7.4 Defining and Leveraging Game Qualities for Serious Games

Defining and Leveraging Game Qualities for Serious Games

Michael W. Martin & Yuzhong Shen
Old Dominion University
Department of Modeling, Simulation, and Visualization Engineering
mmart081@odu.edu yshen@odu.edu

Abstract. Serious games can and should leverage the unique qualities of video games to effectively deliver educational experiences for the learners. However, leveraging these qualities is incumbent upon understanding what these unique 'game' qualities are, and how they can facilitate the learning process. This paper presents an examination of the meaning of the term 'game', as it applies to both serious games and digital entertainment games. Through the examination of counter examples, we derive three game characteristics; games are self contained, provide a variety of meaningful choices, and are intrinsically compelling. We also discuss the theoretical educational foundations which support the application of these 'game qualities' to educational endeavors. This paper concludes with a presentation of results achieved through the application of these qualities and the applicable educational theories to teach learners about the periodic table of elements via a serious game developed by the authors.

1.0 INTRODUCTION

The term "serious games" is somewhat open-ended, and even people who work with serious games have a hard time agreeing upon its exact meaning. This work is not presented with the intent of settling the debate on the meaning of the term, but simply as an effort to add to the greater body of discussion. Additionally, this work is presented because the authors believe that this approach to looking at serious games can be useful, not only in the academic sense of defining the term, but in actual development of serious games, as well.

To that end, this paper will first present a discussion of both common definitions of "games", and "serious games", followed by an effort to identify some of their salient characteristics to clarify the definitions. Then, the paper will discuss the development and deployment of a serious game that was created by the authors, based on these concepts.

2.0 BODY

2.1 Definitions for Game and Video Game

Mirriam-Webster's online dictionary provides several definitions of the term "Game" which are relevant to the discussion:

"3a(1) : a physical or mental competition conducted according to rules with the participants in direct opposition to each other…3a(5) : the manner of playing in a contest… 3c(2) : any activity undertaken or regarded as a contest involving rivalry, strategy, or struggle" [1].

There are a number of more in depth works on the subject of games, and they all tend towards these same basic definitional components. In the 1961 book Man, Play and Game, Roger Caillois, described games as being activities that are fun, distinct, uncertain, non-productive, rule-driven, and fictitious [2]. Clark Abt, in 1970, described games as an "activity among two or more independent decision-makers seeking to achieve their objectives in some limiting context" [3]. More recently, Katie Salen and Eric Zimmerman describe "artificial conflict, defined by rules, that results in a quantifiable outcome" [4]. While each definition has its own nuances, in general, they fairly closely resemble the dictionary definitions found above. Those common recurrent components found in these definitions can be summed up as participants, goals, rules, and challenges. The participants have goals within the game, which they try to achieve via a set of

rules. The rules define the participants' interactions, and in the application of these rules, the participants try to overcome challenges in order to achieve their goals.

The definitions apply to the general term game. However, the focus of this paper will be on computer based games. This is simply the stipulation that the game in question takes part on a computer. Michael Zyda, Director of the University of Southern California Viterbi School of Engineering's GamePipe Laboratory builds a similar dictionary based definition proposing that a video game is:

*"A mental contest, played **with a computer** according to certain rules for amusement, recreation, or winning a stake."* [5] (emphasis added)

2.2 Definitions for Serious Game and Definitional Pitfalls

Having established a basic definition for "game", the next step is to determine the meaning of "serious games".

In understanding the nature of a Serious Game, as defined in this paper, it is helpful to consider that game players learn something in every game. If this were not true, then a player's performance on a game would be the same the first they played as the last. However, this is not so, and players improve their performance by learning the mechanics which govern the game.

Most of the time, what the players learn is useless in the real world. Players of Nintendo's famous game Super Mario Bros. [6] learn that mushrooms are evil, but that the player can jump on them to kill them. They also learn that they can jump on turtles and use their shells to kill other enemies, like the mushrooms. Learning these aspects of the game helps the players perform better, but this knowledge usually transfers very poorly to the real world.

In a Serious Game, the knowledge that the user learns within the game is transferable

to the real world. The game mechanics and content have a sufficient degree of fidelity with real life mechanics and subject. When the player learns something in the game, that knowledge is transferable, within reason, to the real world as well as the game.

A number of established serious game authorities define serious games in terms of their intent. One of the most succinct definitions for serious games is found on the Michigan State University Serious Game Design Program webpage:

"Serious games are games with purpose beyond just providing entertainment." [7]

Put another way, "Serious Games" are game played for a serious intent or reason. Zyda proposes a similar definition, though with more detail as to the nature of the purpose:

"Serious game: 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." [5]

Building upon the definitions above, a Serious Game might be "an activity consisting of participants, goals, rules, and challenges with a purpose beyond entertainment."

These definitions for "Games" and "Serious Games" are useful for grounding the baseline understanding of these concepts. However, as analytic propositions, they may also be seen as being overly inclusive. They encompass the concepts in widely applicable terms, and as a result, may also be valid for things which are not games. For example, a game of football has participants, goals, rules, and challenges. However, arguably the chore of mowing the lawn has all of these components as well. This does not necessarily invalidate the definition as much as it highlights that this definition does not provide sufficient

945

information to distinguish games from non-games.

Normally, a traditional game maker will not suffer from such a definitional dilemma. Arguably, the one and only value metric used for entertainment games is their "fun" or entertainment value. Serious games add a competing metric: the ulterior purpose beyond entertainment. This additional aspect can confound the value assessment.

With these competing values, the field of serious games can become quite confusing. Organizations of all sizes and types attempt to leverage viable serious games to achieve their goals. Ambiguity in what constitutes a game allows the term to be applied to a variety of efforts which are perhaps better identified as non-games.

As with the "lawn mowing" example above, the serious game definition might encompass the use of a budgeting program. Budgeting program have participants, goals, rules, challenges, and a purpose beyond entertainment. Such a definition might be technically correct, but ultimately it is unhelpful in trying to determine how to best make use of serious games. Clearly, if someone expected a game, and was given a budget to balance, they might be dissatisfied. Such confusion could contribute to disillusionment on the part of serious game customers, users, and developers.

2.3 Characterization of Serious Games

To better understand and apply the term "serious games" it is helpful to identify what aspects of games make them unique from non-game activities. There are two serious game counter examples which help provide additional clarity through contrast. The first counter example is generic computer based training, and the second is computerized sand box training.

2.3.1 Computer Based Training

There are a number of computer based learning or training application which have seized upon the "Serious Games" trend. They apply game-like facades to traditional computer education activities and declared them to be games. This misappropriation of the term "Serious Game" is compounded by the fact that, as with the examples above, many traditional computer based learning activities fulfill the definition of game provided above.

A quiz or test, common to most educational systems, is a prime example of an activity that can satisfy the majority of the game attributes listed above. A quiz has rules (fill in the blank, multiple choice, etc.), it has goals (to score the highest possible score) and conflict (the difficulty of the questions). It is a difficult to argue that quizzes or tests are fun, but some educational applications decorate test-like experiences with "fun" veneers, such as cute graphics and silly sound effects and label them serious games. Two examples of this are Grammar Gorillas [8], and Snork's Long Division [9]. Grammar Gorillas has the player select specific parts from a sentence. Snork's Long Division has the player simply perform long division. Both are self declared serious games, but clearly fall short of what would normally be considered a game.

In examining why these activities do not seem like game, one finds that at their core, these programs don't provide the learner with any meaningful choices. The user simply answers the question correctly or fails the question. While the students choose how to answer the question, these choices are not meaningful in that there is only one correct answer, with no viable alternative. Raph Koster identified this pitfall in A Theory of Fun and Learning[10]. Using Tic-Tac-Toe as an example, he illustrates that the game ceases to be a game when the players learn that they have no choices. At that point, the game becomes a simple drill in the rote application of logic.

Further, by not providing meaningful alternatives, these software examples limit

the potential for creating a psychosocial moratorium, as described by James Paul Gee. The psychosocial moratorium, a phrase which Gee adapts from psychologist Eric Erikson, is "a learning space in which the learner can take risks where real world consequences are lowered," [11]. The lack of choice collapses the exploratory learning space, and deprives the player of the opportunity to reflect upon the information being presented and applied. David Shaffer argues that games have the potential to allow a more "authentic" method of learning than traditional schooling techniques because games set the stage for learners to think not only about what the right answer is, but also how they know an answer is right and what is the process by which they arrive at that answer [12]. Quizzes, which limit the "players" interaction with their world (the quiz) to a single correct answer, with all other options being incorrect, do not engender the same degree of introspection that a wider array of viable choices might.

In order to provide that sense of freedom that fosters exploration and, as Gee and Shaffer suggest, learning, games need to adhere, to an extent, to game designer Sid Meier's dictum that games are a "series of interesting decisions" [13]. Meier is renowned for his complex and involved strategy games, like the Civilization and Tycoon series, where each decision can have profound consequences. However, games can provide the player with meaningful choices without having to resort to such elaborate depth. The term meaningful, in this sense, can refer not to a profound consequence for the available choices, but rather, to having any consequence at all.

Some activities, like the above mentioned quizzes, offer no meaningful choices – the player's only option is to answer the question correctly. At the other extreme, some games offer a wide array of choices that effectively have no consequence. For example, many games allow the player to visually customize their character. A player

can spend hours adjusting the eye color, cheek bone height, hair style, etcetera, but ultimately none of that has any effect on the game play. In contrast, a meaningful choice allows the player to select between viable alternatives with concrete consequences, without any clear optimal choice, thereby allowing the player to freely explore the conceptual space created by the game.

In order to differentiate games from quizzes, the first necessary characteristic of games (and serious games) is that they provide the user with an array of meaningful choices.

2.3.2 Sandbox Experiences
The next counter example of non-games is the open sandbox experience. These types of programs are commonly used in military and police training. They are programs that create worlds in which typically large groups of individuals engage in educational or learning scenarios.

Such programs have been in use for several decades. One of the first was SIMNET, which was developed and deployed in the early to mid 1980's [14]. For many years, such programs have used specialized hardware and software, which was inexpensive in comparison to the resource cost of conducting the training using real world equipment and locations.

Recently, however, the commercial entertainment software industry has proven that high quality experiences can be delivered on commercially available hardware and software. And these experiences can be delivered for even less than the cost of simulation using specialized hardware and software.

One recent development in this field is the US Army's adoption of a program called Virtual Battlespace 2 (VBS2) [15]. VBS2 is developed by Bohemia Interactive, which was previously a commercial entertainment company. Bohemia developed a great number of games including a tactical virtual reality shooting game called Operation Flashpoint. Unlike earlier training

947

simulations using specialized software and hardware, VBS2 is based on the Operation Flashpoint game, and is designed to run on common desktops and laptops. Because the program shares software technology with Bohemia Interactive's new game, Operation Flashpoint II, there is a natural tendency to call VBS2 a serious game.

However, VBS2 is not a game in the traditional sense. It is designed to host large numbers of networked users in a virtual environment. In game terms, it would be considered a large multiplayer game. Unlike games, however, this experience is not a closed system. The multiplayer sessions don't have scores, or objectives defined within the game. They lack the framework associated with even freeform multiplayer games. Instead, VBS2 sessions are designed to be administered by teams of instructors, who then take on the role of giving the players objectives, assessing their performance and providing them with feedback. In commercial terms, this would be considered an open world experience, similar to Second Life. Players can interact, but there is not game structure to support the interactions.

In commercial games, a player can play the game entirely by himself or herself. This concept even applies to multiplayer games. A player sitting down with the commercial version of the game Operation Flashpoint can play the game by themselves, even when engaging in multiplayer sessions. They can join a multiplayer session with no prior coordination, play the game, and then quit when they desire. Most importantly, the game provides internal feedback loops, via scores and other performance measures, to let the player know how well they performed. Granted, in games which are exclusively multiplayer in nature, this assumes a robust network structure with available sessions, but given that assumption, there is no overhead to playing the game other than the player and the game itself. VBS2 and other serious games

like it lack this fundamental game characteristic.

If VBS2 did have those qualities, then users could train at their own pace, learning the materials as appropriate to their individual skills. Targeting training at the individual level could greatly increase the user engagement and ultimately the effectiveness of the training. No longer would quick learners be held up by the slow members of traditional classes or training groups, nor would the slow learners be dragged along faster than they can assimilate the material. If the instructional framework were properly embedded, then the serious game would be a self encapsulated experience, just as commercial video games are.

Therefore, the second quality that a serious game should have is that it is a self encapsulated experience. Given that this discussion has been centered on video games, it is worth noting that this quality would not exclude serious game that are not played on a computer. Because of their automation advantages, computers facilitate this characteristic. However, it is possible to have board or card and paper games, or even athletic games that are playable solo as well as with other people. Granted, these games are rare, and the difficulty in creating them is much higher than traditional board games, but it is not impossible to conceive of.

2.4 The Issue of Fun

A few of the definitions of games, such those of Caillois and Zyda, also refer to entertainment or fun. Many of the definitions omit such concepts, perhaps due to their highly subjective nature. However, as a basic metric of value for games, it is undeniable that these are fundamental aspects of the concept.

Customers pay money to play games not because the games provide some sort of reward, but because the game experience, itself, is rewarding. The intrinsic value of

the game experience outweighs any extrinsic benefit bestowed by playing the game. The games, without any consideration to outside benefit, are intrinsically compelling.

"Intrinsically Compelling" encompasses the concepts of "fun", but it also makes room for other aspects, such as the satisfaction of overcoming a challenge, or earning a reward, which may not be entirely fun. For example, many Massively Multiplayer Online Role-Playing Games (MMORPGs), like World of Warcraft [16], routinely include what player communities often refer to as "grinding". World of Warcraft is a game in which players try to improve their character by accomplishing various tasks and thereby gaining experience points. Grinding is a low risk way to gain experience points. It is a repetitive act, which is widely described in negative terms, often involving tediously killing large numbers of weaker enemies which pose little threat. Killing these weak enemies might be a boring and repetitive task, but it gains points which grant the player some form of in-game reward, such as a more powerful character. It is a significant component of this game genre which is not normally deemed as fun. Yet it is intrinsically compelling.

Regardless, however, of what creates that intrinsic compulsion, be it fun or the feeling of achievement, or some other factor, this intrinsic compulsion and educational value do not necessarily compete. Raph Koester proposes that fun is, in fact, the brain's reaction to learning [10]. Keeping in mind that paradigm that players are always learning when they play, it follows that the two are closely interrelated.

Even from a practical stand point, a player who feels intrinsically compelled by a serious game is more likely to engage with the game, and therefore, assuming the serious game is designed well, more likely to achieve the desired "non-entertainment" purpose.

Thus, the third quality of a serious game is that it should be intrinsically compelling.

3.0 DISCUSSION

Based on these concepts, the authors have been developing a Serious Game entitled Elemental Solitaire™. The effort to develop the game began simply enough with the idea to build a combination of popular classic card game mechanics, such as solitaire, and the periodic table.

Because of the nature of this project, it was more likely to fall prey to the "Computer Based Training" pitfall than the "Sandbox Experience" pitfall. The mechanics of the game lent themselves well to creating an encapsulated game-play experience. However, avoiding the "quiz-like" danger required more effort.

Fig 1: Elemental Solitaire Game Screen

In early iterations of the game, the simplest designs precluded any such meaningful choice. As the players were given elements, they either placed them correctly, or they were penalized for failing to do so. Though the program had a graphic interface and the elements had an appearance of playing cards, there was no conceptual space to explore. The program simply presented the user with quiz questions disguised in a graphical form. Though different in execution, this program, in spirit, resembled many of the aforementioned online quizzes. In order to add more

decision space to explore, three items were added to provide the user with more meaningful choices.

First, players were given ten 'skips', so if they wanted to delay placing an element, they had the ability to do so ten times, without penalty. This gives the player a small degree of control in choosing whether to place an element or not. It also adds a measure of strategic depth, as players must ration their skip choices, and forcing them to weigh the risk of skipping a present element versus the need to be able to skip an element later on.

Second, when placing an element, the players are given a countdown timer. As the time passes, hints as to the correct element position on the table are automatically given, including the family color, the row, and ultimately the actual element position. The balance is that the score the player receives for placing a card decreases as more hints are provided, until, ultimately, no points are awarded if the card's correct position is shown to the player. A player can also choose to capitalize on this, and if they are willing to take a lower reward, can even manually advance the timer to display the next hint, without having to wait. Again, this mechanic allows the player decide how to balance risk and reward. As risk diminishes, so does the reward.

Lastly, as mentioned above, an abstract scoring mechanic was added to the game. This system rewards the player with a specified amount of points for each element correctly placed, and deducts an amount for incorrect placements. The amounted award for correct placement is inversely proportional to the time taken to place the element. Additionally, not only do players get rewarded for correct answers, but they also increase a score multiplier, which links their decisions on how they choose to answer questions with the rewards they can receive on future correct answers. As they score better, their multiplier increases,

allowing them to score even higher on subsequent correct placements. This factor also adds significance to the decision the player must make in balancing the risk and reward of placing the elements.

These three mechanics of the game combine to create a decision space for the player to explore, and extend the game space beyond simply entering a right or wrong answer. These "choice creating factors" do not possess the depth nor the scale of the types of decision often made in a highly strategic game, such as Sid Meier's Civilization games, but they do create a small space for the learner to explore. These factors set the conditions for the psychosocial moratorium, and presumably improve the facilitation of learning. With an array of possible actions, the player can play how they like, and, in the words of game designer Chris Crawford, imprint their own personality on the game [17]. Fig. 2 shows a screenshot from a game in play, with a hint showing the family and row of the element.
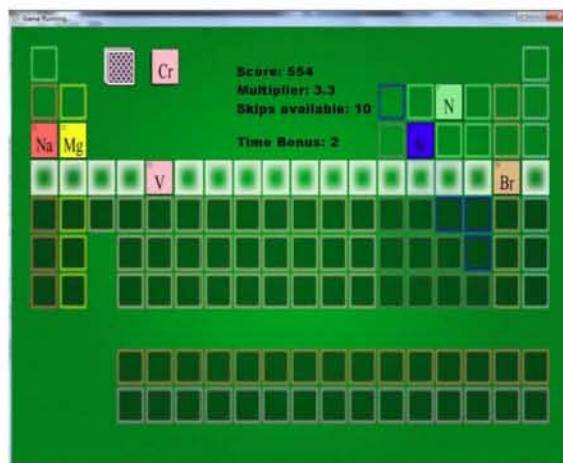

Fig 2. Game Screen with Hints

Additional discussion of the development of Elemental Solitaire™ can be found in the paper *Differentiating Between Serious Games and Computer Aided Instruction* [18].

4.0 CONCLUSION

While the traditional approach to understanding something is to examine what it is, this paper presents a characterization of Serious Games based on what they are not. From this examination of counter-examples, we have derived three qualities which a Serious Game should possess:

1. They provide meaningful choices to the user.
2. They are self encapsulated experiences.
3. They are intrinsically compelling.

Elemental Soliatire™ is an example of how these characteristics can be used to guide the development of a Serious Game. This program is going to be used as a test platform to assess the effectiveness of these and other game design principles in developing Serious Games.

5.0 REFERENCES

1. Merriam-Webster Inc. *Game - Definition and More from the Free Merriam-Webster Dictionary*. Mirriam-Webster Online 2010 [cited 2010 15 July]; Available from: http://www.merriam-webster.com/dictionary/game.
2. Caillois, R., *Man, Play and Games*. 1961, New York: Free Press of Glencow.
3. Abt, C.C., *Serious games*. 1970, New York,: Viking Press. xvi, 176 p.
4. Salen, K. and E. Zimmerman, *Rules of Play: Game Design Fundamentals*. 2003, Cambridge: MIT Press.
5. Zyda, M., *From Visual Simulation to Virtual Reality to Games*. Computer, 2005(September 2005): p. 8.
6. Miyamoto, S., T. Tezuka, and H. Yamauchi, *Super Mario Bros*. 1985, Nintendo Co., Ltd.
7. Michigan State University. *MSU Serious Games Design Program*. [cited 2010 July 15]; Available from: http://seriousgames.msu.edu/.
8. *funbrain.com Grammar Gorillas*. 2010 [cited 2010 20 Feb]; Available from: http://www.funbrain.com/grammar/index.html.
9. *Snork's Long Division Game - KidsNumbers.com*. 2010 [cited 2010 20 Feb]; Available from: http://www.kidsnumbers.com/long-division.php.
10. Koster, R., *A Theory of Fun for Game Design*. 2005, Scottsdale, AZ: Paraglyph Press. x, 244 p.
11. Gee, J.P., *What video games have to teach us about learning and literacy*. Rev. and updated ed. 2007, New York: Palgrave Macmillan. 249 p.
12. Shaffer, D., *In Praise of Epistemology*, in *The Design and Use of Simulation Computer Games in Education*, B. Shelton and D.A. Wiley, Editors. 2007, Sense Publishers: Rotterdam. p. 7 - 27.
13. Camargo, C. (2006) *Interesting Complexity: Sid Meier and the Secrets of Game Design*. Crossroads: The ACM Student Magazine.
14. Lenoir, T. and H. Lowood (2003) *Theaters of War: The Military-Entertainment Complex*.
15. Bohemia Interactive Simulations. *BISimulations*. 2010 [cited 2010 23 July]; Available from: http://www.bisimulations.com/.
16. Blizzard Entertainment Inc. *World of Warcraft Community Site*. 2010 [cited 2010 27 July]; Available from: http://www.worldofwarcraft.com/index.xml.
17. Crawford, C., *The Art of Computer Game Design*. 1984, Berkeley, Calif.: Osborne/McGraw-Hill. xiv, 113 p.
18. Martin, M.W. and Y. Shen, *Differentiating Between Serious Games and Computer Aided Instruction*, in *Virginia Modeling, Analysis and Simulation Center 2010 Student Capstone Conference*. 2010: Suffolk, VA.