gameplay

Given that Braid performed slightly better than both I-Fluid and Portal 2 in terms of providing activities to support creativity-relevant skills, it is helpful to examine expert review data for its game activity components. Braid did well at supporting players in recovering from errors and at minimizing errors that are detrimental to gameplay. Compared to the other two games, Braid provides the most effective mechanisms for players to interpret the outcome of actions through mechanisms that give immediate and continuous feedback. Fig. 4 illustrates this analysis of game activity components and identifies areas of strength that may contribute to the ability of a game to facilitate creative activity.

4 Guidelines for Creating a Game with Creative Potential

As a first step towards producing guidelines that will aid in the development of games that facilitate creative problem solving, we have mapped game activity components (Fig. 4) to the mechanisms identified as facilitating creative potential (Fig. 3). These

prelimary guidelines are outlined below, with the creative component facilitated included in brackets:

- Ensure that the game includes open-ended goals that allow players to develop their own sub-goals (wide focus, playful exploration)
- Create narrative mechanisms that allow players to understand their progress towards achieving goals and that clearly link to choices in the game (understand what is required, clear pathways to complete tasks)
- Create challenges that require logical thinking and strategic planning (complexity in problem solving, planning, refining problem solutions)
- Ensure that there is variety in the type of challenges provided and that these challenges can be perceived and approached in different ways by players (wide focus, complexity in problem solving, facilitate striving activity, playful exploration, object use and manipulation, planning)
- Implement challenges that develop at an appropriate pace and match a player's skill level (facilitate striving activity, environments that instill confidence)
- Implement rules that offer freedom of choice, where players have options about actions to use to solve a problem (wide focus, object use and manipulation, planning)
- Ensure that player actions have an impact on and shape the game world (wide focus, object use and manipulation, playful exploration)
- Ensure that actions available to the player relate to the overarching story/setting of the game and that feedback makes sense within this context (understand what is required, clear pathways to complete tasks)
- Manage player errors by allowing support for recovery from errors and ensuring that the impact is minimal (facilitate striving activity, environments that instill confidence)
- Ensure that the player has a sense of control of interactions through creating a game interface that is easy to learn, use and master (environments that instill confidence)
- Provide mechanisms that allow players to receive immediate and continuous feedback on their actions (environments that instill confidence, understand what is required, clear pathways to complete tasks, refining problem solutions)
- Ensure that feedback provided to the player positively reinforces good choices and allows for free choice and self-awareness (facilitate striving activity, understand what is required, refining problem solutions)

5 Conclusion

In this paper we map the results of our analysis of players engaging in creative problem solving during puzzle game play to the expert review of the components of these games. We have used data to better understand how in-game activities influence a player's engagement in creative activity. We have developed preliminary guidelines that consider the specific ways we can align game goals and challenges, actions and interactivity and interpretation/feedback mechanisms to support creative problem

solving processes. Future work will investigate the applicability of the Creative Potential Game Design Model across different game genres. Furthermore, the guidelines produced will be applied and evaluated in the development of a game to support creative activity.

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