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# An Emerging Model of Creative Game-based Learning

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**Abstract.** We consider the integration of creative approaches to problem solving into pervasive games is a natural extension of play for creative thinking – one that can innovatively drive technology-led changes to the facilitation of creative thinking and pose a new genre in serious gaming for learning. This paper presents an initial proposal of a new model of creative game-based learning (CGBL), which emerged through mapping of established characteristics of climates that encourage creativity and innovation to characteristics of effective serious games.

**Keywords.** Creativity, serious games, game-based learning, model

## 1 Introduction

There is increasing evidence that utilizing games to train and educate has been effective [1, 14, 15, 20]. One consequence has been widespread gamification resulting in many different types of serious games [23], for example to train marine staff [2], treat cockroach phobia [3], overcome negative emotions [24], manage large-scale investment resources [12], rediscover cultural heritage [9] and help cancer patients make decisions about their health [16].

One consequence of this trend is not to make games that are better and more immersive versions of reality, but to make the world a better and more immersive reality [19]. Games can be explicitly designed to improve our quality of life by providing opportunities to solve problems and intervene in social situations, and studies have revealed positive effects such as the acquisition of skillsets among diverse user groups [19, 22]. However, at this time, we are unaware of much research that has sought to introduce techniques to encourage creative thinking explicitly to support such problem solving and social interventions in computer-based serious games. Therefore, we sought to investigate a new approach to the design of serious gaming experiences – Creative Game-based Learning (CGBL). The approach seeks to deliver creative serious games that will enhance creative problem solving skills in players with learning objectives in various professional environments that require flexibility, self-organization and curiosity.

Harteveld's [11] design philosophy treats a serious game as a multi-objective problem in which trade-offs need to be made in a space defined by play, meaning and reality that a player must trade-off during a game. Encouraging players to rethink these trade-offs in engaging, non-repeatable and self-regenerating ways has been shown to encourage collaborative creative problem solving in game play. Indeed, the complex strategies and behaviours that a player can demonstrate from a simple set of rules can enable effective learning, in contrast to games in which users simply play digitized versions of quizzes that do not lead to knowledge retention [16].

Of course, the rule sets that each game provides can still constrain creative thinking – perhaps the player generates a new idea or seeks to undertake a new behavior that the game's developer did not consider, and therefore cannot use or do. New rule generation appears to be an important characteristic of creative serious games – one that is shifting games from simulation to interaction in order to create new combinations of rules and pervasive environments. If creativity can be incorporated into serious games, then it can allow players not only to immerse themselves in stories that make things meaningful, but also to create their own stories, ideas and reflection spaces [4].

Play as a means of thinking creatively to generate outcomes that are both novel and useful has been recognized for many years. Indeed Katz [14] claims that games can support people to play with ideas, explore possibilities and break the usual patterns of thought, and established creativity techniques already have elements of play, suggesting an appreciation of play in creative problem solving.

We consider the integration of creative approaches to problem solving into pervasive games is a natural extension of play for creative thinking – one that can innovatively drive technology-led changes to the facilitation of creative thinking and pose a new genre in serious gaming for learning and reflection.

## **2 A Model of Creative Game-based Learning**

Several authors have developed descriptive models of user behavior during the play of serious games [10, 25, 26]. One such model from Garris et al. (2002) [7] reports that games should enable and allow the user to choose to enter them to accomplish a goal or overcome a problem, and introduce a model of user behavior accepted within the serious games research community. We selected this model as the baseline upon which to develop a new model of creative game-based learning (CGBL) by extending it with descriptions of goals and behavior associated with creative thinking.

The first stage in our development of the CGBL model was to analyze the characteristics of environments and climates common to both serious games and creative problem solving. We mapped established characteristics of climates that encourage creativity and innovation from the established Creative Problem Solving method [13] to characteristics of effective serious games reported in the serious games research literature discovered through selected keyword searches. The result was 6 characteristics shared by creative thinking and game play, each of which is summarized in turn.

## **2.1 Challenge**

In a creative climate, the overcoming of challenges can guide people to find joy and meaning in tasks, as well as inspire them to initiate more motivated involvement with their work. Likewise, in game play, a challenge is met when a learner “gets ample opportunity to operate within, but at the outer edge, of his or her resources, so that (...) things are felt as challenging but not ‘undoable’” [8].

## **2.2 Freedom**

In a creative climate, allowing and rewarding active learner control can directly influence the level of acquisition and sharing of information about the task, and subsequently new modes of methods emerge from the interaction. The concept of freedom in game play is closely related to personalization of navigating obstacles. If freedom is supported during play, “people genuinely feel they have something individual to them that they can shape” [5].

## **2.3 Trust and safety**

In a creative climate, trust is connected with openness and emotional safety in relationships – it assumes that people have respect for one another and give credit where it is due. Similarly, one reason that serious game play is recognized as an effective learning tool is because it provides a space in which to explore hypotheses and to fail safely [21]. Any consequences remain safely within the training setting, thereby encouraging greater risk-taking and debate to question ideas in a positive context.

## **2.4 Humor and playfulness**

This characteristic of a creative climate manifests itself through the spontaneity and ease of the people in it and the effect on their social, emotional and cognitive behavior in the climate. Likewise, humor has been used in game play for “smoothing and sustaining game mechanisms, enhancing communication, learning and social presence, making it richer and more fun” [6].

## **2.5 Idea support**

In a positive creative climate, new ideas are treated attentively and professionally. A similar level of support for ideas is needed in serious games, because ideas need to be preserved for the assessment of learning outcomes and to respond to the learner’s actions – “performance feedback should be presented in a way that minimizes the possibility of damage to one’s self-esteem” [18]. Idea support can also be linked to concepts of reward in creative climates.

## **2.6 Persistence**

In a supportive creative climate, there should be sufficient time available to people to generate and elaborate ideas over multiple sessions, i.e. their ideas need to persist in the space. This characteristic of persistence is also required in serious game play because "...with a persistent environment, when you go back in, it remembers where you were before: the assets and marks you created, your achievements; there is a kind of mirror image of the real world you can create for yourself" [5].

## **2.7 Other characteristics**

Not all the reported characteristics of creative climates could be mapped to the reported characteristics of serious games, which revealed both game characteristics to exclude from creative serious games and new opportunities to introduce new characteristics into serious games through explicit creativity support. For example, one oft-reported game characteristic is the need to foster conflict and competition between players or between the player and the game. However, conflict and competition are undesirable characteristics of a creative climate, and hence were excluded from our model.

## **2.8 The emerging CGBL model**

These common characteristics of creative environments and of serious games became the foundations of the new CGBL model, describing both the characteristics required of a serious game to encourage creative thinking and the user behavior needed to demonstrate creative thinking in game play. The purpose of the model will be to provide domain-independent guidance for the design of such games, and is being developed concurrently with iterative playtesting of prototype games that instantiate the model. In particular, the new CGBL model extends the original Garris [7] model with:

- A required set of characteristics common to creative climates and serious game environments that can impact positively on and support both the process of play and the outcomes from it;
- Clearer forms of implicit creativity support incorporated into the game's contents, environment and borders;
- The implementation of explicit creativity support that directly engages the player in the use of one or more creativity techniques during the process of play;
- A learning component within the process of play that differentiates serious from entertainment games;
- A distinction between what each player generates in the form of ideas from playing a serious game, more related to the game contents, and the longer-term learning outcomes related to the creative thinking and other skills learned from the game play;

- Explicit support for reflective learning after game play, as part of continuous learning from reflecting on past actions that individuals engage in to explore their experiences to form new understandings [4].

A player's experience with a creative serious game that is an instance of CGBL model is divided into 2 basic activities – exercising judgment during game play, then – reflecting to learn after game play. Game play takes place in an environment that encourages and supports humor, idea support, trust and safety, persistence, freedom and playfulness. The game's content and environment are designed to encourage players to undertake certain types of creative thinking throughout the play process, for example to overcome challenges, but without the use of explicit tools and techniques for creative thinking. In contrast, explicit support for creative thinking is introduced periodically during the play process in order to train and support the players to think creatively in certain sub-processes using creativity techniques. In each discrete period of creative thinking, idea generation is followed with one or more periods of reflection about these new ideas to support idea learning and hence the persistence of these ideas.

### **3 Future Work**

We plan that future versions of the descriptive model will be developed using iterative playtesting of prototype serious games that instantiate selected elements of the model and answer research questions, for example how characteristics such as challenge and humor impact on creative thinking during play and subsequent reflection about that creative thinking.

If the synergy between creativity facilitation and gaming environments proves to be complementary, then their mutual extension, theoretically introduced by CGBL model, could guide development of innovative software systems, elevating both motivated learning and creative outcomes in the general practice of HCI. New instances of creative serious games could be made for various application domains, by replication of the developed approach.

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