

# **Serious Games for Sustainable Development: A Decision-driven Transformative Approach**

*Completed Research*

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## **Abstract**

Digital games are pervasive, prevalent, persuasive and powerful. Several researchers recognize that sustainable development is an area that can benefit from persuasion, particularly, of values. We therefore explore serious games for sustainable development in this paper. We find that decision-making underpins learning and persuasion in serious games. As a result, we propose a decision-driven transformative approach for the design of serious games for sustainable development. This research uses design science research to propose conceptual artifacts for the design of serious games for sustainable development. We also create actual game prototypes as system artifacts to demonstrate the application of the proposed conceptual artifacts. We draw inspiration from the 17 internationally endorsed UN sustainable development goals, focusing on goal 6 – Clean water and sanitation. We believe that this approach has helped lay a solid foundation for creating artifacts to further support the design and development of serious games for sustainable development.

## **Keywords**

Serious Games, Sustainability, Values, Decision-making

## **Introduction**

It is widely known that serious games are “powerful” because of their “persuasive” nature. In fact, some researchers describe game designers as being in the “behavior business” (Fabricant 2009). This is because the word persuasion involves values. It involves prompting the player to make certain decisions or making decisions in a certain way. One area that requires persuasion and a shift in values is sustainability. Sustainability refers to practices that enable the survival or preservation of existing systems or processes. Several researchers in the sustainability arena believe that to address the world’s sustainability issues, we need to understand and foster the values positively linked to sustainability (Karp 1996; Leiserowitz et al. 2006).

The need to persuade values, as well as the recognition of serious games as being powerful has lead researchers to identify the existence of both implicit and explicit values in digital games (Belman et al. 2011; Schrier et al. 2010). For games intended to persuade, researchers have proposed theories and methods such as the Design with Intent method (DwI) (Lockton et al. 2010). However, despite the recognition of this gap, research on, and usable artefacts such as design models, frameworks, processes, principles, architectures or roadmaps to guide digital game designers are lacking (Belman et al. 2011).

The urgency to address this issue is further exacerbated by the fast-growing mobile games and apps market. With hundreds of games being deployed every year, and the number of users growing, it also brings to light, the lack of research, and usable artefacts for consumers of the digital games (Larkin 2015) to determine the values carried in games. This is also related to the need for context and user group specific game design (Tilwala et al. 2018). For example, there are minimal (Belman et al. 2011; Flanagan et al. 2007; Gee 2003; Haugland and Ruíz 2002), if any, usable artefacts to help educators and parents determine which digital games they can give their children. Most consumers therefore solely rely on other users' reviews, which are not always comprehensive, and often subjective.

The aim of this research is to lay the foundation for research in this area by exploring, proposing and demonstrating the application of design artefacts that can be used for the design of serious games for sustainable development. We focus on values for sustainability, hence draw from the 17 UN sustainable development goals (United Nations 2018), specifically, Goal 6 – Clean water and sanitation. We also plan to research, design and deploy on mobile devices given their pervasive and ubiquitous nature.

The paper begins by briefly outlining the research method adopted for the explorative and design nature of this research. Next, we provide a summary of serious games related to the 17 UN sustainable development goals. We then unpack the aspects of game design in the games summarized to propose a conceptual design approach. Then, we outline scenarios for a proposed game based on past research and observation of successful games for sustainable development. This is followed by a synthesis of the findings from this research in the discussion section. Lastly, we conclude the paper with implications for future research.

## **Research method**

The nature of this research lends itself to a design science research approach. In particular Hevner, March, Park & Ram's (2004) design principles will be applied to the creation of a sustainable development value-based game prototype. Design science involves four major steps – observation, theory building, system design and experimentation. We carry out observation through literature review and a review of various games. We have also partially addressed theory building through the creation of a model. In terms of system design, we have a number of prototypes including decision-trees and game prototypes. We will evaluate the prototypes through experimentation and the use of qualitative methods such as interviews and focus groups.

## **Sustainability, Values and Serious Games**

Sustainability refers to practices that enable the survival or preservation of existing systems or processes. The main types of sustainability are: personal – practices or beliefs that enable individuals thrive in the world; social – practices or beliefs regarding one's engagement with people in their surroundings, economic – beliefs regarding a country's survival and upkeep; cultural – practices or beliefs regarding the preservation of cultural aspects such as customs, language, dressing style; and environmental – refer to one's beliefs about maintaining and preserving the environment for the wellbeing of both the current and future generations.

In a broad sense, we can define values as “central desires or beliefs regarding final states or desirable conducts that transcend specific situations, guide the choice and evaluation of our decisions and, therefore, of our conducts, becoming an integral part of our way of being and acting to the point of shaping our character” (Schwartz and Bilsky 1987) in (Argandoña 2003). Values, when studied closely, relate to the various types of sustainability, and sustainable development initiatives. For example, respect for nature is about promoting behaviors, attitudes and beliefs to save nature from misuse, pollution and destruction (Karp 1996; Leiserowitz et al. 2006).

There are a number of serious games focused on sustainable development. We reviewed a handful of games related to the UN Sustainable Development Goals (UN SDGs) (United Nations 2018). Two shortlists of mobile based games are created based on their target audience (Table 1 and Table 2). The brief review of existing games in this domain reveal the different orientations of the games. Some seem to have a merely informative motive, where as some go on to challenge the users to respond to scenarios in the game. This is more engaging as it prompts the user not only to act, but to reflect on the reasons leading up to their

decisions and potential consequences, both in the virtual and real worlds. Some games even go beyond this by presenting similar opportunities for decision-making and demonstrating the complex and interconnected nature of our decisions in real life. The patterns seen in the games are aligned with research on teaching sustainability, where researchers note that “educating for sustainability demands learning approaches and environments that require the development of systems thinking and problem-solving, rather than solely the acquisition of factual knowledge” (Fabricatore and López 2012). The review of the games reveal levels of game design that a designer could refer to and plan to achieve in their game. This is discussed later in this paper.

<b>Digital Game</b>	<b>Purpose</b>	<b>UN SDGs addressed</b>
World Rescue Game (ZU Digital Ltd 2019)	A research-based video game where players take on the roles of young heroes to solve global problems such as displacement, disease, deforestation, drought, and pollution at the community level to achieve a more sustainable world. Players are specifically taken across 5 countries - Kenya, Norway, Brazil, India, and China	2-Zero Hunger, 3-Good Health and Well-being, 6-Clean Water and Sanitation, 7-Affordable and Clean Energy, 9-Industry, Innovation and Infrastructure, 11-Sustainable Cities and Communities, 12-Responsible Consumption and Production, 13-Climate Action, 14-Life Below Water
3 <sup>rd</sup> World Farmer (3rdWorldFarmer Team 2018)	A platform created to spark discussion about 3rd world problems people from Africa have to face every day. In the game, the player gets to manage an African farm and is soon confronted with the difficult choices that poverty and conflict can cause.	1-No Poverty, 2-Zero Hunger, 3-Good Health and Well-being, 4-Quality Education, 5-Gender Equality, 6-Clean Water and Sanitation
Sai Fah! The Flood Fighter (Opendream 2014)	A game to teach children and teenagers life-saving skills in emergency situations. Using the classic run-and-jump style, players must guide a child called Sai Fah through typical scenarios that arise during floods as he tries to find his mother.	11- Sustainable Cities and Communities
Phone Story (Molleindustria 2011)	A set of 4 mini games, each representing one of the steps of supply chain process: coltan extraction in Congo, outsourced labor in China, e-waste in Pakistan and gadget consumerism in the West.	1-No Poverty, 10- Reduced Inequalities, 12- Responsible Consumption and Production
McDonald’s Video Game (Molleindustria 2006)	Aimed at making players aware that food-focused corporations’ negative impact on modern society, environment and health is born from rising demand for products created by consumers themselves.	3- Good Health and Well-being, 12- Responsible Consumption and Production
Once Upon a Tile (prototype stage) (Games Beyond Games n.d.)	A prototype for a mobile game about peace and sustainable development where players manage an evolving world by matching resource tiles and generating new results and products.	2-Zero Hunger, 3-Good Health and Well-being, 6-Clean Water and Sanitation, 7-Affordable and Clean Energy, 8- Decent Work and Economic Growth, 9-Industry, Innovation and Infrastructure, 11-Sustainable Cities and Communities, 12- Responsible Consumption and Production, Climate Action, Peace, Justice and Strong Institutions

**Table 1: Games for Sustainable Development Targeting Everyone**

<b>Digital Game</b>	<b>Purpose</b>	<b>UN SDG addressed</b>
Energy Hog (Alliance to Save Energy 2018)	A set of mini games for children aimed at teaching them how to conserve energy. Players check each room of the house searching for 'Energy Hogs'. When they are found they can be beaten in a mini game.	7- Affordable and Clean Energy
Electrocity (Genesis Energy NZ Power Company 2019)	Developed to increase public awareness – particularly among students, of the basic “common knowledge” of these topics i.e. energy conservation.	7-Affordable and Clean Energy
Food Import Folly (Persuasive Games LLC. 2018)	A game aimed at educating about Food and Drug Administration. The player takes on the role of the FDA (Food and Drug Administration) inspector in a world of increasingly numerous food imports and increasingly unmanageable risk. The goal is to protect your country and do not let any contaminated food cross the border. The task will get harder and harder as food import shipments number is increasing but FDA personnel and resources are remaining roughly constant.	12- Responsible Consumption and Production
My Sust House Games (Screenmedia 2018)	A set of 3 games (environment game, building game and town game) to educate school children on the challenges of sustainable building design. Each game shows the player different aspects of sustainable house development and sustainable town planning. In every game, ideas about sustainable design are presented and after that, the player has to make decisions that will affect their sustainability score.	6-Clean Water and Sanitation, 7-Affordable and Clean Energy, 8- Decent Work and Economic Growth, 10-Reduced Inequalities, 11- Sustainable Cities and Communities, 12- Responsible Consumption and Production

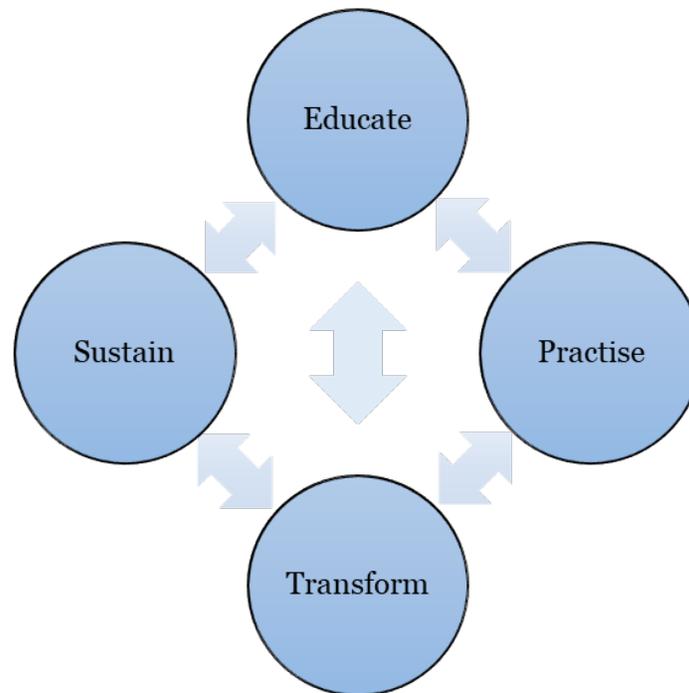
**Table 2: Games for Sustainable Development Targeting Children and Youth**

## **Designing Serious Games: A decision-driven transformative approach**

Our objective is to design a game/game scenario to exemplify, assess, demonstrate and motivate sustainable value/s we wish to foster in the player. We would therefore like to go beyond educating the player to initiating transformation in the player, particularly, influencing the players' values.

### ***Educate, Practise, Transform and Sustain Model***

Based on the review of games (Tables 1 and 2), there are various levels of design when the objective is to influence a value in a player. These levels may be represented as part of a model where one level leads on to the next. For example, if you want the player to practice the value of conserving energy, it is important to first educate the player on why conserving energy is important, then prompting them to analyze a scenario to recognize how energy may be conserved. This can then lead to the next level where the player has the opportunity to reflect on their own practices and make decisions in the game, based on these practices i.e. subtle changes in a player's decision-making process. Lastly, the player needs to be shown the rewards of conserving energy to help them sustain the practice and value of conserving energy. This is comparable to Duhigg's (2012) habit formation process where forming a habit involves reminders, routines and rewards. In a game context, the player advances to understanding further complexities of the scenario and is able to make future decisions that align with the objective of the game. These levels and possible progressions across levels are illustrated in Figure 1.



**Figure 1: Transformative Game Design**

### ***Decision-making and Target user***

The progression through the transformative game design model (Figure 1) is underpinned by the decision-making processes of the players. Therefore, when designing the game, the audience for the game is an important consideration. Children, for example, have vastly different mental and decision-making models when compared to adults. While adults are able to make decisions that will result in long-term gains, most children under the age of 8 make decisions for instant gratification (Saxler 2016).

Further, different players may react to different scenarios in the game differently. For example, children in the developed world may be unfamiliar with life in the developing world, especially in the context of the UN SDGs. This means that they may not be able to relate to the situation presented, or even feel disturbed upon seeing the realities and life in the developing world. A recommendation in the game design and creation is therefore to introduce the player to the issue in a gentle yet relatable manner, using one of the most persuasive mediums – video, preferably animated videos (Janík and Seidel 2009).

In the next section, we discuss the prototype created based on the transformative game design approach.

### **Prototype**

We have designed a game prototype guided by the transformative game design model proposed in the previous section. We do this via scenarios, each representing different stages in the model (Figure 1). The objective and intent for the game is drawn from the 17 UN Sustainable Development goals. We have chosen goal 6 – Clean water and sanitation.

**Sustainable value(s) to be communicated:** Value of water and the difficulty of sourcing clean water; conserving water helps; and ways of conserving water

**Target group:** Children

**Game title:** Save H<sub>2</sub>O

**Introduction to game:** Cartoon video on a discussion about conserving water (Figure 2).

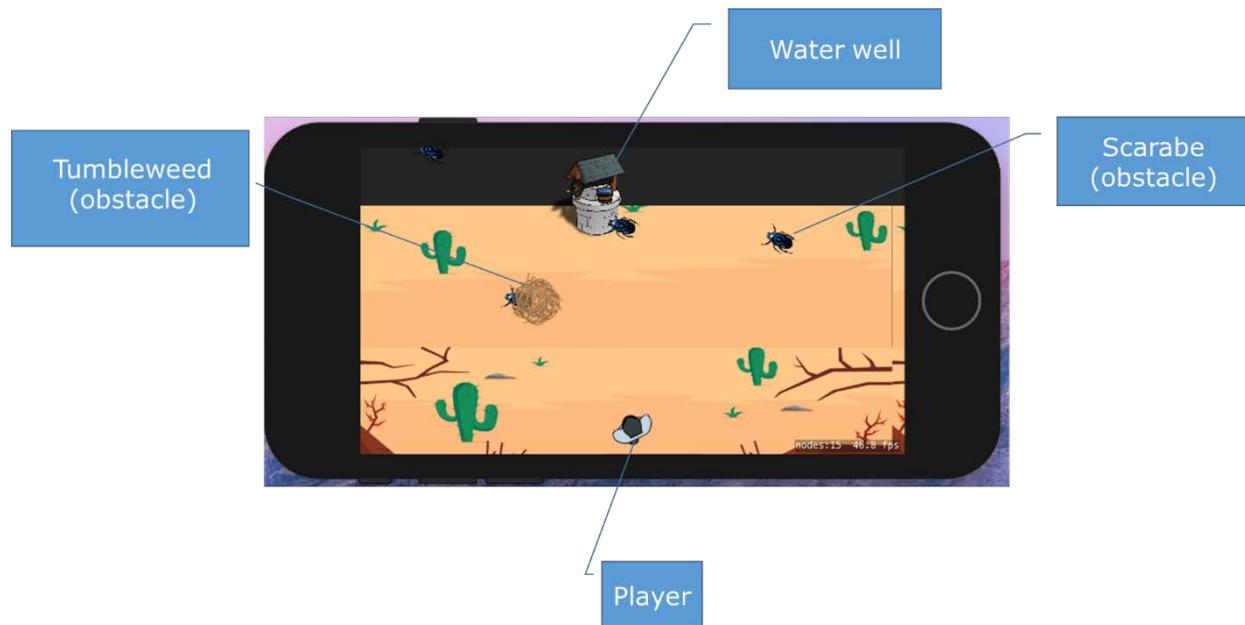


**Figure 2: Conserving Water video**

<https://www.youtube.com/watch?v=r10YiZjTqpw>

### **Educate Scenario**

The intention of this scenario is to educate the player(s) on the challenges of sourcing water. The objective of this scenario is to collect a pail of water. The analogy of the desert is used to show a watering well that the player needs to get to, to collect water. The longer the player is able to stay at the well, the more water they will collect. However, there are several obstacles along the way, as well as at the watering well. If a player gets hit by the obstacles, it slows down the player or results in a loss of “lives” that the player begins with when they start playing. A screenshot of this scenario is attached (Figure 3).



**Figure 3: Educate Scenario of the Save H2O Game**

### **Practise Scenario**

This scenario continues on from the educate scenario. The player begins with amount of water they collected in the first scenario. The player is then be presented with different opportunities to use water more sparingly. The water level in the pail will slowly drop with every use. Use will be measured in terms of time spent doing an activity. For example, if they selected bathing, the challenge would be to use a minimum

amount of shower or bath to get clean. Their score is measured in terms of how well they balance their time vs. cleaning up. A screenshot from this scenario is attached (Figure 4).



**Figure 4: Practise Scenario of the Save H2O Game**

### ***Transform Scenario***

The transform scenario will present new opportunities for conserving water. Variations of the previous scenario will be shown to the players in a fun and relatable manner, prompting them to make decisions for the avatar in the game. The repeated decision-making by the player will demonstrate the transformation in the player's actions as they progress through the scenarios.

### ***Sustain Scenario***

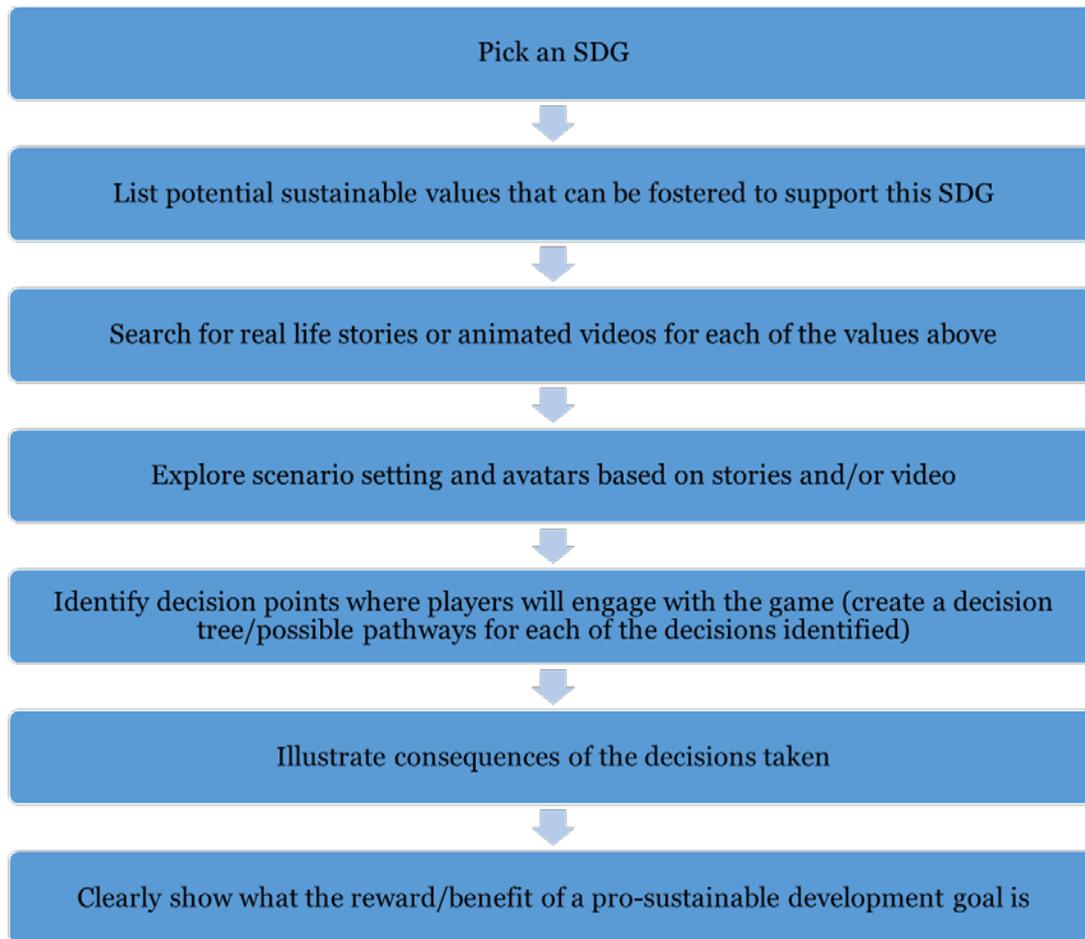
For this level of the game design model, a log of all the repeat scenarios are presented to players. The player is then prompted to go beyond the virtual world by presenting real world challenges to the players. This involves reporting back via pictures/stories of children conserving water to demonstrate they can sustain this practice/sustainable goal.

## **Discussion**

This research contributes to the theory on values-based digital game design in four main ways: Firstly, it proposes a transformative game design approach and demonstrates its application. Secondly, it presents a scenario creation process for future designers/stakeholder involved in creating scenarios. Thirdly, it demonstrates various game elements employed in the scenarios and their levels of persuasion (macro, meso and micro). Lastly, it suggests a design architecture to support the transformative game design model proposed. These findings are synthesized in this section.

The game design model proposed will be implemented in the future stages of this research, and further analyzed. It is however complete as it is and provides an opportunity for future researchers to further explore and improve it.

We also propose a scenario planning process based on our experience of creating a UN sustainable development goal related scenario for the game. This process is relevant for future game designers, as well as potential players or facilitators of games to customize specific scenarios for the targeted players. The process is illustrated in Figure 5.

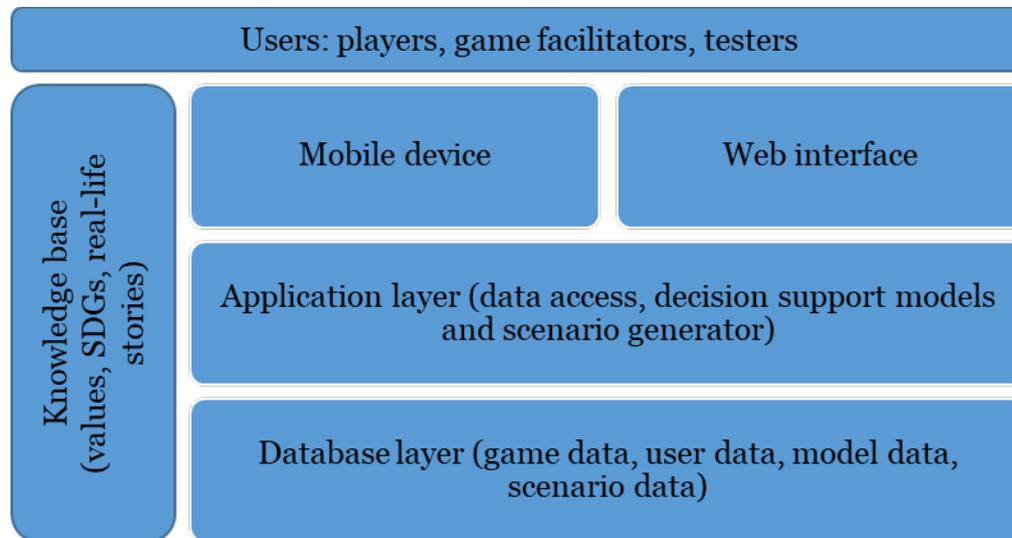


**Figure 5: Scenario Creation Process**

Further, the process of designing the game reminded us that games are made up of a number of basic elements and sub-elements (Schell 2014). These elements persuade the player at different levels. Understanding the persuasion levels (Fogg 2003) and categorization of elements may therefore be useful in designing future values-based games. Based on this, we suggest outlining preliminary micro, meso and macro level elements used in the proposed game prototype.

Macro level elements used in the prototype include the overall description and overview of the purpose of the game, as well as the introductory video. Meso level elements include the game setting, including the environment set up as well as any information on how players can progress through the game. Micro level elements include the physical objects used in the game. For example in the H<sub>2</sub>O game, the tumbleweed, scarab, and the pail of water with levels (virtual reward). It also includes the player's movements and pace, as well as intrinsic motivators such as the challenge of fetching water.

Lastly, the game design experience reveals a potential game design architecture for designing games to foster values. The initial architecture is presented below as a starting point. In our future research, we intend to explore the detailed components of the architecture, in particular, the components related to decision support since this is at the heart of influencing or transforming a player's values. Future iterations of the architecture will also consider variations associated with different users' (game designer, facilitators of games and players) perspectives.



**Figure 6: Values-based Games Design Architecture**

## Conclusion

Serious games are widely labelled “powerful” because of their “persuasive” nature. Research on their power to educate and transform behavior has also been growing. An area that can benefit from the potential of serious games is sustainable development. Sustainable development is closely linked to values. However, research on and design artefacts for the creation of values-based digital games is still lacking.

The aim of this research was to explore, propose and demonstrate the application of design artefacts that can be used for the design of serious games to foster values related to sustainable development. Specifically, we focused on serious games on mobile devices, and games linked to the 17 UN sustainable development goals.

We applied a design science approach to explore existing research and games, and applying the conceptual design artefact by creating a game prototype. When the prototype is complete, we will evaluate it using experimentation, as well as qualitative methods such as interviews and focus groups with experts in the area.

The key contributions from this research are the conceptual artefacts proposed, as well as the game prototype implemented using some of the artefacts. The real value from games in terms of persuasion is exploring decision-models, and how best to design the game so players have a real-world experience without bearing consequences in the real world. Future research may further explore decision-making theories to extend this research.

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