Understanding systems problem solving: what sets competent vs. expert players apart at high-level game play

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EXTENDED ABSTRACT OF PAPER

Overview

Strong arguments have been made for the importance and implications for learning complex systems ideas and perspectives (Jacobson & Wilensky, 2006; Liu & Grotzer, 2009). This comes on the heels of professionals, policymakers, and citizens recognizing that we are faced with increasingly challenging social and global problems in the 21st century; a systems thinking perspective is necessary to fully understand and generate viable solutions to these complex issues. The high-order learning and thinking skills involved in systems thinking has also been deemed critical to teach by national standards and frameworks as necessary 21st century skills (AAAS 1993, 2009; Partnership for 21st Century Skills, 2009). As a result of the importance placed on complex systems learning, much research can be found on what makes complex systems concepts challenging to understand and pedagogical research into how students can better learn these systems concepts (Perkins & Grotzer, 2005; Resnick, 1994). More recently, with the increasing power and decreasing cost of computational visualizations and modeling, students are able to investigate complex systems more directly (Resnick, 1996; Wilensky, 1999) or even be immersed in virtual worlds designed for students to experience systems concepts first-hand (Metcalf, Kamarainen, Tutwiler, Grotzer, & Dede, 2011). However, as of current, this is where much of the research ends in complex systems learning. Little research has been done where students are truly exercising systems thinking to solve a problem, or systems problem solving. Many systems curriculums poised to teach systems thinking more often teaches what makes one a system and explains phenomena as a result of systems dynamics than allow students to engage in systems thinking (e.g. Ben-Zvi Assaraf & Orion, 2005). Most systems thinking research and computational tools or games help people think *about* systems rather than have them engage in decision-making and problem solving within a systemic framework. The few studies that address systems problem solving, more often engages students in theoretical exercises, asking students to give hypothetical solutions to hypothetical questions (e.g. Jacobson, 2001), than truly immersing students in a systems problem where there's an interplay between individual action and system outcome.

This exploratory study looks at how people engage in systems problem solving using a multi-player online battle arena setting in World of Warcraft (WoW) as a model system of study. More specifically, arena players at different levels of game play success, or mastery of systems problem solving, are compared to elucidate the differences between increasingly more expert systems problem solvers[1]. Differences in 1) systems concept understanding, 2) thinking patterns,

[1] It is important to note that the significance of this research lies in that it does not look at complete novice vs. expert players, but rather focuses on players at the higher level of game play to investigate what truly pushes one over the threshold to become an expert problem solver vs. a competent player.

3) behavior, and 4) collaboration are analyzed. Findings highlight factors that promote successful systems problem solving.

Multi-player Online Battle Arena

With 11.1 million subscribers as of June 2011,World of Warcraft (WoW) is currently the world's most-subscribed MMO (massively multiplayer online) game (Wikipedia, 2012). Several key features of a battle arena setting like that in WoW, though not limited to WoW, make it a valuable resource for systems problem solving research. For example, the battle arena setting provides the appropriate level of complexity for the study of systems problem solving. The arena system is neither too simple like a game of tic-tac-toe, nor too complex like trying to reform the US economic system. It involves a finite set of interactions among a handful of agents. The interactions are both technical and social (working with teammates). The game represents a contained system that one can gradually understand and continually experiment with. Secondly, the game has built-in measures to minimize non-skill-based advantages that may favor certain players, diminishing confounding variables to the study of systems problem solving. Thirdly, arena team members are given an arena rating that reflects how well they are doing. One's rating can range from 0 to about 3000. Winning against a higher rated team results in a big increase of one's rating, but losing against a higher rated team decreases one's rating for only a small amount. As a result of the game being highly dependent on the player's skillful understanding and awareness of the system, the arena rating may be used as a metric to measure a player's extent of systems problem expertise.

WoW is a game-of-games of considerable breadth and depth, a game that comprises many sub-games that can be divided into two categories: player-versus-environment (PvE) and player-versus-player (PvP). WoW's PvP arena is a unique game that involves small teams of players trying to defeat each other on an arena terrain. While arena exists in three formats: 2v2, 3v3, and 5v5, the 3v3 format (a three-player team versus another three-player team) is the most emphasized format because it's neither too predictable like 2v2 nor too hectic like 5v5. There are well over 30,000 teams currently participating in 3v3 arena on the North American WoW servers alone, with publicly displayed ratings and win-loss statistics.

A 3v3 team typically comprises one Healer, whose primary role is to mend the teammates' wounds, and two Damage Dealers, whose primary role is to cause damage to the opposing team. However, a small number of teams choose to have three Damage Dealers, or only one Damage Dealer but two Healers. A match is won when all member of the opposing team have been killed or decide to forfeit. Players generally have two types of abilities, one that can be used constantly (limited only by the amount a resource available, e.g. energy), and another that can be used only once a while because there is a necessary cool-down period between uses (e.g. two minutes). The abilities with cool-downs are more powerful than the ones constantly available. Games can last anywhere between 20 seconds to 40 minutes. The abilities can be generally categorized as a damage ability, healing ability, defensive ability, or incapacitate ability. Players can be one of 10 different classes, each with three possible specializations, giving them differing abilities. Games are won and lost by intelligent use of team positioning and well-timed uses of their abilities with cool-downs. Arena PvP is akin to a game of chess, but with three players on each side. The game involves a system of six players interacting with one another and with the arena terrain—there are five different terrains players are randomly placed into. Successful systems problem solving would entail reaching the desired end state of defeating the opposing team. The ability to consistently reach the desired end state, with changing variables from game to game, makes one an expert systems problem solver.

Methods

Arena achievement benchmarks are set at the 1550, 1750, 2000, 2200 rating. Findings from the analysis of six participants, three participants from two different arena rating categories (1750-2000 and 2000-2200) in WoW's arena season 11 (from December 6, 2011 to August 28, 2012), will be presented. These two categories were specifically chosen as most competent players progress rapidly up until the 1750-2000 bracket and plateau in this bracket, with relatively few players being able to go over the 2000 rating hump to become experts.

Sixty-minute semi-structured interviews were conducted. Interview questions explored participants' systems concept understanding, thinking patterns, behavior/actions, and collaboration/team dynamics. Interview questions were open-ended to allow for the participants to structure their responses and to give salience to what they deemed to be important. As with all interviews, there is no way to ensure that participants are not presenting biased interpretations of their actions, or not leaving out details that they take for granted as part of their tacit knowledge. Thus, observations of the player's game play via real-time video and audio streams were used to corroborate the interview data. Interviews were coded for overarching patterns found in the data using grounded theory (Charmaz, 2006). Grounded theory methods consist of systematic, yet flexible guidelines for analyzing qualitative data to construct theories grounded in the data.

Significance and Implications

Successful WoW arena game play involves systems thinking and actively engaging in systems problem solving to attain the desired goal of defeating the opposing team. Arguably, in order to solve a systems problem (or manipulate the system to a desired state) within a knowledge area, one must have an understanding of systems concepts, or to be able to think about systems in that area. However, almost all research around systems thinking and learning is around students' learning and appreciation of important complex systems concepts; little is actually looking at how they are able to leverage their systems understanding or thinking skill to diagnose and solve a problem with the system. It is commonly taken for granted that an understanding or appreciation of systems concepts and dynamic patterns will automatically translate into an ability to be able to solve and respond to a systems problem. However, from our study, we found that this is not the case. Having a deep systems understanding does not guarantee successful problem solving, though expert problem solver must have a sophisticated understanding of systems concepts.

While the author understands that being an expert systems solver is specific to the context of the study, and in this case the arena setting in WoW. Findings from the study is nonetheless significant beyond the immediate gaming context as it elucidates various overarching contributing factors to successful systems problem solving and help directs the course of future systems learning research. After all, the cross-disciplinary field of expert-novice research in problem-solving had its beginnings in the study of chess players.

By looking at players at the high end of game play, as opposed to the traditional novice vs. expert comparisons, we are better able to investigate what truly pushes one over the threshold to become an expert problem solver vs. a competent player; a competent player being one who seems to have a good understanding of the game and even systems concepts, but falls short of mastering the system. This study is unique in that little to no research has been done at the esport level, or very high level game play, where differences between players cannot be simply explained away by lack of motivation or effort and time invested to succeed.

This study also contributes to the little research that has been done so far on systems problem solving where students are truly exercising systems thinking to solve a problem. In the study, participants are thoroughly immersed in a complex systems phenomena, where every action taken results in a change affecting the overall system of the game—this being highly analogues to real world situations. This study was made possible by uniquely leveraging the affordances in a multi-player online battle arena setting to investigate systems problem solving. The multi-player online battle arena gaming environment allows students to continuously and directly test their theories and understanding of the system every match. Their understanding is continually being tested as they face different opponents and find themselves in different situations; though there is only one underlying systems, there are many variations to it with different combinations of players, terrain, and game mechanics from season to season.

The benefits of games and meaningful play to education is exemplified in this study, as it not only provides a means for students to engage and practice systems problem solving, but can be ingeniously used as an educational research tool.

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