

***Board Games as Tool for Teaching Basic  
Sustainability Concepts to Design Students***

Ricardo Victoria Uribe, Autonomous University of the State of Mexico, Mexico  
Sandra Alicia Utrilla Cobos, Autonomous University of the State of Mexico, Mexico

The European Conference on Sustainability, Energy and the Environment 2014  
Official Conference Proceedings

**Abstract**

One aspect of sustainability that often baffles design students is the need to balance concepts such as the triple bottom line (environment, economy and social issue) with the product's life cycle in their design process. In some cases, this is a result of a lack of understanding of interactions between these aspects since the theoretical part of them is often removed from the student's daily life experience. One proposal to solve this barrier and allow for a better understanding and integration is the use of board games. Board games have shown to be a useful tool to teach conflict resolution, strategy development, forward and lateral thinking, either through cooperation or competition. Therefore they can be used to teach basic sustainability concepts (i.e. the tragedy of the commons, population bomb) and their participation in the triple bottom line. Games such as Settlers of Catan, Civilization, Carcassonne and CO2 (an example of a board game with environmental aspect as the core concept), are games where winning conditions can be achieved through balancing several aspects. Therefore this can be extrapolated into the development of educative board games that can be used as a tool to explain design students the need for balance the triple bottom line and other sustainability concepts and allow for a better understanding. The aim of this paper is to reflect upon the initial findings of a research project whose objective is to develop board games for use as learning tool in sustainable design courses at undergrad level.

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## **Introduction**

Data from educational psychologists tell that people retains 80% of what they do as opposed to 10-20% of what it is heard and read (Bhamra & Lofthouse, 2004). Individuals tend to filter information based in a series of factors among them interest, preconceptions and clarity of information during the transference and delivery (Treher, 2011). As well, experience by itself hardly grows into meaningful learning unless the events in such experience allow giving meaning and relevance (Treher, 2011) upon reflection and thus, developing the corresponding skill and mind set.

Sustainable development, by its nature can't be taught efficiently by traditional methods. There is too much information, too many variables to consider which at times can difficult how the student or in a broader context the general public takes that information and transform it into action. Adding the topic in current curricula faces the same barriers trying to raise awareness among the general population. Sustainability requires system thinking, hands on- heads on approach with certain degree on multi disciplinarily. People won't internalize the knowledge unless there is a responsive, dynamic and process learning is enabled, simply because for most of them, it is too abstract or detached from their day to day experience. One of the main barriers to adopt sustainable thinking both in design and in everyday activities is the lack of awareness. Both, users and designers claim to be concerned by the effects of their actions in terms of resource consumption, but they rarely, if ever take any action, because when presented with the issue, they only see abstract information that doesn't relate to them.

As result the pedagogic approach for sustainability necessitates a shift away from traditional techniques towards more diverse, fun and engaging one that allow the student and the general public to make sense of the information and apply it into action rather than just merely memorizing it. By making the knowledge something internalized, the barriers faced become less difficult to overcome.

The aim of this paper is to present the early discussion for a research project being carried out on how to develop and use board game in order to help design students to understand, adopt and ground sustainability concepts into their projects and daily life routines. In this regard, it is expected to make the case of why board games should be used as a tool to teach sustainability.

## **Methodology**

The discussion reported in this paper represent the initial stages of a research project which aim is to develop the framework to design and build board games that can help to teach sustainability concepts to design students and if possible, be used to raise awareness amongst a wider audience. In the majority, it has emerged from an in depth literature review being currently carried out, of books, journal articles and game design and hobby aficionado related websites. This with the aim of understanding the state of the art on three main axes for research to draw useful lessons: sustainable design education, game based learning and board game design basics.

Following this, a basic framework layout will be proposed, along with the generation of ideas for games (presented in this paper). Surveys will be used to delimit some

starting points for the project. Testing and research of existent games will be carried out, in order to draw insight on how mechanics can be designed to incorporate the concepts of sustainability in complex, yet fun and useful ways. This will include interviews and observation. The latter part of the project will be to develop at least one of the proposed game concepts into a working prototype that will be tested with gamers (to polish the mechanics), design students (to understand how the process of knowledge transfer is working) and with general public (to understand how the game can raise awareness). Again this will include surveys/interviews and observation to measure the results.

## **Design Education and Sustainability**

In the case of design education the best practice design education shares some key characteristics with a transformative education approach, not dissimilar to how people learn through play during earlier formative stages:

- Creative, solutions-focused learning;
- Self-directed team work;
- Learning by doing (commonly 'live' projects);
- Iterative refinement and reflection;

Like with sustainability, design requires drawing from a range of disciplines: e.g. mechanics; electronics; manufacturing; marketing; sociology; ergonomics; and history, to inform the outputs that emerge as a result of design-based activity. (Bhamra & Lofthouse, 2004)

Sustainability is becoming a topic with a great importance within education programs, from elementary school to postgraduate education. However there is still much work to do in order to increase awareness and to transfer the body of knowledge on sustainability from the academics into the daily life, making the pertaining concepts more understandable in terms of impact on the daily life. This is more important than ever in the case of designers, since the profession carries an important social weight because design can alter the surrounding world, modifies habits and creates solutions (sometimes even new problems) that can have a great reach and even a greater impact both in terms of environment and society.

Be it due social pressure, the current economic system or how learning programs are designed, most people is being educated to be part of a system that rewards competition and consumption, rather than collaboration and conservation (Sterling, 2001). While there is nothing inherently wrong with competition within set boundaries (sports, games, ludic activities), it becomes a problem when this competition is seen through the eyes of the high consumption market, where the people is often valued only in which things can buy and feeds individualism without regard of the needs of others, forgetting that all people are interconnected and the actions of a few effect the rest of population, often negatively.

Thus, the current paradigm regarding the concept of 'sustainable education' is that of seeing it as a simple 'add-on', a patch or at worst, an afterthought (Sterling, 2001). Humphries-Smith (2008) considers that most design students see sustainability as a technical problem often ignore the social and cultural aspects. Experience by the authors of this paper teaching sustainability related modules in higher education for

designers has shown that they see creating a design that is sustainable as only 'look for other materials, better materials', often disregarding the real needs of the user or the social aspects of sustainability and then focusing solely in the production or financial aspects. It is clear that it is needed a paradigm shift where the sustainability is seen more as a socio-centric aspect, where the user, the person is the most important person in terms of design; in equal terms to the environment, rather than just the technology, financial centric views currently adopted.

In the teaching of sustainable design with a focus on social responsibility, students need to have an inquisitive mind that allows them to identify patterns of behavior from the users to develop better solutions. This requires the development of abilities of lateral thinking within a framework of sustainability. Learning through play can allow designers (and in a second stage, users) to ground the concepts of sustainability in the way the design the daily object we use in our lives as well as understanding how the kind of impact they have in the environment and the society.

### **Learning through play**

The concept of learning through play is used as a very efficient way to be used during human development, helping to the mental and physical growth of the person. As well it helps to reaffirm aspects such as personality and the ability to solve problems. Within the classroom, the use of play allows improving creativity and lateral thinking, improves communication and eases the teaching process.

In this case, learning to play becomes an open, engaging experience where every participant is equal to the other in terms of hierarchy, facilitating the knowledge transfer process. Through games, users can undertake different roles, understanding different points of view that they would not normally experience. This has a considerable impact in how people absorb information as it becomes part of a pattern that can be incorporated in habits, rather than feeling that some actions are being imposed on them by social pressure. A major challenge in any education is to keep the learner's attention, while communicating detailed information about the topic. There are many choices when it comes to resources: seminars, pamphlets, activity workbooks, videos and websites with on-line tools. Many of these do not meet the criteria of heads- and hands-on learning tools or promote engagement (Treher, 2011)

In the case of design, which is by definition a creative endeavor, gaming can provide an excellent path, tailored for their particular 'quirks' to understand how sustainability works, both in its environmental and social aspects.

### **Board games as education tool**

Sustainability requires system thinking, hands on- heads on approach with certain degree on multi disciplinarily. Thus board games are the perfect tool to teach the topic as they can combine complex knowledge with hands on practice to improve understanding. Gaming is a natural way for the learning process, allowing for a bridge between theory and practice in a risk free, flexible setting. This helps to develop creativity, strategy and understanding of a particular topic. As well add social interaction, really needed for undergoing sustainable development.

Board games are an important tool to provide hands-on and heads-on skill and knowledge development for people of all ages on all subjects, since they provide an adequate environment where the user can learn from mistakes and success to build upon strategies and knowledge. It also promotes problem solving, visual analogies and metaphors to link new information, and use of abstract concepts (Treher, 2011).

They can be used as a possible solution due the act of play being ingrained in people's learning process from the beginning. Board games are also supported by the tendency that people have to form patterns to deduce information and to incorporate those patterns into the daily habits, using them as conduits to carry out the knowledge transfer process of a specific topic.

Knowledge transfer is defined, by Major and Cordey-Hayes (2000) as:

*"...the conveyance of knowledge from one place, person ownership, etc. to another"*

It is the process of transferring a series of know-how procedures, information and expertise from those who originated the knowledge or have improved it, into a recipient that will apply it in the foreseeable future (Major and Cordey-Hayes 2000). In order to fulfill this transfer process, there should be a source (usually the original holder) of the knowledge and recipient or destination (Major and Cordey-Hayes 2000). Research in the field has identified a series of requirements in order to allow the transfer to be successful. Organizations should be able to (Major and Cordey-Hayes 2000):

- Search for new information
- Identify potential benefits
- Communicate and assimilate the information
- Apply the information

While there are several models of knowledge transfer, the model showed in Figure 1, developed by Major and Cordey-Hayes (2000) depicts the condensed process.

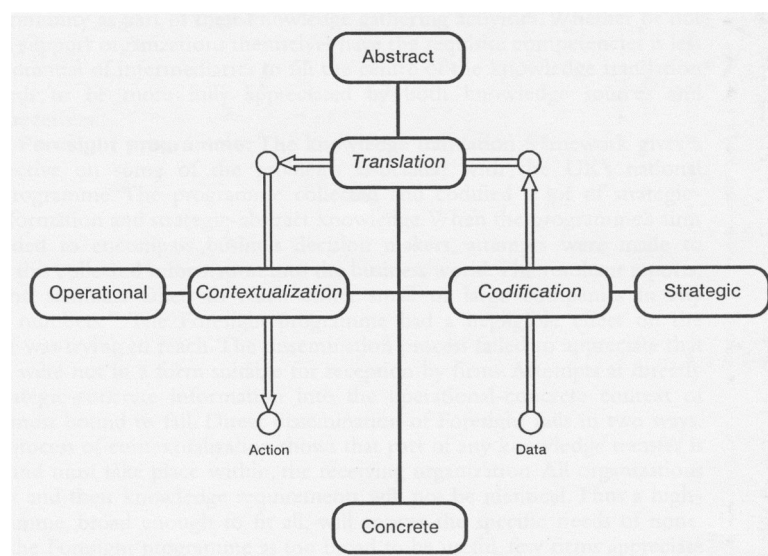


Figure 1: Knowledge Transfer Model (Major and Cordey-Hayes 2000)

The basic process goes from collecting the data, to its assimilation and application, going through a process of 'translation'. However, Major and Cordey-Hayes (2003) warn that this process can be incomplete, and therefore generate a knowledge gap, if concrete and strategic data are not transformed through abstract elements, before they can be used as concrete and operational wisdom, as showed in Figure 1. This gap can be avoided by the contextualization of the information through intermediaries (Major and Cordey-Hayes 2003).

Board games can be used as a possible solution, since they provide all in one the codification, translation and contextualization of a particular topic and transform data into action, by asking the players to understand a set of rules within the context of the game and then put that learning into action. Also, because the act of play being ingrained in people's learning process from the beginning. Board games are also supported by the tendency that people have to form patterns to deduce information and to incorporate those patterns into their daily habits. By using this tendency, certain knowledge can be incorporated into the daily life of a person in a way that produces positive results.

Transition towards sustainable development requires a radical change in the way of thinking. How the actions taken by people in areas such as consumption and production affect the world. Games work under a relationship of cause-effect, which can be used to illustrate this, since they can simulate complex situations and relationships between diverse actors while empowering people in making their own choices within a safe environment, ideal situation for topics such as climate change (Eisenack & Reckien, 2013). This, because often, classroom lecturing is limited in how to deal with unexpected situations and surprise, basing its methods more into memorizing and repetition, rather than critical, systematic thinking (Valkering, et, al, 2012). More complex games (in terms of ways to achieve the victory condition) force players to think in a systematic way, balancing different conditions, actions and consequences; as well as understanding the critical routes that allow them to reach the victory in a successful way, developing their own strategies. Game theory is not just something applied to games or mathematics; it has touched sustainability even in the earliest discussions and proposal (e.g. the Tragedy of the Commons). Games are a good way to teach people (and in this case design students) in a creative, appealing way about trying to reach optimum conditions to solve a need in a sustainable way while understanding that there are other people in the board playing as well. Authors such as Gilbert Ahamer (2006) argues in favor of games as a method to learn how to manage large-scale problems, as they promote an explorative, reflexive discussion that goes beyond mere theory and data without any connection to real life experiences.

In this regard, board games are an excellent conduit to learn about environmental impact as well a social responsibility of the actions of the individuals in a different, more immersive manner.

### **The basics of a board game**

Board games can be defined as "an interactive mathematical system, made concrete, used to tell a story" (Daviau, 2011). In other words, a game is a set of rules and mechanics (depending on luck, strategy or both), designed into a set of components

(boards, paper, dices, graphics) and that have a theme or themes that provide a wider framework within the minds of the users.

Game developers usually follow this sentence to describe and thus ground the basic concept of the game (Forbeck, 2011):

*“[Game name] is a [category of] game in which [the players or their avatars] [do or compete for something] by [using tools the game provides them]” (Forbeck, 2011. p.p. 21)*

This structure can be applied as well to this project when defining the theoretical frameworks under which work to develop games with sustainability topics. Translating such topics into a game has to be done using metaphors and mechanics. In game industry lingo, both are the main components of a board game. Mechanics are the steps and rules that the players need to follow in order to complete the aim of the game while interacting with other participants.

Metaphors are the themes about what the game is supposed to be, what it gives the game meaning for its existence. Matt Forbeck (2011) considers that a game without mechanics is more a toy or a story than a game. One without a metaphor is nothing more than a math problem or a puzzle. Not all the games have a deep and complicated set of rules (Monopoly is as simple as they come by) or full of rich metaphors (Jenga is not exactly dripping stories by the thousands).

But any game has at least a veneer of each one. Understanding this will enable to develop the founding stones to design one or several board games. It has to be noted that in board game design literature it is pointed that it doesn't matter which one comes first, the mechanics or the metaphors, as long as they exist in the planning of the project. In this case, the project has the overall metaphor, which is sustainability.

The next needed step is to choose which particular topics are more suitable to be transformed into such metaphors and desirable to be taught through a board game, in order to create a framework to develop the game or games and thus, elaborate upon the actual mechanics. Although a game could in theory choose to use all of them, this would increase its complexity and make it too clunky. In this regard the old say of 'Keep it simple' would apply, using the before mentioned basics for knowledge transfer. Thus we could choose three main areas, going from the general to the specific:

1. General concepts of sustainability; in this case the three spheres seen in a general context and their influences in general population (some would argue even in policy making).
2. Specific, design related tasks, using lateral thinking, design thinking, system theory or fuzzy end to develop sustainable solutions within a pre-set condition.
3. The relationship between systems (ecosystems, social organizations) by linking actions in a sequence of cause and effect that can develop different strategies for each player.

Topics such as the triple bottom line, consumption vs. resource management and waste, urban planning and incorporating sustainable requirements into a design development are good options. As well, and to determine the kind of mechanics needed for the game or games, it is necessary to understand the type of games that exist.

There are three main types of board games, based on the kind of interaction required from the players (Zagal et al, 2006) and the final aim of the game in question:

**Competitive games:** Those that require developing a strategy opposing the actions of the other players in order to win. They range from the simpler such as Monopoly and Risk to more complex games such as Magic the Gathering.

**Cooperative games:** Those that while allow only for a winner, they require that players have at some stage of the game objectives that are compatible or allow for trade and alliances, even if is only for a round. Usually these games have a developed 'economy' system that allow for negotiation and resource management. A good example of this kind is Settlers of Catan.

**Collaborative games:** Often seen in horror themed games, these require that all players agree in coordinating common strategies to win, since the rival is a 'virtual' foe (or in some cases a single player opposing the rest in a different role). Either all of them win or lose (albeit some games allow for acceptable 'losses'). Examples are: Shadow of Cthulhu, Mansions of Madness and Fury of Dracula.

### **Putting the pieces together**

To develop a board game with sustainability as theme, it is needed to build an adequate transfer knowledge framework in order to convey properly the message and to identify those concepts that are susceptible to be developed into a game as simple as possible. There are good precursors for this kind of project within educational design tools such as Flowmaker, developed by WeMake design and Layered games, developed for a master thesis at Cranfield University (Bhamra & Lofthouse, 2007). There is even an example of a commercial game that uses environmental issues as main theme. That game is named: CO2 and is about stopping global warming. In that game, the players are trying to build renewable energies to stop global warming from annihilating the planet. The core mechanic in this game is a three-step process in which each player in their turn you either start an energy plant research project, convert a research project into a pilot energy plant, or convert a pilot plant into a full-on power plant and requires from cooperation between players to achieve the final objective of the game (Bird, 2013).

While more research is needed to actually ground which particular concepts to use and how to design mechanics around them, it is possible to propose initial ideas for four game ideas can be developed from this. At this point it should be noted that these are mere suggestions and thus, more research has to be carried out to develop the framework needed to design and test such ideas:

One where the player needs to manage the resources of his tribe to achieve sustainability within the context of the three spheres. In a rough draft of the



mechanics, in this game, each player has to provide a 'tribe' through different means available in a 'world map' a sustainable living before the counter runs out and in some way has to cooperate with other players or risk burning his resources faster and ahead of time, ensuring the defeat. For this, games with multiple victory conditions that afford a point tally shall be examined.

In the second game, the player plays the role of a mad designer tasked to create the most crazy/fun/useful gadget to solve a pre-set condition or need draw from a bag of tiles. The players, using a set of cards can mix and match several options for their product, including source of raw materials, energy consumption and user behavior and scores points not only for creativity but for creating the most sustainable invention.

A third kind of game would draw inspiration from Collectible Card Games such as Magic the Gathering, Pokemon and Yugi-oh in order to present fantastic battles between the forces of nature and creatures of pollution. Due the thematic, this game would be more suited for younger kids.

A fourth game would need for the player to 'build' a city using tiles, asking them to interconnect services to run fluently while considering population growth and needs.

It has to be noted again, that these are just some venues worth to explore in the following months of the research project. As well it has to be noted that for the knowledge transfer to occur properly it has to blend in the right mix the metaphors with the mechanics to make a game with commercial potential as to reach easily a wider audience. In words of Rob Daviau (2011):

*"Rules shouldn't explain the game; they should only confirm what the rest of the game tells you."*

Any proposed game should achieve the right mix between learning and fun. If it works to explain design students concepts about sustainability in a fun way that eases the process of knowledge transfer, it should work as well for a general public and vice versa. The funnier the game, it would be bigger the degree of knowledge absorption, overcoming the natural barriers to learning. A game solely focused in the academic part could become either very boring or very clunky, maybe both. A game focused only in fun will miss the target of knowledge transfer in a meaningful, proper way, glossing over the metaphor and defeating the purpose of the project. Therefore it should be the aim to develop a commercial game (in terms of reaching a wider audience beyond the classroom so as the sustainability awareness increases), with a solid academic background that enables the right mechanics and metaphors.

A good game is one that manages to craft an experience that makes sense to the players in such ways that they become immersed on it. By doing this, it would be possible to immerse people into understanding what sustainability means in their daily lives in a way that overcome most learning barriers and can reach a wider audience.

## **Conclusions**

Board games are a viable way to teach different aspects of sustainability and integrating it into design thinking. However, as the knowledge grows in complexity, different kinds of games are needed to explain certain interactions of such knowledge. As well, an entertaining game should have clear and concise rules and mechanics to ensure meaningful learning and replay value (as well as to allow the game to be used in a commercial way rather than just in the classroom and thus, widespread the awareness on sustainability issues).and as such, it would be hard to compress all the information in a single game. Therefore it is proposed to create a tiered system of games according to the topic in question. One disadvantage to bear in mind is that in the classroom, this would be manageable through several copies of the game or small groups.

As well, and in terms for this project, there is need for more research into game developing, particularly game mechanics; as well as analyzing some of the games mentioned in previous sections to understand how they are incorporating several aims or victory conditions focused in a single objective and how this allow users to develop their own strategies. The development of these strategies is what can help design studies to incorporate sustainable design thinking into their projects from the beginning instead of trying to add it after their proposals are developed as some kind of add-on fix.

Finally, developing a commercial game it is not in conflict with creating an educational tool. On the contrary, developing a commercial game that deals with sustainability and design can help to raise awareness in both topics amongst the general public, which can be a valuable asset. This important now both by the current need to raise awareness in terms of sustainability and since the topic are one way or another, in the mind of most people.

In conclusion, a successful game and more important, an entertaining one, should always provide replay opportunities and as such, allow for the player to learn in a flexible way different strategies. However, better understanding on how to correlate these issues within a framework for the mechanics of the game or games is needed.

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