Making Games not Work: Paradoxes Embedded in Game-Based Training and Concepts for Overcoming Them

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Abstract: An interest in game-based training solutions is natural. All one has to do is watch someone fully engaged in a modern game to see the potential of harnessing that attention for training. However, the reality of game-based training has not fully satisfied these expectations. This paper explains two paradoxes that must be overcome for games to support training. These paradoxes are a result of the realities of the basic human condition clashing with the requirements of learning theory. Both paradoxes arise from the concept of "engagement" that is central to games. The first comes from a more robust definition of engagement, which is the condition of Flow or Optimal Experience. Flow is the state game developers want to see in users. One aspect of Flow is loss of sense of self as the individual becomes immersed in the experience. The paradox arises because this loss of self directly contradicts the learning requirement of self-reflection. The second paradox comes from theories of play, which state in part that play requires a level of individual freedom. The contradiction arises when game-based play must be harnessed to an organizational training program or regimen. The paper will discuss these paradoxes in the context of an effort to design a game-based training modality to train combat medics and will close with a review of compensating strategies identified by the designers. The paper will provide information important to anyone interested in conceptualizing and designing game-based training.

1. INTRODUCTION

This paper describes the identification of and strategies to overcome two key paradoxes inherent in leveraging "games" to support organized learning or training, or the creation of "serious games." The genesis of this work was a six month effort to conceptualize and design a computer-based modality for training Combat Medics and Corpsmen to react to an Improvised Explosive Device (IED), specifically in terms of site management. As the intended training audience is assumed competent in specific medical diagnostics and treatment, the training solution focuses on higher level cognitive requirements, or decisions on the management of casualty care in a complex and hostile environment. A key requirement for the computer-based training modality was that it be "sim-game based", or more specifically, of the "simulation / strategy game genre."

In order to maximize value to the eventual customer, the research team approached the conceptualization and design of this system grounded research into operational and training environment requirements and constraints. For this project, that grounded research included, among other efforts, a review of both operational and theoretical literature as well as input from subject matter experts. The review of theoretical literature, which will be described in detail here, included examining the concept of games in general and serious games in particular.

The intent of the research into games and serious games was to provide cognitive rigor to the advantages of pursuing effective learning through a serious game strategy such that the eventual conceptualization and design would incorporate these advantages. The investigation, however, identified issues in a rigorous definition of the game construct that culminated in the identification of two true paradoxes. Having identified the two paradoxes, the team built strategies to mitigate their impact.

2. DEFINING THE GAME CONSTRUCT

Anyone who has observed another immersed in a computer-based game can appreciate the attraction of serious game-based training. The lead author has many times observed the intense commitment of his teenage children towards advancing their fantasy character or building a better virtual community, wishing he could transfer that commitment to far more critical but less exciting pursuits, such as math or English. A search of Google Scholar for "game based" returns over 17,400 hits; 778 of those hits are for the first eight months of 2009. Thus, it is no surprise that stakeholders in organizational and individual performance are

pursuing serious game based learning approaches more and more. Despite their increasing efforts, the author still does not have to tell his teenagers to get off the math game and get to bed.

The first question when asked to develop a game-based solution is: What is a game? The answer is not obvious. There are multiple characterizations of a game, seemingly based upon individual perspectives [1]. Webster's New World Dictionary defines game as, "any form of play or way of playing; amusement; recreations; sport; frolic; play" [2]. Clark Abt, who penned the term serious game in his 1970 book, pre-artificial intelligence (AI), *Serious Games* [3], defined a game as:

> Reduced to its formal essence, a game is an activity among two or more independent decision-makers seeking to achieve their objectives in some limiting context. A more conventional definition would say that a game is a context with rules among adversaries trying to win objectives. We are concerned with serious games in the sense that these games have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement.

In 2005, Mike Zyda, Director of USC's GamePipe Laboratory, provided a post-AI definition of a serious game as [4]:

> "a mental contest, played with a computer in accordance with specific rules that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives"

Both of these characterizations can encompass any number of training modalities, including modalities that the serious games community probably would not accept within their portfolio. In recognition of the untidiness present when defining a game, the authors changed strategy, opting away from a game as a discrete phenomenon and towards defining a game construct through a set of game traits, traits that would exist in various numbers and depth in the variety of training modalities.

Following this new strategy, the literature review identified twenty separate game traits, certainly only a partial list of total set. Several of these traits were clearly classifiable under two meta-traits: Play and Optimal Experience or Flow. The exploration into how to incorporate these meta-traits within the serious game-based solution demonstrated a paradox associated with each meta-trait. These paradoxes stand in the way of development of effective serious game-based training solutions.

3. GAME META-TRAITS

3.1 Play

As seen from the above and other definitions, play is an inherent feature of games. Games could be said to be the application of play. This raises the question of what is play, a question as difficult to answer as the earlier question of what is a game.

Again, the answer is not readily apparent. Brian Sutton-Smith in his book, *The Ambiguity of Play* [5], takes the perspective that play is so intertwined in human experience and that there is such diversity in the forms and manners of play that it cannot be separately defined. Rather, it can only be approached through discussion, or "rhetoric" of varied approaches towards the study of play.

French philosopher Roger Caillois studied play and identified six essential elements [6]. These are:

1. Free: in which playing is not obligatory; if it were, it would at once lose its attractiveness and joyous quality as diversion;
2. Separate: circumscribed within limits of space and time, defined and fixed in advance;
3. Uncertain: the course of which cannot be determined, nor the result attained beforehand, and some latitude for innovations being left to the player's initiative;
4. Unproductive: creating neither goods, nor wealth, nor new elements of any kind; and, except for the exchange of property among the players, ending in a situation identical to that prevailing at the beginning of the game;
5. Governed by rules: under conventions that suspend ordinary laws, and for the moment establish new legislation, which alone counts;

6. Make-believe: accompanied by a special awareness of a second reality or of a free unreality, as against real life.

The paradox that is serious play arises from the conflict between two of these essential elements and training. Effective play requires freedom, uncertainty, and lack of productivity. Yet, training is an organizational imperative and training programs are evaluated based upon their support to organizational objectives [7]. Effective and focused training is conducted within a well defined program with designated performance objectives and time and other resource constraints and synchronized with other training events. The conflict between the necessary freedom of play and the requirements and constraints of training is the first decisive paradox to be overcome.

3.2 Optimal Experience

A second necessary meta-trait of games is engagement [8] [9]. Again, there is the question of definitions. What is engagement and where does it come from?

Psychologist Mihaly Csikszentmihalyl provided an answer with his theory on "Flow" or optimal experience [10]. Through empirical research, Dr. Csikszintmihalyl identified a condition where human happiness was obtained in a balance between individual capability and challenge, or when information coming into individual awareness is harmonious with individual goals. This harmonization creates optimal experience, or the opposite of psychic entropy.

Dr. Csikszentmihalyl identified eight elements for establishing flow. These are:

1. The individual confronts tasks that he/she has a chance of completing or challenging tasks that require skills
2. The individual must be able to concentrate on the activity
3. The activity has clear goals
4. The activity provides feedback to the individual.
5. The activity provides a deep but effortless involvement by the individual
6. The activity allows the individual to exercise a sense of control
7. During the activity, the sense of self disappears, but emerges stronger afterwards
8. The sense of time is altered

The fifth and seventh elements, the requirement for deep but effortless work and the loss of the sense of self, generate the second serious game paradox. Effective adult learning requires recognition by the learner that they possess behaviors that, to reach individual objectives, necessitate change [11]. The learner has to perceive their actual abilities against desired abilities as well as the path to close the gap.

In addition, learning requires cognitive effort. For example, in the theory of self-regulated learning, self-reflection is a significant part of the learning process [12] and has been linked to success in learning [13]. Similarly the American Psychological Association identifies cognitive and meta-cognitive learner-centered principles, to include [14]:

- The learning of complex subject matter is most effective when it is an intentional process of constructing meaning from information and experience.
- The successful learner, over time and with support and instructional guidance, can create meaningful, coherent representations of knowledge
- The successful learner can link new information with existing knowledge in meaningful ways.
- The successful learner can create and use a repertoire of thinking and reasoning strategies to achieve complex learning goals.
- Higher order strategies for selecting and monitoring mental operations facilitate creative and critical thinking.
- Learning is influenced by environmental factors, including culture, technology, and instructional practices.

Thus, in a serious game-based training event, the more perfect the game, the less perfect the learning, as Flow indicates effortless involvement and learning requires effort. In addition, Flow requires loss of the sense of self, while learning requires self-evaluation. Last, Flow requires cognitive focus towards the immediate tasks, while learning requires focus on tasks over time and experience.

4. MITIGATING META-TRAIT PARADOXES

As previously stated, this investigation into the nature of games was initiated by a project to conceptualize and plan a game-based modality to train Combat Medics on IED-ambush site

management. Along with identifying desired game traits for the eventual solution, the study team also conducted literature reviews and interviews of subject matter experts to identify performance competencies as well as operational and training conditions and constraints. From this effort, the team developed an extensive set of training modality requirements and then compared over 100 models and simulations to identify candidate systems. Concurrently, the team developed the desired user's experience to maximize learning effectiveness and efficiency.

A central part of this conceptualization and planning effort was the structuring of the training experience to overcome or mitigate the effects of the above paradoxes.

4.1 Mitigating the Play Paradox

The play paradox arises from the conflict between permitting the trainee a sense of freedom and supporting organizational learning requirements through directing him/her along an organizationally directed learning path. The team followed two strategies.

As part of the training solution design, the team included a training matrix that would guide the learner from novice towards expert performance. The training matrix incorporated two axes, cognitive load and environmental conditions. As the trainee progresses through the matrix, he or she would experience greater cognitive load and more complex execution conditions.

Mitigating the play paradox required the inclusion of freedom within this directive matrix. This was accomplished through the provision of multiple missions at each step within the designated training matrix, giving the trainee a choice over which mission he would play in order to fulfill the current training requirement. Giving learners control over the manner in which they learn can be an effective approach to encouraging engagement [15] [16].

The team proposed that the combined coordinates of the two axes provide a small set of similarly challenging scenarios or missions. Each square in the 2D matrix would be a separate scenario or mission. Thus, in a training matrix defined by four cognitive load and environmental condition levels, the trainee would start at the score of two, or at the first load and first environment level (1+1=2). Advancing to a score of three would provide two scenarios (1+2=3 or 2+1=3) and so forth. One advantage of this solution was that as the trainee reached the end of the training matrix, options reduced until there was only one scenario remaining. This scenario would serve as a gate for movement to a higher matrix.

4.2 Mitigating the Flow Paradox

Mitigating the flow paradox was more challenging and required some potential sacrifice in the training design. This started with the intent to create an environment conducive to the trainee entering a personal flow experience. The first route to this objective was to prioritize environmental and experiential fidelity. The chosen game engine should be able to maximize the realism of the IED-ambush scene as well as accurately model IED-ambush related medical trauma. The team assessed that this dual realism would quickly inject the user into a flow state where they could lose their sense of self.

The second route taken to mitigate the flow paradox was a willful decision to delay self-reflection until after the scenario was complete. This is an acceptance of risk as learning theory would lean towards self-reflection immediately following a learning experience. In the context of Combat Medic training, this would mean a pause from the simulated experience immediately after reaction to the IED. This pause, however, would break the flow and so the team opted to forego it. Instead, the Medic would "stay in character", completing the scenario prior to an opportunity for the necessary self-reflection. At higher levels within the training matrix, this might mean multiple IED-ambushes within the same scenario.

The team compensated for this delay in reflection by emphasizing self-reflection in a post scenario review phase. The review would be guided by an intelligent tutoring capability, but would emphasize review of actions by the trainee, including the recording of those actions. This in turn was intended to support long term learning strategies necessary to learner-centered development.

5. CONCLUSION

Serious games do possess a promise of more efficient and more effective learning. However, they are not a panacea. Preparatory work must

be accomplished in order to maximize their potential. This preparatory work includes understanding the real interplay between serious games and humans. This paper has addressed two aspects of that interplay, identified during research into the conceptualization and design of a serious game meant to train Combat Medics. These aspects, Play and Flow, generate serious game paradoxes, which must be mitigated for a successful serious game application.

6. REFERENCES

1. Akilli, G (2007) Games and Simulations: A new Approach in Education? In D. Gibson, C. Aldrich, and M. Prensky *Games and Simulations in Online Learning* (pp. 1-20). Hershey, PA Information Science Publishing.
2. *Webster's New World Dictionary* (4th ed). (2007). Springfield MA: Merriam-Webster.
3. Abt, C. (1970). *Serious Games.* New York: The Viking Press.
4. Zyda, M. (2005). From Visual Simulation to Virtual Reality to Games. *IEEE Computer.* Vol. 38 (9), pp. 25 - 32.
5. Sutton-Smith, B (1997). *The Ambiguity of Play,* Cambridge, MA, Harvard University Press.
6. Caillois, R. (1958). *Man, Play and Games.* (Meyer Baraxh, Trans.) Urbana IL, University of Illinois Press
7. Kirkpatrick, D (1994) *Evaluating Training Programs: The Four Levels.* San Francisco, CA, Berrett-Kohler Publishers.
8. Quinn, Clark N (2005) *Engaging Learning: Designing e-Learning Simulation Games*, San Francisco, CA, Pfeiffer
9. Becker, K. (2007) Pedagogy in Commercial Video Games, In D. Gibson, C. Aldrich, and M. Prensky *Games and Simulations in Online Learning* (pp. 21-47). Hershey, PA Information Science Publishing.
10. Csikszentmihaly, M. (1990). *Flow: The Psychology of Optimal Experience*. New York, NY. Harper Perennial Modern Classics.
11. Knowles, M, Holton, E. and Swanson, R (2005). *The Adult Learner*, 6th Ed. San Diego, CA. Elsevier
12. Zimmerman BJ. (1990). Self-regulated learning and academic achievement: An overview. Educational Psychologist. 25(1):3-17.
13. Zimmerman BJ. (2002). Becoming a self-regulated learner: An overview. Theory into Practice. 41(2): 64-70.
14. Alexander PA & Murphy PK. (1998). *The research base for APA'a learner-centered psychological principles.* In How Students Learn: Reforming Schools through Learner-Centered Education. American Psychological Association: Washington, DC. 1-22.
15. Morrison, G.R., Ross, S.R., & Baldwin, W. (1992). Learner control of context and instructional support in learning elementary school mathematics. Educational Technology Research and Development. 40:5-13.
16. Cordova DI & Lepper MR. (1996). Intrinsic motivation and the process of learning: Beneficial effects of contextualization, personalization, and choice. Journal of Educational Psychology. 88(4): 715-730.