Serious Game Design:

Balancing Cognitive and Affective Engagement

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A Brief History

The relatively new focus on serious games is relatively old. By this I mean that we have been working with student engagement through a variety of mediums since the early 1930's and games have been considered a viable option from the beginning.

John Dewey looked at the current "industrialization" of education methodology in the 30's and realized that, just as we are driven now by NCLB minimum level standardization of education, the focused engagement of the student and integration of art forms into the curriculum was producing students who were less critical thinkers, and were also less "expressive" as students who previously had been exposed to a broader range of studies in the humanities. He then proposed an increase in broader experiential education that included much more interaction with the current environment for learning. This experiential education was defined at the time in much the same way as we now justify the need for our students to be immersed in the experience of games.

Edgar Dale begin recognizing board games, and role playing games as critical opportunities for engaging learning environments in the 40's and this approach has been current in Instructional Systems Literature ever since. Abt, Greenblat & Duke, Crawford, and Thatcher began a line of critical analysis of games from informal to formal games that began the first directly targeted literature on Serious Games. They also became some of the first to address the current issues of the differences between fun and learning, which is a topic still unclear in the literature today.

Csikszentmihalyi entered the fray when he posited the experiential introspective analysis of flow. With this definition now on the table, game critics, developers, and players then had their goal to achieve, which was the total immersion into a game. Developers wanted to now create games that elicited such immersion as, and just as an addicted person wants a fix, the search for a game experience where one could enter "flow", was begun. The confusion in a serious game is whether or not this flow is synonymous with engagement in learning or just deep concentration on game play and fun.

With the advent of video games in the late 70's that offered immersive functionality, there became more of a focus on how an educator could utilized this new medium format for the purposes of educating students both in the public and private sectors. Petranek, Thiagarijan, and Savery and Duffy began tying a variety of epistemologies to engaging problem-based scenarios. These scenarios were defined along a wide continuum of face to face small group

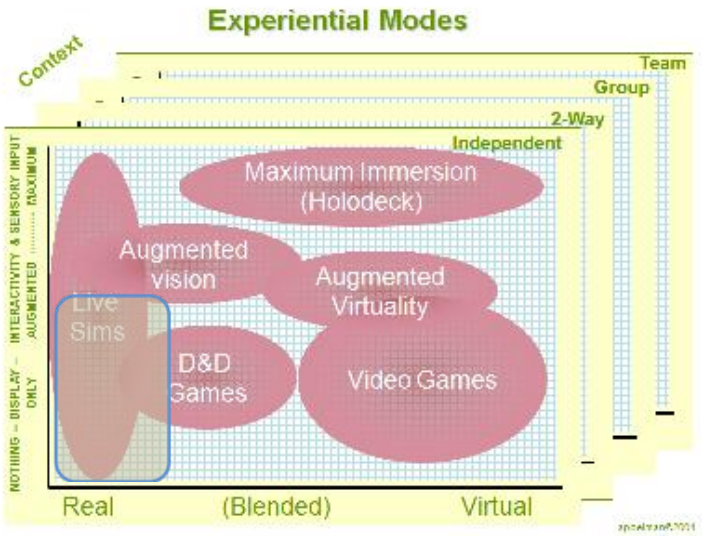
activities and extended into deep experiential learning environments. This new focus of teaching methodology allowed for the use of games as a viable path to provide the experiences that could possibly satisfy the requirements for high functionality and manipulation of the critical variables for learning, as well as being based on challenges presented to the learner. Even with these extensive efforts, to date there are very few examples that demonstrate the level of control in methodology that is comparable to the levels achievable by a live instructor in a face to face context.

Appelman and Goldsworthy, Salen & Zimmerman, and Wilson have all contributed to "calling the question" on the serious game effort to establish norms and procedures that seek to create methodologies assisting in the development of serious games. Because of the complex variables and intensely deep and complex technical decisions necessary in this medium, there is a desperate need to blend the efforts of the instructional designer and the artistic game developer. The goal of bringing these two expertise together is directed towards a goal of games that are equally strong in game play as they are in manipulation of learning variables within the game. This effort is often compared to mixing oil and vinegar, but there are enough examples of collaborations that have moved along the path of creating serious games that the latter metaphor can be viewed as a possibility, but not a necessity. Appelman points out that engagement of the player is the common point of crossover in goals for both the game developer and the instructional designer. With engagement as the focus, the need is more on the definition of engagement from both perspectives

A Focus on Engagement with the Environment

The definition of engagement must have elements of a learner/player experience as variables to manipulate, and these would most necessarily come from cognitive, perceptive, haptic, kinetic, and the affective domains of human experience. Also necessary are standard identifications of the physical and virtual elements that the learner/player is encountering at any given moment that they can be said to be experiencing. At its most basic level, Appelman compares levels of human sensory perception against degrees of virtuality, thus allowing the comparison of current common genres of real and virtual environments (Fig. 1). Such a comparison allows for any learning environment from classroom instruction that is normally limited to audio and visual perception of real elements and minimum virtuality of images and video, to experiences involving full sensory immersion such as flight simulators and theme park rides such as Spiderman at Universal Studios. For Star Trek fans, the Holodeck is the obvious ideal virtual environment for learning, where the AI has ultimate control of what is available to perceive at a maximum level.

Figure 1



Also indicated on this representation of Experiential Modes is a boundary placed around the most common learning environments used today. These all can be described in the bottom left of the figure since there is normally mostly audio presentation with minimal visual support in teaching practice today. This conclusion is presented not so much as a complaint, but as an acknowledgement that if we have been able to achieve the levels of learning just using these minimal tools, it is unimaginable what the potential for learning would be if we utilized the full spectrum of game and simulation tools as well.

The virtual environments of serious games to date are largely ether representations of concrete board games, or visual imagery that have limited functionality. The interface functionality of most "learning games" designed for youth is normally executed by clicking key elements for identification of what they are, or to click on an object to actuate a wide variety of animations. Adding "Drag-and-drop" interfaces as well as some 3D VR perspective tools are gradually appearing on the scene, but these interfaces normally are coupled to minimal content manipulation, such as selecting a number or just "looking around" an environment (Madeline, Oz, Albert, Carmen San Diago). One needs to see corporate and military training tools that are now being produced in fully robust game engines that allow the user a multiplicity of functionality to both fully experience their virtual environment and also to interact with it in a more realistic manner (Virtual Heroes: America's Army, Adaptive Leadership Training).

Serious Games require Serious Learners

It has been said by many that once instruction is placed into a game it no longer becomes fun to play. Although I take issue with this statement as being a factual one, I do recognize that our history of creating immersive games that can produce purposeful learning are notably boring. I also have seen the same content presented in a lecture mode in both engaging and boring fashion, so the art of designing engaging games that produce purposeful learning perhaps have not been made yet. Also, note that I did not say "fun" but as mentioned above, the focus needs to be on engagement with the serious game and not just how fun it is to play. A metaphor that illustrates this difference resides in the differences in expectation and focus of a student while on the playground at recess, or in the classroom of a learning context. If one were to stop a child from swinging on a playground swing and suggest that they could learn a great deal of physics and math by calculating how their swinging motion represents a pendulum scribing an arc of a circle, they would laugh at the suggestion that it was even appropriate to consider working at thinking in such a context. However if I were to construct a pendulum from the ceiling in a science lab and let them swing it for the purposes of understanding pendulum motion and the calculations involved for predicting its outcome, it would not only be accepted, but students might even comment that this class session was certainly engaging, and maybe even fun. This metaphor suggests that not only must the serious game be constructed differently and based on learning outcomes, but that the learners themselves must approach the game with an intent to learn in a hopefully engaging manner. Serious games will, by nature, have a higher content density along with a requirement that the content itself must be more authentic. Such demands limit any game or simulation's use such that it only is engaging when both the appropriate context and user's learning needs match. Such limitations severely limit marketing demands, and thus can not be the model that drives the design and creation of a serious game.

No Engagement – No Learning

I believe that it is not a stretch to say that if there is no engagement, then there will be no learning outcomes as well. The same could be said for having fun in a game as well, but if fun is the only goal, it is possible to have less deep engagement with the content, and enjoy mostly the interface manipulations. For instance, it is fun to just follow a good player in "observer mode" in Call of Duty without the added goal of understanding the strategy that that "good player" is using. The latter takes considerable more cognitive effort and even trial and error practice in an actual "play mode" to fully learn these strategies, but from a game play observation status it is difficult to tell how the player is processing the experience. This is why research into Game Play Analysis must include not only quantitative observation measures, but also qualitative reflections from the players themselves.

Toward a Definition of a Serious Game

There are three elements that must be in place for a serious game to be effective and even be able to be called a serious game. These critical elements are Serious Content, Serious Outcomes, and Serious Players, and can be outlined as follows:

Serious Content:

1. The content density may exist either inside or outside of the game
2. There will be more content in a serious game than in a game designed just for play
3. Manipulation of content within the game is critical and a central focus for learning
4. In the case of a *Simulation* the reflection on decisions made within the sim are the key focus of the learning
5. Authenticity of TARGET content within the game will have real-world application, and/or will be true to real-world action

Serious Outcomes:

1. In a Serious Game there is an expectation that people will be different after the game play experience
2. This difference will be manifested as having new/different concepts, understandings, skills, attitudes, and/or beliefs

Serious Players:

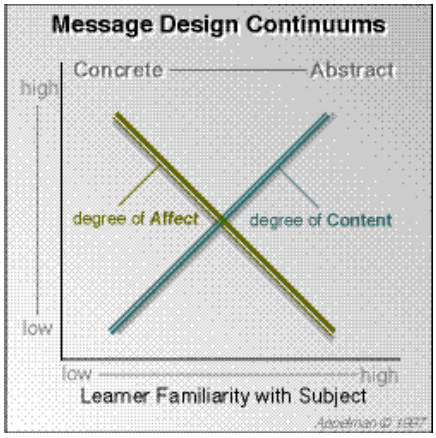
1. The context for why the player is playing the game or sim is motivated by curiosity, a desire to understand, and/or a desire to learn and acquire new skills.
2. The player entry level with the content and target skill acquisition must be quantified to assure appropriate match with the specific learning goals of the game/sim
3. Pre-game player motivation to achieve personal, social, contextual, and entertainment goals must match the learning environment's ability to meet these goals.

Both the professional game designer and the professional educator can predict outcomes of the engagement with the environments they create. In the case of the game designer, a specific level of fun and engagement is not only necessary for their game, it is essential to their livelihood that it be that way in order to sell, thus recovering the costs of development. In the case of the educator, the use of a game as an intervention for training or classroom contexts that is to bring a student to a specific level of learning should also be predictable, and is critical not only to the educator, but most often to the student.

Introducing Message Design into Serious Game Design

At the heart of the play/learning debate is achieving the appropriate balance between the affective and content components of the game. Appelman posits that to adequately manage this balance, one must quantify both the degree of content density in the game environment as well as the content understanding of the player. The interaction between these two quantities is embedded in Message Design Continuums as illustrated below (Figure 2).

Figure 2



Following the assumption that within a serious game there is authentic content and objectives that are to lead to serious outcomes, the discipline of message design is appropriate, albeit a new path for game analysis, to employ. A brief summary of the implications of the interactions of these message design continuums, is to say that as the learner's level of understanding of the content increases the requirement of the learning environment to provide highly affective (or fun) experiences lessens. Also as the content knowledge increases, the content form may move from more concrete examples to more abstract representations. This inverse relationship of affective forms and content density is completely supportive of the earlier statement that games can kill the fun by adding content. This illustration would prompt a response that an inappropriate amount of content was the focus relative to the understanding of the content by the player/learner. It would also suggest that for beginning knowledge acquisition the use of games could be very appropriate, as the demand for content density is quite low. However, the vast amounts of available content in simulations make them very attractive for later course use where the player/learner is quite familiar with the content and needs an environment where manipulation of the variables are authentically fluid.

An Experiential Mode Framework

Serious game design involves the quantification of key operant categories of both the player experience and the game or simulation structures. The following framework is offered as a starting point for the design of serious games, and may be extended to the design of any learning environment.

The Player Experience:

1. **Cognition** – changes in cognitive and affective domains

2. **Metacognition** – all that the player is aware of including:
   vision, audio, olfactory, kinesthetic, and haptic senses,
   plus an awareness of time, objects, & content

3. **Choice** – perception of:
   degree of control, and access to
   variables and information during game play

4. **Action** – perception that they can do things such as:
   interact with objects and elements within the game,
   have control of objects, elements, and own identity,
   have mobility to move through the environment,
   manipulate control interface to effect change.

Game Structure:

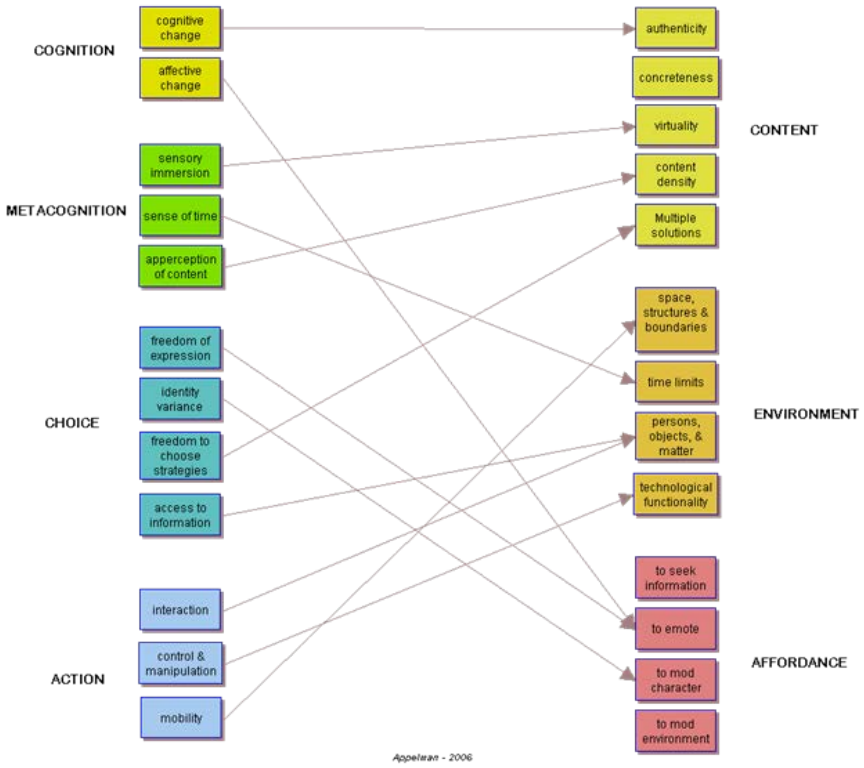
1. **Content** –
   the story, the context, the amount of information available,
   the degree of concreteness or abstraction of the content,
   the authenticity, and its variability

2. **Environment** –
   the virtual spaces and boundaries, the objects within
   these spaces and their functionality capabilities,
   plus any time limits imposed by the game

3. **Affordances** –
   the abilities made for the player to change, manipulate, the
   objects, information, environment, their identity & capabilities,
   and/or to seek alternative information

The decision paths to integrate the decisions made for the game structure that illicit or match a particular player experience should be iterative in development. This is because the content and context are so completely interwoven that there are numerous ways to embed the content and provide specific functionality to access or encounter content. Beginning with game scenarios, paper prototypes, simulated game play, and constant revision, a viable strategy appropriate to the content and context may immerge. Learning goals must first be defined for each type of content or experience imagined, and a starting point for determining structure can be facilitated by using the Experiential Mode Triage framework below (Fig. 3)

Figure 3



For instance, using this framework, if the learning goal required that the learner understand the relationship of how he or she reacts to another person, then one would want the learner to have an experience that involves both *cognitive* decisions and *affective* attitudinal choices. One triage path suggested in the framework is that a demand would be placed on the structural components of *content* to be authentic representations of interactions with other players or avatars within the game, and also that there would be *affordances* for them to emote and adequately manipulate how they respond. Likewise if there is a continuum that needs to be constantly evident, such as how the other character in the game is perceiving the player, then the metacognition of the player regarding this information could be heightened by providing a UI that displays a meter of the other

character's attitude, thus increasing the data flow of the content within the game. In this manner the framework is not designed to generate solutions, but instead to trigger possible solutions that illicit the appropriate player/learner experience.

Summary

It is evident that the complexity of developing serious games can be massively complex depending upon the learning goals targeted for the game to meet. What has not been discussed here has been the structuring of a framework around the use of a game or simulation that could produce a scaffold outside of the game/sim itself, thus potentially leaving efficient decision-making within the game being the primary focus. In this context the use of pre-existing games for learning can be effective if the proper scaffolding is done before and after the experience with the gaming environment. I would hesitate to call the actual game a serious game, but more to call the learning environment a blended one that included an entertaining exposure to some of the content and variables that related to the target objectives.

A definition of engagement as one that illicit a significant concentration by the player on the tasks of play and also the content variable targeted for learning would be acceptable to both the game developer and the instructional designer. As we begin to understand the variables of play and how the manipulations of these variables can be correlated with specific learning outcomes, we will be moving toward a realization of a true serious game. Hopefully both game developers and educators will recognize the need for a robust collaboration to meet such a goal.

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