A Brief Analysis of Fishbanks and Natural Resource Management Decision-Making Simulation Games: Converting a current NRM game into a web-based application

Introduction

Simulations and games have been used for a variety of purposes throughout history. “The first use of decision-making games for education and intellectual development were the war game simulations of Wei-Hai, which originated in China about 3,000 B.C., and the Hindu game of Chaturanga” (Keys & Wolfe, 1990; Wilson, 1968). However, more recently, simulations and games have been utilized in workshops and in classrooms for training purposes, as well as tools to promote learning. NRM simulations have shown to be effective in supporting decision-making processes and training.

“When you give a lecture about overfishing, students nod and say, you’d have to be kind of foolish to wipe the stocks out, but then they play the game and that’s exactly what they do. It makes a huge impact”, says Sterman (“Not enough fish”, 2013). Fishbanks is an example of a simulation that has been implemented in workshops, seminars, and in classroom settings. FishBanks is a board game as well as a web-based, multiplayer, natural resource management simulation game. The web-based platform style is the version that was primarily researched for the project. Fishbanks is intended to simulate the natural resource management of a common-pool resource in the context of the commercial fishing industry. The simulation is performed with groups of individuals, who are placed in teams, with each team representing a fishing company. These individuals could potentially be high school students, students in higher education, faculty members in higher education, corporate managers, corporate trainers, consultants, policy makers, etc. Fishbanks has a participatory design, which allows for numerous and diverse interactions between actors and their environment. This interaction is meant to simulate the complex interconnectedness and relationships among individuals in a multidimensional socio-economical system.

The goal of the simulation game, Fishbanks, is for teams to maximize their net worth by the end of the game and to beat the competition. Profit is determined by subtracting expenses from the income. Sources of income include fish sales, ship sales, and interest earnings (Sterman, 2010). All of the sources of income have their own equations. Expenses include operating cost, ship purchases from other teams/players, ordering new ships from the shipyard, and interest charges (Sterman, 2010). Like the sources of income, all expenses have their own equation. Revenue will come from teams selling their catch, choosing to sell any ships at auction, and if the team in question had a positive minimum bank balance through the year they will receive interest in their bank
balance (Sterman, 2010). The simulation consists of ten rounds, with each round representing a year. The teams compete with each other for the shared resource, and the revenue that the resource in turn generates. There is no specified goal to manage and sustain the fish-banks systematically that would allow for the stocks to flourish. There is also no specified goal of minimizing ecologically unsound conditions while operating a profitable business. These goals seem like they would be important to convey to the participants. By stating these goals, participants then would have the idea that maximizing profit, though significant, cannot be sustained if the resource is not managed efficiently and subsequently crashes. Algorithms imbedded in the Fishbanks model are dynamic and immediately react to changes in the system. The model supports the framework of the simulation and embodies the entire system, while the simulation itself represents the processes, functions, and actions of the system over time.

The web-based version of Fishbanks uses a systems dynamic computer simulation model that actively involves participants, with the intent to teach them the ideologies of sustainable natural resource management. Former MIT Sloan faculty member Dennis Meadows originally developed a tangible board game version of this game in 1993, and revised it in 2001 into its final form, which uses wooden chips to represent each fishing fleet, with the purpose of illustrating the collective sharing of a common pool resource (“Not enough fish”, 2013). In 2011, MIT Sloan faculty member John Sterman created an interactive, scalable web-based version (“Not enough fish”, 2013). “It [Fishbanks] can be played during a 90-minute workshop, or over the course of an entire semester, and we’re teaching elementary school teachers how to play it with their students. The basic lessons of the game are relevant at any age”, says Sterman (“Not enough fish”, 2013).

Through the course of the simulation, the outcome that often occurs as a result of the collective group sharing the common pool resource is known as the “The Tragedy of the Commons”. The “Tragedy of the Commons” occurs when several individuals share a limited resource and behave according to their own self-interest rather than the best interests of the whole group (Hardin, 1968). The individuals then consume that resource unsustainably, which results in the depletion of that resource due to overconsumption or under provision. When this happens, there really is no “winner” in the game. The nature of the Fishbanks simulation game often leads agents involved in the various processes to look at short term consequences, and in so doing, deplete and destroy the fish stocks that are critical for long term survival. This is due to the long-term consequences being too temporally and spatially removed, compared to that of short-term consequences, to effectively control behavior.

A strategic systems dynamic NRM decision-making simulation game, called Catch©, was developed as a response to Fishbanks, which is meant to illustrate “The Tragedy of the Commons”. Dr. Harold Glasser, a faculty member and Executive Director for Campus Sustainability at Western Michigan University, created this simulation game in 2009. The simulation is currently available as a board game. Catch© aims to explore individual and collective management of a shared renewable resource in an open access environment (Glasser, 2009). This game uses fish to represent a generic renewable, common pool resource (Glasser, 2009). Like Fishbanks, Catch© operates through the course of ten rounds, with each round representing a year. There is no overly stated goal of maximizing one’s profit and beating the other groups or teams. That is up to the participants to decide for themselves. The participants are explained that the goals to be
achieved by the end of the game are to catch as many fish as you can, but also leave as many fish as possible in the ocean (Glasser, 2009). These goals address the important content of resource allocation and natural resource management. Understanding and trying to achieve these goals also clearly displays sustainability competencies in action by the participants. Fishbanks seems to drive participants to be more concerned about monetary data and the observable net worth outcome, which the goal of maximizing one’s net worth and beating the competition reinforces. This seems to negate participants from fully acknowledging the underlying natural resource management of a common pool resource aspect of the simulation. Catch© is currently only available in board game form.

The primary goal of this project is to make all the Catch© game materials open sourced and available on a web-based platform for the general public to utilize and play. This will be accomplished through a browser based game management utility. This utility will authenticate users, take demographic information, and supply a keychain for logging into the game management system and support the game management process. The game management process includes recording the decisions that up to 6 teams make throughout all of the rounds of the game and a place to include relevant PDFs and Powerpoints. These PDFs and Powerpoints will contain the rules of the game, debrief, game cards, worksheets, etc. The game management process will also include a back-end database that records all of the game activities and responses of the users within the simulation environment. The back-end database will allow for follow up research on how the game is played, the strategy of the participants, as well as to explore game decision dynamics and track the status of the renewable natural resource during the ten rounds of play. It will also allow us to investigate game results relative to a variety of demographic and factors of the game participants and gather data across cultures. These factors include age, race, gender, occupation, major, etc.

This goal will be accomplished by establishing a cross-disciplinary team of researchers, consisting of a behavioral psychology student, computer programmers dealing with front-end, back-end, and database management, a supply chain management student, a tech lead, as well faculty. The faculty members that will be involved are Dr. Harold Glasser and Dr. Alan Rea. Dr. Glasser is the Executive Director for Campus Sustainability at WMU and Dr. Rea is a professor of Business Information Systems at WMU. These individuals bring invaluable and diverse skill sets to the research team. The research team is set to start collaborating the Spring 2016 semester.

Methods and Results

The current project consisted of utilizing a number of online databases to search for relevant articles addressing natural resource management decision-making simulations and games. Some of the databases that were searched include JSTOR and Google Scholar. In particular, articles focusing on Fishbanks were analyzed. EndNote, a software tool for publishing and managing bibliographies, citations and references, was used to archive the articles relevant for NRM simulations research. The articles were first read, and then the basic details of the articles (author, title, date, type of source, etc.) were
entered into EndNote. A brief summary of all the articles that were read was also entered into the EndNote system.

Searching and reading the relevant articles resulted in the competition of a literature review of Fishbanks, as well as a draft of a brief analysis of NRM decision-making simulations. These analyses were done in preparation for the research team’s collaboration. As a researcher, it is important to become well informed of the topic of interest before further exploring the issues surrounding that topic. Conducting these analyses were helpful in preparing for working with a team of researchers who may have little or no knowledge of NRM decision-making simulations and games.

NRM decision-making simulations have been shown to be socially valid and are effective in getting participants to actively engage in an educational setting. Common principles discussed among the literature that are crucial for evoking learning include debriefing, feedback, negotiation and compromise, collaboration and cooperation, the presence of a teacher or facilitator, and devising heuristics that promote the occurrence of systems thinking. The literature pertaining to Fishbanks has shown that Fishbanks has received positive remarks from the participants engaged in the simulation through written surveys and verbal responses. The literature also provides evidence that suggests that FishBanks has a valid purpose for being in the classroom because it adds educational value and makes the course more interesting and experiential. FishBanks has been shown to engage students, and the students provided feedback stating a perceived increase in analytical reasoning and critical thinking skills.

Commentary, Reflection, and Next Steps

The next steps include to now actually finalize and plan meetings with the multidisciplinary team to transform Catch© into a web-based application with all of the material being open source. This will begin the beginning of the Spring 2016 semester. Through the overall analysis, it has been concluded that more research needs to be done to clarify and state specific research questions to be addressed and whether the learning outcomes meet the goals of simulations through quantitative measures. The intent of the learning goals of the simulation should be evident to the agents interacting in the system in order to bring about the intended decision-making strategies and heuristics that are pertinent for sustaining and maintaining the NRM system. In reflection, it was also found that a lot of the studies implement the simulation to see how the agents act in the environment and then gauge learning outcomes through survey measures or through being engaged during the simulation. It would be an assumption to conclude that being engaged equates to learning. There is also a shortage of establishing and stating dependent variables and independent variables in the research that relate to systems thinking and overt behavior during the course of the simulation. How can we confirm a change has occurred without specifying the behavior that is being measured? The literature often lacks identifying what the experimenters actually intend to measure and how they systematically and operationally define, as well as measure, it. A clearer view of what should be attained by the use of simulation games would surely help the credibility of the field (Ulrich, 1997).
References


