A DESIGN MODEL FOR EFFECTIVE SERIOUS GAMES

James Baker
University of Southampton
Southampton, UK

Ashok Ranchhod
Winchester School of Art
Winchester, UK

Gary Wills
University of Southampton
Southampton, UK

ABSTRACT

Many theories have arisen about how to design serious games, but the ideas presented are often disparate, or miss important aspects arisen in others, making further advancement in the field more difficult. To solve this problem, a model is proposed in this paper to help design more effective serious games. The model integrates key characteristics of learning, gameplay, and serious game theories to outline the key considerations in compelling educational gameplay.

KEYWORDS

Serious games, education, gameplay, narrative, multiplayer

1. INTRODUCTION

As the popularity of computer games has grown, many companies and researchers have been interested in the potential of games in non-entertainment fields: this led to the creation of non-entertainment "serious games". (Harteveld, et al., 2007) (Squire, 2006). In particular, educators and researchers alike have shown great interest in serious games for education; when constructed well, these games can provide more engaging, progressive learning experiences and provide a greater understanding of the subject area than traditional textbook learning can. (Squire, 2006). Unfortunately, creating games that offer these benefits is not a trivial task. Creating an educational serious game requires more than simply taking an existing game and awkwardly integrating pedagogical content on top of it. Likewise, serious games are not equivalent to simulations, and require more subtle considerations for how to make its gameplay both entertaining and relevant. Several theories have attempted to clarify how learning with serious games occurs, but they are relatively diffuse, and lack a clear unification of ideas.

This paper proposes a potential unifying theory for designing effective serious games. To this end, recurring themes from learning theories and serious game theories (as well as some serious game implementations) were explored, and combined in a model that elaborates the most important design considerations.

2. EFFECTIVE SERIOUS GAMES MODEL

In order to clearly outline the key factors contributing to effective serious games, an Effective Serious Games model was created (represented diagrammatically in Figure 1). The model is intended to represent a clear unification and expression of crucial learning and gameplay components for serious games.

2.1 FLOW

Engaging players in a 'flow' state is critical for any game, serious or not, since it is fundamental to keeping player attention on the game. 'Flow' in games is the active, exclusive concentration on a particular activity, which the player is feeling positive and playful in (Chaisriya, 2012). When they end this flow state voluntarily, the players reflect on their flow experiences, and how they have been affected by them.

One important aspect of this is also important to tune a game's difficulty to the skill level of the player. If the game obstacles are too easy, the player loses interest; if they are too hard, the player becomes frustrated (Chaisriya, 2012). In terms of serious games, this can be applied both to gameplay elements and educational content.

Serious game should also have a clear focus on the intended learning outcomes (ILOs) that it is trying to convey (Gunter, et al., 2006), or risk its pedagogical content being overshadowed, and the serious game rendered pointless. To this end, there should not be sections of gameplay that contribute nothing to the player's understanding. Developers must also ensure that the game rules they establish are consistent throughout the game, and based on a logic that is clear to the player. In addition, it is important for a serious game (like any game) to ensure its gameplay components mesh well together, without any element seeming too disparate from the rest (Harteveld, et al., 2007). Gameplay should also involve some progression in ability and 'steps' or 'awards' on completion of certain learning goals, which will help the flow to continue.

To further supplement immersion, the player's control and customisation over their in-game character (avatar) is highly important. Having an avatar to personalise gives the player a greater emotional investment in the game, acting as a surrogate for the player in the virtual environment. Furthermore, it involves the player more in collaborative play, as their skills may make them a desirable part of a group, to performing a particular role (Dickey, 2007). Having a virtual avatar also gives a sense of anonymity, and thereby security, to the player. The central consideration is how much control the player is allowed to give, ranging from the avatar being a completely blank slate to be built upon, or imbuing the avatar with certain fixed elements (e.g. character backstory).

2.2 KNOWLEDGE-BUILDING

For an educational serious game to be effective, it must provide facilities to teach a particular subject. While this does involve conveying the ILO content, the key contribution serious games can make is reinforcing the content to ensure the players understand and retain the knowledge. These reinforcement techniques are categorised as 'knowledge-building'.

In any kind of learning, there need to be opportunities for the learner to reflect on the newly taught knowledge. This is in order for them to form their own conclusions and understanding about the presented material. Reflection is consequentially a crucial component of many learning theories, as well as serious game theories. It is important that this reflection on knowledge occurs frequently as feedback is received, as this allows continuous understanding of the new material (Barab, et al., 2010)

In addition, while serious games do not have to obey real-world conventions, they do need to demonstrate how the ILOs can be applied in real-world situations. Merrill's First Principles of Instruction (Merrill, 2002) emphasise the importance of this, as it allows the content to be made relevant and important for the learner, and thus more likely to be taken seriously and retained.

One of gaming's great appeals is their ability to encapsulate ideas and processes in a fantasy environment, removed from reality. This makes the experience more engaging for the senses, allows ILOs to be presented from fresh perspectives, as well as providing a 'safe space' to experiment in (Garris, et al., 2002).

However, to maintain a player's interest, developers of serious games cannot arbitrarily apply a game genre to a particular ILO and expect their game to be effective. For instance, in the development of serious game *Immune Attack*, the idea of using the First-Person Shooter genre (while popular) was vetoed as it did not suit the concepts being conveyed (Kelly, et al., 2007). To create an effective serious game, it must be ensured that the gameplay elements included are well suited to the ILOs that are to be conveyed.

In both playing games and learning, providing feedback is necessary to assist the learner's understanding. For serious games, this would involve providing positive and (as appropriate) negative feedback depending on whether the learner understands particular ILOs. This is a key component of Laurillard's conversational framework (Laurillard, 2002), as well as in serious game theories and general theories of game motivation.

2.3 NARRATIVE

While not all games require narratives, for games that encourage active learning of ideas (such as serious games), narratives help give players focus and motivation to see the game through to its conclusion. Narratives in games generally come in two forms: **embedded** (predetermined progression and characters, with some player influence) or **emergent** (based predominantly on the player's actions in the game world) (Jenkins, 2004). Embedded narratives seem well suited to games requiring more focused overall objectives, while emergent narratives seem better suited to game worlds that encourage more exploration.

In either approach, having clear indications of objectives, whether overall or immediate, helps give context and purpose to the tasks the player must perform to proceed. As a result, the game activities feel less arbitrary and more engaging for the player. Furthermore, having a source of conflict gives more interest to the narrative, giving the player more impetus to continue. Conflict in this case refers to an antagonistic figure or force, not necessarily characterised by violence. (Qin, et al., 2009)

It is also important to maintain uncertainty and flexibility in the narrative. If the player is able to predict exactly how a game narrative will progress with each play-through, there is little impetus for the player to return to the game, and thus the game cannot effectively reinforce its information. (Harteveld, et al., 2007)

The game's narrative should also foster curiosity, particularly in serious games. In doing so, the player gains more immediate satisfaction from exploring the game's world and will be more attentive as a result. Both novelty (**perceptual**) and problem-solving (**epistemic**) curiosity must be considered. (Dickey, 2011)

A narrative is only effective as long as it keeps a person's interest and attention. To that end, serious game narratives need to be consistent and coherent with respect to its story and its gameplay. For instance, the progression of the story needs to make sense with respect to its presented world and characters, and its presented themes need to be consistent throughout. (Hargood, et al., 2011)

2.4 EXPLORATION

Many learning and serious games theories agree that providing an open, flexible environment is highly important, in order for learners to test their understanding. The components of consequentiality and boundaries are thus highly important considerations for the development of serious games.

The quality that makes open environments desirable for learning is in experimentation. Players can interact with these environments in certain ways, and be able to observe the consequences of these actions. In this way, it is easier for the players to grasp how concepts and processes work; in addition, when combined with the game's narrative, the player feels more compelled to get their understanding right to produce the best possible result. Consequential game worlds are the basis of Barab's 'transformational play' theory (Barab, et al., 2010), and a key component of certain serious games e.g. (Harteveld, et al., 2007).

Open serious game environments require certain restrictions to make sure the players stay attentive to the learning objectives (Dickey, 2011). With this in mind, one important consideration is how far player exploration should be focused (Yusoff, et al., 2009), or indeed whether an open environment is appropriate for the ILOs that the developers wish to convey.

2.5 MULTIPLAYER

Including multiplayer gameplay aspects to serious games can be very useful for conveying certain types of ILOs, particularly if they are inherently linked to group work. Furthermore, the discussion and theory-sharing between players (mirroring the "reflection" aspect of learning theories) helps to clarify subjects for them, and in turn deepen their understanding (Stahl, 2000).

Collaboration occurs when a group of people have some common goal; multiplayer serious games therefore need to provide motivations that appeal to groups of players. These refer not only to the task objectives, but also to the self-actualisation goals of each group member, such as increasing their social status. Furthermore, it is necessary for multiplayer collaborative games to provide tasks that cannot be completed alone; otherwise players would find the idea of collaborating pointless. One potential motivator for collaboration is resource sharing, where a collaborative group has a set of resources that are vital to completing the game task, and can be given, exchanged and used by group members. This in turn encourages interaction and cooperation between group members. (Wendel, et al., 2012)

The capacity for inter-player discussions, such as through forums and instant messaging, are deemed core for the educational value of multiplayer online games. Through these, players can build up a collective knowledge of the game world, and are encouraged to explore theories about its nature scientifically, which deepens player engagement in the world. It also allows for further reflective opportunities, since discussing the pedagogical components allows for a more refined understanding of the new knowledge presented (Stahl, 2000).
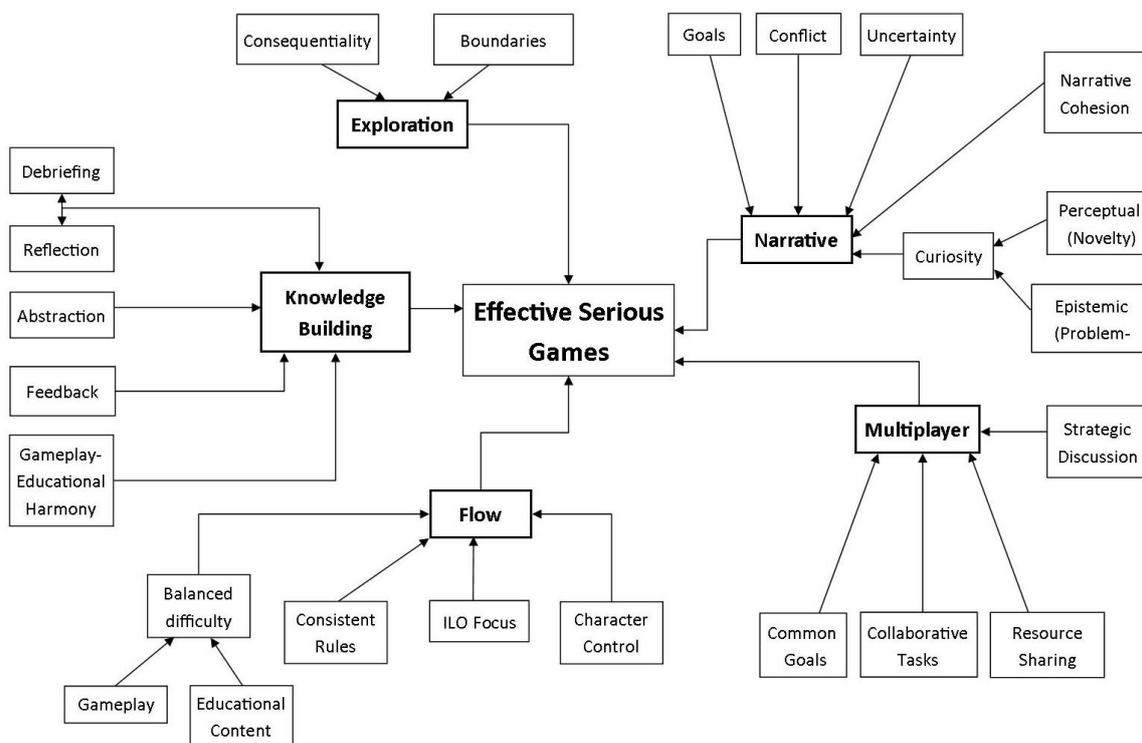

Figure 1. Effective Serious Games Model

3.   CONCLUSION AND FUTURE WORK

Research into serious games has provided a range of important design considerations for making games compelling and educational, but they lack a clear theory which unifies all these ideas. In this paper, an Effective Serious Game model was proposed to attempt to unify these ideas, in order to clearly demonstrate the design challenges surrounding serious games. By doing so, this model can provide a foundation for developing serious games in future. Following this report, it is intended to validate this model by conducting surveys on serious games experts and game players regarding the model's contents and connections. With this information, the model will be refactored and refined to provide as accurate a representation as possible.

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