# An Instructor's Guide to Teaching the Pisces Game for Sustainability Ethics

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## Abstract

While sustainability is increasingly recognized as an important ethical principle, *teaching* ethical reasoning skills appropriate for sustainability is problematic. The classic approach in professional ethics education makes intensive use of behavioral codes and retrospective case studies. The least-conventional methods employ creative frameworks for approaching complex moral problems. However, these approaches are limited in their ability to prepare students for the unfamiliar and forward-looking problems of sustainability because they emphasize abstraction and reflection at the expense experimentation and experience.

Our Sustainability Ethics Pedagogy compliments the traditional methods by providing an experiential learning encounter for students that mimics real life ethical dilemmas. Using non-cooperative game theory, we simulate problems of collective action where tension exists between individual interests and group benefit using grade points. Four games have been developed that focus on salient sustainability problems including environmental externalities, Tragedy of the Commons, weak vs. strong sustainability, and intergenerational equity. The games are designed to foster strategic deliberation and interactions among peers to achieve the ideal class outcome. A successful group playing our games will collectively cooperate by acting in the interest of the entire class, which is likely to be representative of a sustainably managed system.

Each of our ethics games brings students completely around the Kolb Learning cycle, which includes four stages: 1) abstract conceptualization, 2) active experimentation, 3) concrete experience, and 4) reflective observation. Our pedagogy is organized into game modules that start with a review of theory and relevant concepts in the form of assigned readings and lectures. Then students are primed for game-play by experimenting, collaborating and strategizing with peers. Game-play consists of active deliberation, negotiation, and sometimes frustration, as students confront issues of trust, leadership, communication, and cooperation. Post-game play, students reflect on their experience through class discussions and reflective essays. The individual grades from game-play, various writing assignments, and participation in class discussions provide a quantitative assessment for the game module, but do not capture much of the qualitative learning and outcomes inherent to experiential learning. Each game experience results in surprising outcomes and topics of discussions that are difficult to categorize or sometimes even articulate.

A popular game we have developed and tested is called the Pisces Game, and has been designed to introduce the concept of the Tragedy of the Commons. The game can be played in class or online (i.e. discussion boards, tweets, or wikis) and takes about 60-90 minutes, depending on the number of players. Students are divided according to their individual zodiac sign, which determines the teams and the order of play. Each zodiac group represents a village of fishermen and all the villages are fishing from a shared common lake to survive. Each village has a single fishing boat (with limited carrying capacity) and on each turn, can harvest fish from a common lake. Villages must harvest enough fish in each round to survive (four per person). Any extra fish may be used as capital to build a private fish pond, stock their private pond with fish; or share their fish with other groups. Some teams may opt to eat as many fish as possible to gain points towards their grade, others may adopt strategies to manage the common lake or help other teams survive. The teams at the end of the harvest order (e.g., the Pisces team) are at a disadvantage because they will often suffer from a lack of available common resources. This fosters discussions of fairness and responsible decision-making during and after play.

During the Pisces game we have witnessed conflict, signs of emotional investment, great selfishness, and genuine altruism. Playing the game online with classes at different universities has resulted in rich experiences for our students. It introduces challenges to overall communication and cooperation and creates incentives for selfish decision-making. Many game experiences include extremely active participation from a few, with the rest of the class following their lead. It is important to keep in mind that learning can be done even at low participation levels, and that it is an essential role in teams and collective action. We have begun building perturbations into the games (i.e., introducing a new rule half-way through the game) to see how various interventions effect learning outcomes. Our hypothesis is that given the right perturbation, we may be able to engage more members of the class while simultaneously introducing additional impediments to cooperation.

In general, we observe that moving from a traditional pedagogy to the game-based pedagogy fosters a transition in students from spectators to players, from passive to active, from apathetic to emotionally invested, from narratively closed to experimentally open, and from predictable to surprising.

## Introduction

Traditional ethics education employs exemplary case studies to teach students about responsible moral decision-making. For example, an Australian engineering ethics course examined 30 case studies of ethical failures that were presented and analyzed in the classroom (Bowden, 2008). This is problematic because abstract case studies only teach students to recite normative information (e.g., general rules of moral conduct), but fails to deliver the valuable experience of personal cost involved in real ethical dilemmas. Moreover, the classic read-discuss-write strategies typical of the humanities emphasize abstraction and reflection at the expense of two modes of learning more familiar to many professionals (e.g., engineers and physical scientists): experimentation and experience.

Less conventional approaches to ethics teaching allow students to experiment with moral problem solving using familiar frameworks. For instance, engineering students at Northern

Arizona University (NAU) were asked to role-play an ethics problem and apply the engineering design process to ethical decision-making. (Bridget Bero, 2011). While students are sometimes taught novel ways to analyze ethics problems, they still do not encounter the real-world challenge of the ethical dilemma through these approaches.

Other ethics pedagogies attempt to provide realism for students, and require students to imagine the problem being examined. In one study, public relations (PR) students interviewed PR professionals about real ethics problems they had faced. This helped students 'relive' the experience and pre/post surveys indicated the students connected ethical theory to the real-world situations (Eschenfelder, 2011). Imaginative as this may be, it falls short of providing students with the tensions characteristic of urgent, real-time, and personal ethical conflicts.

A study at the University of Houston (UH) Engineering School compared traditional abstract ethics pedagogies to using an online tool that simulates ethically challenging scenarios, in which students must gather data, assess the situation, and make decisions. Pre/post surveys indicate the simulator to be superior to traditional abstract methodologies (Christopher Chung, 2009).The UH results confirm the pedagogical advantage in simulating real-world ethical dilemmas as a teaching strategy.

Our Sustainability Ethics Pedagogy builds on the strengths of the aforementioned approaches by creating real dilemmas for students through non-cooperative games which result in a grade for each student. The games are characterized by complex interactions, conflicting interests, constraints to achieving universal success, and frequently produces surprising consequences, communication challenges, moral ambiguity, and pronounced time constraints that are not replicated in other current ethics pedagogies. While there is valuable learning in the other pedagogies mentioned above, we find that our Sustainability Ethics Pedagogy provides an experiential learning encounter that comes closer to mimicking real life ethical decision-making.

## A Game-based Pedagogy

The Sustainability Ethics Pedagogy has developed non-cooperative educational games that are based upon game-theoretic tensions and structure. Non-cooperative game theory is a tool used to understand the strategic interactions among two or more agents, where what is best for one decision maker may depend on what the other decides to do and vice versa (e.g., the classic prisoner's dilemma). Non-cooperative games help illustrate the ethical ramification of a player's decisions, as well as the way in which these decisions influence the behavior of others. The games give students valuable experiences by simulating the tension between individual-level interests and group benefit, which is characteristic of *collective action problems* (Ostrom, 1990).

In the games, the lack of a third party enforcer (e.g. the police) forces the players to decide the best course of action as a group. That is, there is no government or authoritative figure guiding players to either make responsible decisions or keep their promises to other players. Elinor Ostrom's research shows that individuals are only trapped by the Prisoner's dilemma if they passively accept the suboptimal strategy, but they can overcome and succeed by creating contracts with other players who are likely to cooperate; ultimately they must create an institution for collective action that benefits all (Ostrom, 1999). A successful group playing our games will collectively cooperate by acting in the interest of the entire class, which is likely to be representative of a sustainably managed system.

Our pedagogy for sustainability ethics is comprised of four non-cooperative, game-theoretic modules, which include pre-game and post-game activities and suggested assignments. The games present students with collective action problems based upon salient moral issues inherent to sustainability, including: 1) environmental externalities, 2) the tragedy of the commons, 3) weak versus strong formulations of sustainability, and 4) intra-generational equity (Seager & Selinger, 2009). In all of the games, we position students in explicitly social settings that require coordination of decision processes to ensure group success. More specifically, students earn grades for their individual decisions during game-play, which also play a role in determining the grades of the other students in the class. The games are designed to steer students towards two moral questions: "What are my obligations to my fellow classmates?" and "What am I willing to risk in my own well-being to meet those obligations?"

In this guide we will describe how to successfully administer our games to your class. We will first tell you *what to think* about in preparation for and during game-play, explain *what to do* in terms of the actual activities and assignments involved in the particular game-modules, and *what to expect* from your students during and after playing the games.

## What to Think About

As sustainability attracts increasing interest, the ethical principles it encompasses are becoming more important, yet they generate unique teaching difficulties. While the traditional pedagogy in professional ethics education makes intensive use of behavioral codes and retrospective case studies, these approaches are limited in their ability to prepare students for the unfamiliar and forward-looking problems of sustainability. Sustainability ethics specifically addresses issues of equity between and among generations, systemic consequences to actions, and forward oriented thinking that is challenging to capture in general ethical codes of conduct.

In using traditional pedagogical methods educators may,

(1) decrease engagement by employing only abstract and conceptual approaches to learning,
(2) limit curriculum to being static and retrospective, which fails to prepare students for future problems in a world of changing morals and expectations (e.g., unfamiliar ethical dilemmas surrounding topics like biotechnology or geo-engineering) ,
(3) fail to account for unexpected developments, the essence of moral dilemmas,
(4) lack an experiential element, leaving students subject to the fallacy of the moral saint where beliefs are inconsistent with actions,
(5) fail to capture the complexity and contextual importance of real moral dilemmas,
(6) not create a shared experience which is important in facilitating a productive group discussion with which students and teachers can relate personal experiences, and
(7) reduce students ability to reason through a problem by leading them toward a pre-conceived conclusions.

Our pedagogy is a solution to these deficiencies because it creates a platform for rich experimentation and improvisation where real ethical learning comes from unanticipated outcomes.  Important ethical questions are always surprising because predictable ethical questions are likely to have already been addressed and regulated by law or codes of ethics. Teaching ethics is not about the imposition of standards, but the development of an approach. For a student to develop an ethical thinking process they must be allowed to practice in a similarly stressful scenario, yet most people do not find themselves in these dilemmas until they are facing dire consequences.

Central to a student's personal journey is improvisation from the instructor and flexibility from the curriculum. This is the beauty and difficulty of the game; surprising situations are likely to start by students questioning the boundaries and rules, and the instructor must know how to react to this. If the game becomes a data entry exercise it loses its value, so the instructor must force students to question their actions and their implications. As Dewey writes, "Experience and experiment are not self-explanatory ideas. Rather, their meaning is part of the problem to be explored," (1938, P. 28). The improvisational teacher must facilitate that exploration. Additionally, the social elements of the games build auxiliary skills important to sustainability ethics and professions in general, such as teamwork, leadership, and communication.

To further understand how our pedagogy is an improvement to the status quo of ethics education, we introduce the Kolb learning cycle, which is the theoretical foundation of our ethics pedagogy. According to the Kolb learning cycle, a successful learning experience contains both active and passive styles of learning, these include: 1) abstract conceptualization; 2) active experimentation; 3) concrete experience; and 4) reflective observation (Kolb, 1984). These learning components occur sequentially, transitioning from one learning style to another as displayed in the representation of the cycle in Figure 1. *Abstract conceptualization* is thinking about the underlying principles of a system. This includes theories, patterns, rules, methods, and beliefs. *Active experimentation* is testing knowledge gained, trying out various methods or strategies and beginning to create a personal working understanding of the system. *Concrete experience* is the creation of a discursive understanding of the system and an explicit experience on which to reflect. Finally, *reflective observation* is when a person describes and analyzes the effects and outcomes of their experience. What worked and what did not? What was observed? What did you learn about yourselves and/or others? The learning process can begin at any phase, but in regards to our game pedagogy, the learning process begins with abstract conceptualization.

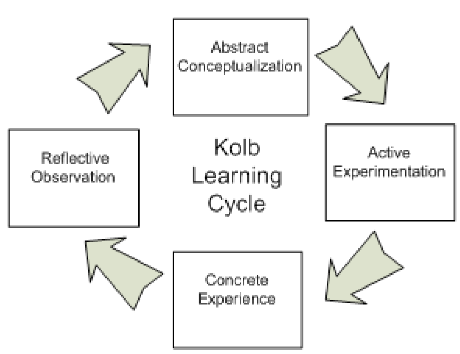


**Figure 1. The Kolb Learning Cycle includes both active and passive components**

## What to Do

Each of our ethics games brings students completely around the Kolb Learning cycle. All four modules start by priming students for game play through assigned readings, PowerPoint style lectures, as well as videos. This provides the background information and theory for the particular sustainability issue and allows students to *conceptualize* the problem and possible solutions. Theory may be assessed through graded writing assignments such as formal essays or less formal entries online (wikis, tweets, blogs, etc.) Next, students are encouraged to *experiment* with the each game's unique calculator (used to model decisions and consequences) to become familiar with how the game works and to determine possible game strategies.

Before playing with the entire group, students must hypothesize what will happen during game play, and comment on the level of cooperation they expect from their peers. This serves as an assessment tool for experimentation, as they apply theoretical solutions to their knowledge of the game. While playing the ethics games, students *experience* the consequences of their moral actions on themselves and others. For an outline of how our pedagogy addresses the specific components (objectives, activities, assessments, and expected outcome) of each learning stage of the Kolb cycle, see Table 1 of the Appendix.

### *The Pisces Game*

The most widely adopted of the four games we have developed and tested is called the Pisces Game. It has been tested at six different institutions, including graduate, four-year undergraduate and community college settings. The game is designed to introduce the concept of the Tragedy of the Commons. We outline the complete game module below.

*Theory*-- The Tragedy of the Commons (TOC) has explicit moral implications (Hardin 1968). Devising a solution is tricky because individual incentives are in conflict with collective outcomes, that is, individual rationality leads to group *irrationality*. TOC can be observed in a wide variety of problems in ecology and economics. One example is overfishing, where individual incentives to catch as many fish as possible don't align with the desirable outcome of sustainably managing the fish population. If we model the problem through non-cooperative game theory then there are two possible resolutions: collapse of the fishery resulting from unrestrained competition or a sustainable fishery resulting from self-restraint.

Hardin's theory predicts that the collapse scenario is inevitable without strict individual privatization or third-party enforcement, which could come in the form of government action or cultural norms. On the other hand, more recent work by Elinor Ostrom (1999) describes case studies where groups have successfully managed common-pool resources without government intervention, but rather through local/regional institutional arrangements. The Pisces Game allows students the opportunity to experiment with both Hardin's and Ostrom's theories of managing the commons in the context of fishing for survival on a shared lake.

*Pre-game activities*- Prior to game-play students should be intellectually primed for the exercise by reading Garrett Hardin's *The Tragedy of the Commons* (1968) and Elinor Ostrom et al's later response entitled *Revisiting the Commons: Local Lessons, Global Challenges* (1999). By reading these articles students gain the abstract knowledge necessary for them to understand the theory and potential solutions for managing common resources. Once the students read these articles, it helps to solidify their understanding through a powerpoint lecture, such as the one we created, that reviews the articles and explains the biologically-based reproduction function used within the Pisces Game. Showing your class a youtube video of Ostrom herself explaining the theory above may also be advantageous. Understanding the theory may be assessed through graded writing assignments such as formal essays or less formal entries online (wikis, tweets, or blogs).

After the lecture, the students should be provided with game rules as well as the game calculator spreadsheet. Encourage your students to actively experiment with game strategies using these materials. For homework, tell the students to familiarize themselves with the rules as well as provide a hypothesis of what they think will happen when the class plays. They are expected to apply the theory and concepts they learned in class to justify their hypothesis. This serves as an assessment tool for experimentation, as they apply theoretical solutions to their knowledge of the game.

*Game-play*-- The actual game-play experience occurs in class and takes about 60-90 minutes, depending on the number of players and how long the teams are allowed to deliberate between decisions. The instructor administers the game and records the team’s decisions in the game calculator. The game can be played once or multiple times, depending on time availability and at the discretion of the instructor. First, the instructor divides students into teams based on their individual zodiac signs, which determines the teams and the order of play. By using zodiac signs, the class is grouped in a random manner that causes team sizes to vary and allows students to experience what it’s like negotiating with different sized groups. Additionally, the teams at the end of the harvest order are at a disadvantage because in later rounds they will often suffer from a lack of available common resources. The tension between teams that can harvest early in each round with those harvesting later fosters discussions of fairness and responsible decision-making during play.

The storyline of the game can be explained like this: Each zodiac group represents a village of fishermen and all the villages are fishing from a shared common lake to survive. Each village has a single fishing boat and on each turn, can harvest fish from the common lake. The boat capacity is equal to number of people playing the game (e.g., if there are 30 people playing in the class, then a village can take up to 30 fish from the common lake per round). At the end of each round of play (i.e., once every zodiac village has had a turn to harvest), reproduction occurs in the common lake. Reproduction increases the fish population in the lake by as much as 30% or as little as zero, depending upon the current fish population and carrying capacity of the lake (which varies depending on the number of players in the game). The reproduction function is parabolic (see Figure 2), which means that the reproduction rate is highest when it is at about half capacity (also known as maximum sustainable yield or MSY) and decreases when the lake’s population is close to empty or close to the carrying capacity.

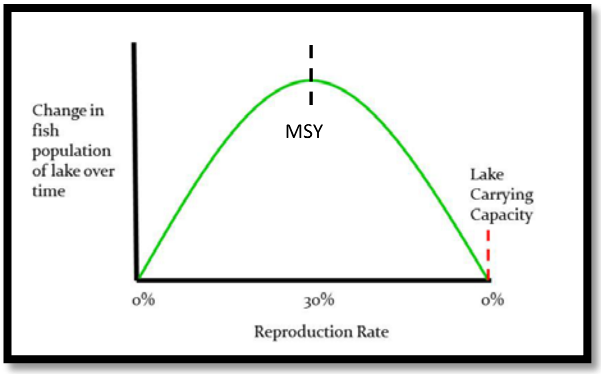


**Figure 2. Schematic of the common Lake reproduction function**

Villages have four options for the fish they harvest: 1) In order to stay alive, each group must eat at least 4 fish per person in their group every turn (i.e., if you have 2 villagers to feed, you need 8 to eat 8 fish per harvest). Fish eaten go towards each individual's grade; one fish eaten equals one grade point. Note that if a group cannot eat 4 fish per person then they must decide which member(s) of the group will "die" and will no longer be able to play OR appeal to other groups to share (see option 4). An individual's final grade is the sum of all the fish they ate in previous rounds. 2) The group can also use fish (i.e. capital) that they harvested from the common lake to build a private fish pond. The carrying capacity of the private fish pond increases at a parabolic rate, described by equation (1) and represented schematically in Figure 3:

$$\left(\frac{\sum fish\ invested}{2}\right)^{1.5} \qquad (1)$$

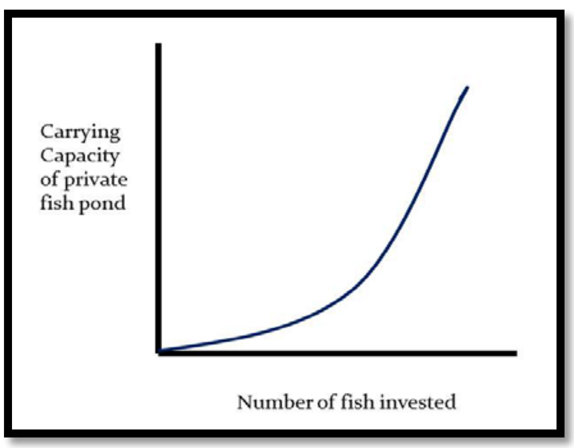


**Figure 3. The carrying capacity of a village's private pond increases according to a parabolic function.**

Hence, the private pond can only hold a small quantity of fish with initial investments, but the size of the pond increases rapidly after significant investments are made. 3) The group must also stock their pond with fish that they harvest from the common lake. Fish in your private pond reproduce at a 30% rate, up to the carrying capacity of the pond. Note that the number of fish in the private pond cannot exceed the pond's carrying capacity. The benefits of the private pond are that no other group can extract fish out of a group's pond and, unlike the common lake, the reproduction rate in the pond remains stable due to a lack of predation and disease. Also, there is no limitation to how many fish a group can take out of their own private pond in one round. 4) Groups can also share their fish with other groups, if they desire, but fish can only be transferred to groups that have yet to harvest in the current round. We call this the 'pay-it-forward rule' and introduces a challenge for some popular strategies (i.e., collective fish pond ownership). Villages report their decisions to the class on each turn in a consistent manner that corresponds to the spreadsheet for ease of data entry, see Appendix section entitled, 'Data Entry' for more information. If a village fails to report their decisions to the instructor in the time allotted, the harvest order is updated so that the delinquent village goes last in the current and all subsequent rounds of play.

The remaining population of fish in the common lake is calculated and announced after each full round of play by the instructor. If teams harvest fish in the common lake to extinction, the game can continue only for teams that have enough fish in their private ponds to eat the required four fish per person. The game ends after eight full rounds of play, or when there are no villages left "alive." Final grades are assigned based upon the sum of all consumed fish that the individual consumed.

During actual game play, students experience ethical tensions directly as they make decisions that impact themselves and others in the class. By observing the interactions among students, tracking individual/team decisions, and through the communication record of online chat boards, instructors may assess the quality of discourse. The resulting game grades of each player will quantitatively express the level of coordination obtained. That is, a large variation in scores suggests a competitive environment in which decision-making is unilateral, whereas low variation implies successful class collaboration.

*Post-play*--After game-play, the instructor facilitates a reflective discussion. In particular, students are asked to comment on why they made particular decisions, if/how they were influenced to make certain choices, what they thought their moral obligations to other groups were, and how they might play differently under different circumstances. Discussion often focuses upon questions of responsible management (by sustaining the common lake of fish) or individual well-being (by consuming fish for grade points). Students should be assigned the task of composing a reflective essay on their individual experience of game-play (refer to the 'Reflective Exercise' section of the Appendix). We have found that the Pisces Game module is best administered over multiple classroom sessions, rather than attempting the difficult task of packing everything into one class period. For more teaching suggestions, including a discussion of improvisation by the game-administrator, see the 'Additional Teaching Tips' section of the Appendix.

*Online Game-Play Option:* An option for administering the Pisces game is through an online communication platform called EthicsCORE, which allows students the opportunity to play the Pisces game online with their peers with and/or against other classes at other universities. Students are encouraged to communicate via EthicsCORE, where they can strategize, deliberate, and inform each other of what is occurring in multiple classrooms. Online play adds a new dimension to game-play, in that decisions made by an individual student, or a small group of students, will impact the grades of those present in the same classroom and also the grades of students located at distant geographical locations. This allows game-play among students with potentially very different experiences, cultures, and educational backgrounds to collaborate in ethical decision making and creates a much more realistic and applicable ethical situation for the students to experience. There is also the opportunity for players present in one class to make decisions that affect others who are absent from the deliberation. Thus, playing the games across universities allows instructors to simulate intergenerational ethical considerations, as a class that meets at an earlier time at one university represents an earlier generation, and a later class plays the role of the next. Instructors can also use EthicsCORE as a tool for cooperative teaching and for reporting their game-play experiences to other game administrators.

## What to Expect

At first students can be intimidated and resistant to the unfamiliar and interactive classroom structure. However, the unstructured nature of the class will allow leaders to emerge. Activities are characterized by peer deliberation and conflict, signs of emotional investment, and extremely active participation from a few individuals, with most others following along. In general, we observe that moving from a traditional pedagogy to the game-based pedagogy fosters a transition in students from spectators to players, from passive to active, from apathetic to emotionally invested, from narratively closed to experimentally open, and from predictable to surprising. Next we describe two exemplary experiences with playing the Pisces game.

### *Narrative of in Class Game-play*

The Pisces game was administered to an undergraduate Environmental Ethics class at the University of Arizona (U of A), in Tucson. A diverse range of strategies were implemented by different groups in the game. Some groups opted to catch and consume as many fish as possible for maximum, short-term returns in grade points. Other groups decided to invest in their own private ponds. Three groups joined efforts in the first round of play and formed a collective, in which the groups worked together to build and stock one large private pond. Alternatively, one student attempted to be a “conservationist” by only catching enough fish to survive. The altruistic efforts of the conversationalist motivated another group to share fish with him. The conservationist first reacted by passing the fish to another group; however the second time he chose to return the gifted fish back to the common Lake.

Although the game was played for only three-and-a-half rounds (due to class time restraints), the many diverse strategies that were represented fostered a productive discussion. The class conversed about the ultimate outcomes of each attempted strategy and the moral questions surrounding them. For example, the conversationalist and the immediate consumers were prompted to debate over their approaches to the game and to explain their actions to their peers.

### *Narrative of Online Game-play*

The Pisces Game was also administered online with the Sustainability Ethics class at Arizona State University (ASU) and two introductory Engineering classes at the nearby Mesa Community College (MCC). The first MCC class (MCC1, about 24 students) played the first four rounds of the Pisces Game in isolation and passed the resulting shared lake of fish and group resources to students in the later, but simultaneously scheduled MCC (MCC2, about 24 students) and ASU class (ASU, about 70 students). MCC2 and ASU thus inherited resources from MCC1 and had to complete the final rounds of play through online communication between classrooms via EthicsCore.

MCC1 obviously had a simpler task (less students playing in a single classroom), and came to class prepared with a “master plan” of action. Two students in particular emerged as group leaders and explained the plan to the entire class. As a result, there was a concerted effort to earn high grades through class wide trust and effective communication. All members of MCC1 earned a score of 80% with little conflict and felt pleased with the resources they would bestow on the second generation, MCC2. MCC1 left a message online for MCC2 to enable continuation of the ‘master plan”.

MCC2 and ASU struggled much more than MCC1, as they were trying to organize geographically separated teams to coordinate a synchronized group effort. In MCC2, many students seemed unaware of the ‘master plan’ or even the rules of the game. ASU, on the other hand, had students that were more prepared and were able to build upon the ‘master plan’ provided. Leaders emerged at ASU and elicited the cooperation of teams, suggesting to the MCC2 students that they entrust all decision-making authority to them- a suggestion that created resentment among MCC2 players.

An unexpected occurrence in the game created an interesting dilemma for students. It was discovered that a clerical error in data entry was committed during the last round of play by MCC1 that resulted in the “death” of thousands of fish, and drastically reduced grade expectations for both MCC2 and ASU. The students’ immediate response to discovery of the error was to appeal to the instructors to correct it. The instructors refused, explaining that analogous, unforeseen circumstances occur in real-life and that moral reasoning requires confronting conditions that are unexpected, and even unfair. As a result, the unforeseen error became a ‘perturbation’ to the system and created an interesting teaching moment for the instructors as well as an interesting point of discussion post game-play. While some students assumed that the mistake originated with MCC1, this fact was openly contested by others who thought of this as unfairly passing the blame onto earlier players.

We found it remarkable that despite the communication difficulties and incentives for selfish play (i.e., identity and tacit knowledge of each separate group, the lack of personal experience with players in the other classrooms, and the unforeseen clerical error), the students were successful at coordinating a desirable group outcome and actively committed themselves to achieving it. MCC2 and ASU completed the game, earning a grade of 78% for all players.

Recording the online communication between universities via EthicsCore allowed us to review the quality of communication and level of team conflict through game-play and offers a unique view for instructors to understand the students’ game-experience. By coding the online chat, we have documented the progression of conflict through the game-play experience (Figure 4). Some individual teams recorded little to no conflict among themselves, which may be the result of smaller teams, effective leadership, and/or greater adaptability. Most statements within teams were non-argumentative and were attempts to reach out to team members in the other classroom.

However, in the general chat (where players could communicate between teams) a different story emerges. Contributions to the general chat began when the mistake in the game calculator was discovered. There was obvious conflict among students concerning the error, with some students attempting to explain the situation to others.

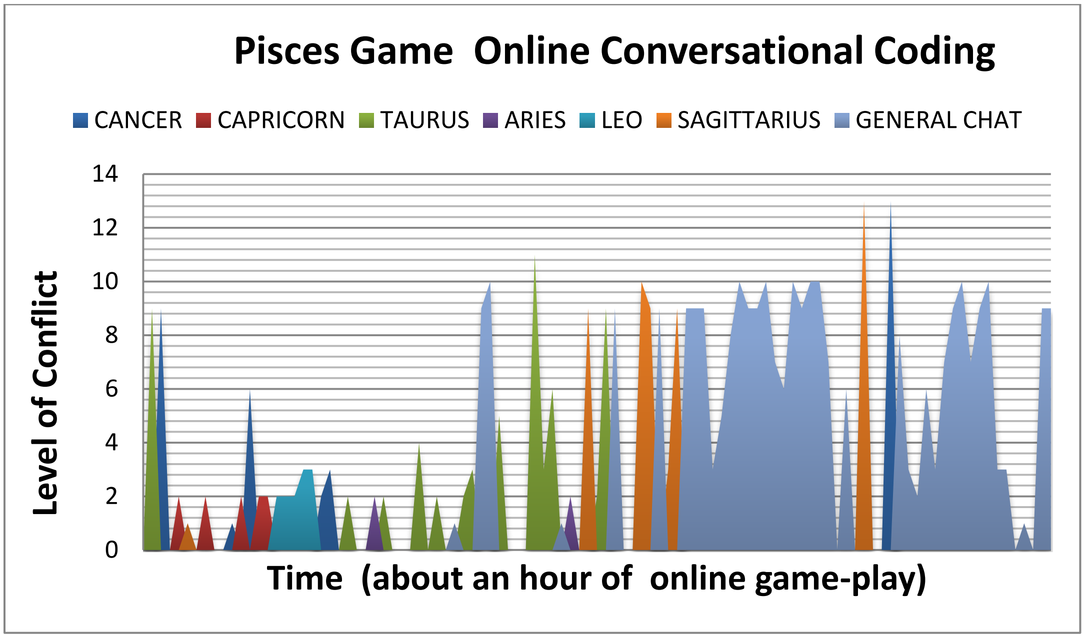


**Figure 4. The online chat messages for the game were decoded using the Conversational Argument Coding Scheme by Daniel Canary (1987). This coding highlights levels of conflict within conversations using 14 different codes which can be arranged by increasing levels of conflict. The bright colors indicate level of conflict among members of zodiac teams, whereas the light blue represents conflict in the general chat across teams.**

At the close of the game several players expressed their frustrations in their game-play experiences. Students from MCC2 generally felt that they were not as involved in the game as they should have been, and made statements about the disorganization and unwillingness to communicate by ASU members. The arguments within the general chat confirm issues of trust, communication, power, and threats that peak near the end of the game. Although there was evident conflict between groups of players, they were able to operate under almost complete cooperation in *action* to achieve the highest grade that could be earned by all players evenly.

### *Student Reflections*

Following the MCC & ASU game, students were asked to reflect on their experience. Here are a few quotes and statements from the students themselves:

- "My hypothesis before the game was that students would initially start to work together for the whole class, but greed would overcome and a good portion of the class would fail. Luckily I was wrong";
- One of the students who became a leader, felt like they "subverted" the intent of the game because they were so organized and somewhat unconventional;
- The class agreed that they were focused on "beating the tragedy of the commons";

- Each student cooperated with the rest of the class because no one wanted to be “that guy” that ‘screws’ the rest of the class;
- Those students who followed the advice of the leaders did so because “they had it all figured out” and “there would be too many chiefs and not enough Indians if everyone worked their own plan;
- Some of the communication with ASU occurred by phone, and that created additional stress;
- “The majority of villages followed the steps set forth prior to the beginning of the game, creating a mutual coercion that forced other villages to question selfish acts - due to the fear of social consequences and thus, saving the commons”;
- “I was a little surprised at how well everyone worked together to design a solution after the lake dried up, but not surprised that all were willing to follow along.”

### *Learning Points and Outcomes*

Our experience demonstrates that through our pedagogy students gain critical team-work skills in addition to moral reasoning. Here describe some of the key lessons and outcomes we have observed through game-play experiences so far:

*Trust*-- Trust has been identified as a critical factor for effective team process and performance (Tseng, 2011; Costa, 2003; Geister et al, 2006; Mayer & Davis, 1999). It serves as the glue that maintains the cohesiveness of a team and allows for effective teamwork. (Tseng, 2011). According to Kayworth (2002), trust can exist among individuals even though they have never met, through reputation and credentials and the inherent belief that people should be trusted unless they do something that questions that trust. However this confidence can be undermined by lack of clarity regarding goals, roles and responsibilities (Kayworth, 2002). We also observe trust as a critical factor in our games. Students in general display a strong ability to trust one-another, unless a player gives them a reason not to. Sometimes mathematical or data entry errors are perceived as intentional acts and betrayals of trust and can inhibit group cooperation.

*Leadership, Roles and Responsibility*-- Roles and responsibilities are also important and should be known before the game, particularly in large groups. Leadership, especially in virtual groups, is vital (Kayworth, 2002). We find that leaders often emerge prior to game-play in discussions online between peers. This greatly improves the likelihood of success during actual game-play since they are usually the ones who are prepared with a game strategy to rally the class. Recent game experiences suggest that the presence of a veteran, or students with other previous leadership experiences, reduces the transaction costs of group deliberation since they are natural leaders and well-trusted by their peers already. On the other hand, we find that sometimes a well-thought out strategy is insufficient for group cooperation, if the person trying to unify the class is not trusted or perceived as being incompetent for class leadership.

*Group Tacit Knowledge (GTK)*-- At low levels of GTK groups are characterized by loose assemblages without group identity or self-knowledge and may have difficulty even following instructions or taking orders. Through repeated game-play, students become conditioned by their previous experiences and display an improved ability to adapt by establishing strong lines of communication and constructive dialogue among players and teams. In later game modules of our semester-long classes, students are able to effectively resolve difficulties of cooperation by instituting self-designed governance structures to ensure formation and enforcement of rules that instantiate a collective strategy. This behavior indicates an improved quality of GTK that allows them to improvise unique and effective solutions to unfamiliar, complex problems (Erden, 2008).

*Working in Virtual Teams*-- The dynamics of online game-play illustrate the challenges of working in teams that are disconnected by location, have different identities, and potentially varied norms and expectations. Online communication lacks the qualities inherent to face-to-face environments and limits conveyance of nonverbal cues, such as facial expressions, voice inflections, and gestures (Barczak, 2003). This lack of 'social presence' may hinder the ability of teams to develop relationships and trust. We find that playing the game online does challenge students to communicate effectively, but that most groups overcome the challenge by identifying leaders and entrusting others to make decisions on their behalf.

*The Power of Collective Action*—Students playing the Pisces Game are confronted with a collective action problem, where their individual interests are at odds with the group benefit. Consistent with the structure of non-cooperative games, students will find that the success of the group is dependent on almost universal buy-in of the group effort, because a few selfish actors can ruin the altruistic efforts of the majority. This is well-aligned with collective action problems in the real-world and therefore teaches students that certain issues (e.g., climate change) can only be effectively addressed when recognized as *macro-ethical* issues (Allenby, 2005).

*Ethical Decision-Making*—Inherent in the game-design, are situations where students must make ethical decisions that impact others. We focus the moral questions that students confront in the games with two questions: "What are my obligations to my fellow classmates?" and "What am I willing to risk in my own well-being to meet those obligations?" We find that often students recognize their obligation to others, at least conceptually, outside of the classroom (i.e., giving to the less fortunate or responsibility to the public), but do not transfer that feeling of obligation to other students in the game. An interesting outcome of the game and the post-game reflection is the realization that identifying the 'right' decision is not sufficient for responsible moral decision-making. What counts is actually following through by 'doing the right thing' when personal interests are on the line.

*The Reality of Group Work*-- When large classes participate in ethics games, we have observed that it is nearly inevitable that a power law relationship will emerge in which roughly 20% of the students do 80% of the work, and the remaining 80% rely on that 20% to think for them. This is consistent with the Pareto principle, created by Joseph Juran, in which 80% of consequences typically stem from 20% of causes (Bunkley, 2008). Analysis of discussion activity and observations from game sessions supports this assertion for the online Pisces game. Figure 5 shows the number of posts each student made to the online discussion boards while playing the Pisces game in a recent test. The red line shown in Figure 5 is a power law equation fitted to the data indicating the number of posts per student in online discussions. The R squared value of 0.88 indicates that equation fits the data fairly well. The trend line is intended to help better visualize the uneven distribution of the level of participation of students. Also of note is the fact that because of enhanced participation of the top students, the rest of the class are technically below the average represented by the trend line in terms of their participation.

Typically, several students work together to devise a plan that seems acceptable to the rest of the class, who then follow orders unless something goes wrong. Even in such a scenario, if the leaders are able to come up with a plausible solution to the problem, most of the class will continue to follow. In this way a power law distribution can be observed during actual gameplay in addition to in online discussions. See section ‘Power Law Leverage Points’ in the Appendix for ways to deal with low participation rates in your classroom.

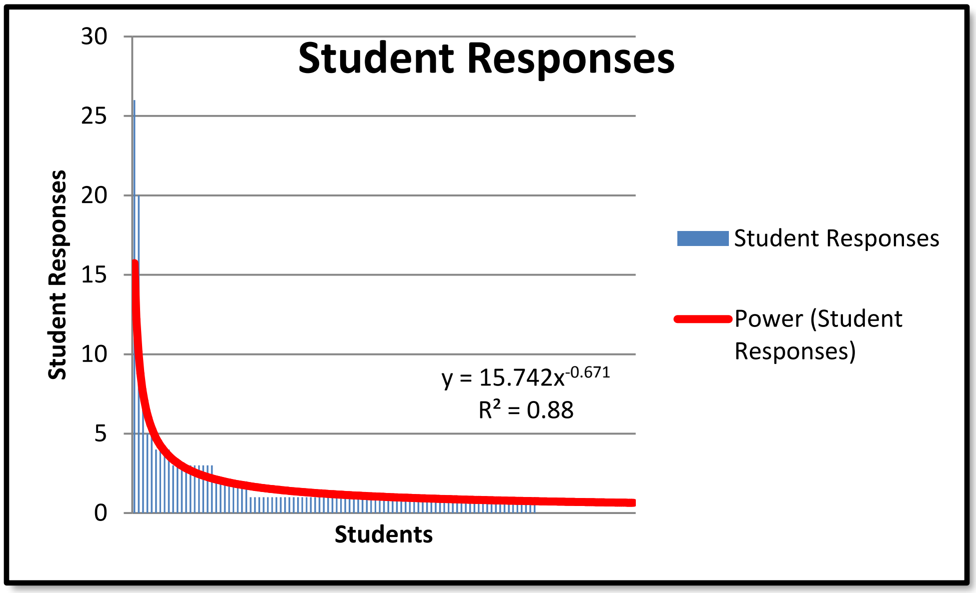


**Figure 5. The number of posts by students during game-play display a power-law relationship, found to be typical of group work in general.**

## Conclusion

The learning outcomes identified above likely account for only a small portion of the lessons that may be delivered by our game-based pedagogy. Each game experience results in surprising outcomes and topics of discussions that are difficult to categorize or sometimes even articulate. The individual grades, various writing assignments, and participation in class discussions provide a quantitative assessment for the game module, but do not capture much of the qualitative learning and outcomes inherent to experiential learning. Time and time again students report that their participation in our pedagogy is enjoyable and elicits quality ethical discussions and reflection on personal behaviors and decisions. Despite our current inability to quantify our pedagogical success, both the instructors and students who employ our game modules serve as a testimony to its effectiveness at teaching Sustainability Ethics.

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# Appendix: Additional Information

## *Kolb Learning Cycle and Sustainability Ethics*

Table 1 outlines how our games specifically address all four stages of the Kolb Learning Cycle of the cycle and the detailed components of each stage (objectives, activities, assessment, and outcomes).

**Table 1. Modules are organized to bring students through the complete Kolb Learning Cycle.**

| | Kolb Learning Cycle Stage | | | |
|---|---|---|---|---|
| | **Abstract Conceptualization** | **Active Experimentation** | **Concrete Experience** | **Reflective Observation** |
| Objectives | • Provide background for sustainability issues<br>• Introduce related theory and general ethical codes of conduct | • Learn how the game works<br>• Determine effective strategies<br>• Identify successful outcomes | • Directly experience ethical decision making with classmates<br>• Sharpen deliberation skills<br>• Practice discourse ethics | • Develop realizations of individual moral fiber<br>• Confront discrepancies between what they say they would do and what they actually did |
| Activities | • Assigned readings<br>• PowerPoint lecture<br>• Educational videos | • Experiment with game calculator<br>• Discuss possible outcomes of various strategies and thought experiments<br>• Students may take a trial and error approach to game-play | • Navigate non-cooperative situations<br>• Role playing<br>• Negotiating & deliberating with classmates<br>• Opportunities for leadership and teamwork | • Compare hypothesis to results<br>• Relate to real-world collective action problems<br>• Debate the actions of classmates<br>• Classroom discussions<br>• Completing reflective writing assignments |
| Assessments | • Graded writing assignments such as essays, wikis, tweets, and discussion board entries | • Students apply theory by publically hypothesizing about expected behavior | • Individual and average grades<br>• Communication record<br>• Observation of game-play interactions<br>• Sharing of game points | •<br>• Graded reflection essays on their experience and/or how they might<br>• redesign system for more cooperation |
| Outcomes | • Students develop interpretations and conceptualizations of<br>• sustainability problems | • Game strategy<br>• Some students emerge as group leaders at this stage | • Relationships and trust between classmates<br>• Heightened emotions and memories<br>• Teamwork skills<br>• Improve ability to improvise<br>• A sense of accountability to classmates | • Group tacit knowledge<br>• Students alter their perceptions and interpretations of theory and conceptualizations |

## Additional Instructor Tips

The ethics games can be challenging to administer because they are nothing like traditional board games, i.e., games that can commence as soon as the step-by-step rules, which bound the game into deterministic relations, are grasped. Instructors can run successful games only by improvising when confronted with unexpected, emergent behavior. For this reason, preparing to run a game is quite a different process than preparing to deliver a typical lecture. Good lectures can be delivered after material is studied and put into a controlled format that is constructed for optimal comprehension and, perhaps, audience participation. This format essentially limits improvisation to ad hoc responses to student questions. By contrast, the games require ongoing, "on the fly" judgments concerning how to best respond to unpredictable student behavior—behavior that directly impacts the feelings, options, and grades of other classmates, and behavior that has direct implications for how players grasp their own moral character. Hence, to run an effective game, it is best to think of oneself as a facilitator.

Although every game is designed with clear learning objectives in mind, instructors can adjust them so that desired skills and content become focal points. In other words, the games can be shaped and molded to be appropriate for a wide variety of teaching contexts. For example, if instructors want to use the games as a tool for exploring leadership, they can modify how the games are presented, calibrated, or run so that students are likely to confront situations in which collaboration requires select players to step up and assume leadership positions. Instructors can also alter the meaning students associate with the games by delivering them in conjunction with self-selected readings that are analyzed in relation to behavior observed during game play, e.g., texts on the ethics of leadership that can serve as ideals from which to judge the conduct of leaders and followers in the games.

Game facilitators need to exercise judgment to bring out moral tension during game play. Amongst other things, this means:

1) Adjusting to emergent behavior with thoughtful ways of responding to student questions about what moves are and aren't permissible;
2) Determining what information is shared with students in advance and what information is presented to students in class, to minimize the amount of advanced preparation available;
3) Determining when to shorten (e.g., if things become too intense) or prolong (e.g., to extend tension) aspects of game play;
4) Determining when important ethical issues arise that students should be more sensitized too;
5) Determining when to add supporting material (e.g., articles) and assignments (e.g., writing homework).

It is possible that the games will put a facilitator in tough or uncomfortable situations. This outcome is likely, in fact, because the games are non-cooperative and the facilitator should not enforce promises, provide strategy advice, etc. Even when students grasp the non-cooperative nature of play, they will still be tempted to look to the facilitator as a guide or savior. Under such emotionally powerful circumstances, it can be difficult to resist the urge to provide help or assistance. Facilitators must be prudent and make quick decisions that ideally will not have negative consequences on the actual game play experience.

A very important factor that can be easy to overlook is the power of framing effects. The manner in which facilitators present the nature of the games to students can directly influence how students perform. For example, if students are told the games measure their ability to cooperate, they might try harder to cooperate than they would if the games were presented differently. Often these framing effects occur subconsciously. Therefore, facilitators must be very sensitive about how they cast each game. Otherwise the moral tensions (or other desired elements) may be inadvertently impacted.

To ensure students take the games seriously enough to be active participants in them, we recommend facilitators count the points earned during game-play as quiz grades. This equation of points to grades has proven sufficient to ensure genuine student interest. Questions arise, however, as to how the games should be calibrated. Should every student be able, in principle, to earn an "A" during each game? Or, should the games be calibrated more severely, such that only a certain percentage of students can earn "A's"?

Each calibration comes with trade-offs. On the one hand, allowing all students in principle to earn "A's" can minimize ethical tension. Students can feel let off the hook from making tough decisions about: how to reward those deemed worthy of special payoffs, acceptable standards for minimal grades, and justifiable gaps between minimum and maximum points. On the other hand, more severe calibrations raise basic questions of justice. Instructors have to confront this basic question: Is it fair to place students in situations where hard work and preparedness can be accompanied by failing grades? A possible compromise solution is to calibrate the games more severely, but allow extra-credit to be earned through optional writing assignments on issues related to game play.

Also, during game play, situations may arise where instructors will have to enforce strict rules that can result in students' grades being adversely impacted. This might be something as simple as skipping a student (or group) if the person is not ready when it's his/her turn to act. Or, the situation can arise when enforcing a rule that directly results in a student (or students) failing. The instructor truly is like a dungeon master— meting out boons and curses as the games dictate and as the instructor judges to be necessary.

## Reflection Activities:

Exercises that instructors could potentially use to stimulate discussion and maximize the effectiveness of the games include in class or online questions that may foster debate and writing assignments to reflect on the game experience. Some potential activities are outlined below:

- Create a homework assignment due before game-play asking students to hypothesize about what they think will happen during the game. This will encourage students to actively think about the dynamic interactions, strategies, and teamwork requirements of the game. Students are expected to use theory and discussed concepts to justify their expectations. Previous game sessions required posts of 140 characters or less to force students to practice effective concise writing.

- Create a writing assignment after playing the game that asks students to connect their experience to the literature. Parts of this assignment might include revisiting their hypothesis and explaining how and why the actual game went differently. Students should also describe what their role was during the game and why they behaved the way they did. Finally, students can also explain how the game relates to their field of study and if they acquired any valuable insights related to it from playing the game.

- Allow students access to the spreadsheet for the game in advance and encourage them to familiarize themselves with it and the rules of the game. This will encourage dialogue both among students and with the instructor because some students will likely attempt to develop a strategy to optimize potential grades that may require clarification regarding rules from instructors.

- Finally, assign relevant readings to students such as “The Tragedy of the Commons” and “Revisiting the Commons” so that they understand the theory behind the game, and can see how what happens in reality differs from what is predicted to happen.

Instructors are also encouraged to improvise and create new lessons or activities related to the game, keeping in mind the learning outcomes they hope to achieve. Combining new and tested strategies should enhance the quality of the experience and education from the game.

## *Data Entry*

*Round 1*--In the first round of play, there are three choices to be made by each zodiac team: 1) how many fish to eat (or put towards grade points), note that each team must harvest at least four per person per round to survive, 2) how many fish to invest in building the capacity of a private pond, and 3) how many fish to give to other teams. If option one cannot be satisfied, options 2 and 3 are not allowed. You cannot yet stock your private pond at this point, only build its capacity. Refer to the table below to understand how these decisions are entered into the excel game calculator. The columns list the zodiac sign team names, and the decisions are entered vertically down each respective column in each round of play. The total fish removed from the lake is calculated automatically in the last row of each round.

| Year | | Aries | Taurus | Gemini | Cancer | Leo | Virgo |
|---|---|---|---|---|---|---|---|
| 1 | EATEN (for grade points) | | | | | | |
| | INVESTED in pond expansion | | | | | | |
| | Fish INTO private pond | Villagers may not stock private ponds with fish in the first year. | | | | | |
| | Fish FROM private pond | | | | | | |
| | GIVEN to other players | | | | | | |
| | **TOTAL removed from Lake** | **0** | **0** | **0** | **0** | **0** | **0** |

*Rounds 2-8*--In all the remaining rounds there are five choices to be made by each zodiac team: 1) how many fish to eat, 2) how many fish to invest in building the capacity of a private pond, 3) how many fish to stock the private pond, 4) how many fish you want to take out of your private pond, and 5) how many fish to give to other teams. These decisions are entered vertically in the excel spreadsheet in the deciding team's column, as shown in the table below.

| **Year** | | **Aries** | **Taurus** | **Gemini** | **Cancer** | **Leo** | **Virgo** |
|---|---|---|---|---|---|---|---|
| **2** | EATEN (for grade points) | | | | | | |
| | INVESTED in pond expansion | | | | | | |
| | Fish INTO private pond | | | | | | |
| | Fish FROM private pond | | | | | | |
| | GIVEN to other players | | | | | | |
| | **TOTAL removed from Lake** | **0** | **0** | **0** | **0** | **0** | **0** |

It helps to post the five decisions (eaten fish, fish invested in pond, fish into pond, fish out of pond, and fish to other players) on the board along with a handwritten form of each team's decisions for each round. This makes data entry into the calculator very easy and students can keep track of what all the teams are doing.  We usually have one person conduct the class and write decisions on the board, while an assistant enters data in the excel file.

## Power Law: Potential Leverage Points

The "inevitability" of the power law distribution raises several interesting questions. First, what does observation mean for the group's learning outcomes? Keep in mind that this distribution does not measure the importance or quality of a contribution; rather we assume that less contribution necessitates an unimportant role. Take for example, a game played at Purdue. The professor divides the class into three groups based on participation in pre-game activities and assignments: a highly engaged group, a moderately engaged group, and a low-engaged group. As expected, the highly engaged group had a very successful and cooperative game experience, the moderate group less so, and the third group had large difficulties. This is interesting since the first group would likely include the natural leaders and decision makers of the class. In a *Brave New World* fashion, one might hypothesize that a group of leaders wouldn't be able to work together because there are "too many chiefs and not enough indians." However, the power-law distribution does not capture the small but important roles others might play, key conversations that convince reluctant players to step-up, remarks that enforce group norms, fact-checking, etc. The experience at Purdue reminds us that learning can be done even at low participation levels, and that it is an essential role in teams and collective action.

The game experience at Purdue also demonstrated that the third group composed of low participators likely had a gainful experience because the students were encouraged to experiment and play roles they might otherwise not have. This is something we've seen in past iterations of the game, when unique circumstances arise in one person groups, or when the leader leaves, people have to re-orient themselves to an unfamiliar, and likely uncomfortable, situation. This is an essential component of teamwork skills. As a result, we have begun building perturbations into the system, a rich source of future work to see what intervention will cause what outcome, and how can we increase role turnover. If the right perturbations are found for a system (i.e., our games), then a power law can be shifted to a more uniform distribution that engages more members of the class.