Combining serious games and Design Thinking: a case study in water management

Mar Escarrabill and Socrates Schouten
Waag | Technology & Society, May 2020

Water management is a complex issue in which many actors are involved. Successfully including civic stakeholders in decision-making requires the use of non-traditional methods of participation. This essay proposes the combination of serious games – games that have another purpose besides entertainment – with Design Thinking to discuss water policies. The main contribution of the study is to see how different water-related serious games may be classified and applied during each Design Thinking phase (discovery, definition, development and delivery). The combination of Design Thinking and serious games has been applied successfully before to discuss and reach agreements regarding environmental actions. This essay is written for those who want to learn about the possibilities of serious games during each phase of Design Thinking processes, with a case study in the context of water management.

Introduction

Serious games are games used for purposes other than mere entertainment. Gaming can help raising awareness about a specific topic, offering critical content, supporting rational decision-making or reaching consensus. Moreover, serious games allow players to experience situations that are impossible in the real world for reasons of safety, cost, time, etc. This was explored in the *Common play with us!* series carried out by Waag, where a number of games were play-tested for their potential to strengthen the commons, such as those aimed at sustainability, community, digital rights or public values.[1]

The serious game concept was introduced by the multidisciplinary researcher Clark C. Abt, who established how simulation games could be used for education, decision-making and for public policy making and not just intended to be played primarily for amusement (Abt, 1970). Since then, serious games have been applied in a wide range of areas, including science, training, military, corporate, peace building, healthcare or water management. In this essay, the applications of serious games in the area of water systems planning and management will be analysed. Furthermore, we will explore how they can be classified in line with the Design Thinking process through which they can be employed more conscientiously.

[1] The results are presented in the 'Gaming for the commons' repository, https://chamberofcommons.waag.org/gaming-for-the-commons/

Serious games to support water systems planning and management

Serious games have been successfully implemented for a few decades as tools for social learning in the water sector, water resources analysis and water management and governance support. Specifically, games have been used to resolve conflicts and define a shared vision planning among different social actors regarding water resources problems (a.o., flooding, droughts, irrigation, drinking water supply, hydropower, and navigation) (Savić et al, 2016).

What are the mechanics and strategies used in serious games related to water management? There are many potential features to identify them. Bellow, the water-related games features identified by the researchers Dragan Savić (2016) and Alice Aubert (2018) will be shown. Both classifications will provide us the elements to create our own classification of water-related games according to its Design Thinking applications.

Discussing and analysing games like Aqua Republica, Shariva Game or Waterstory, Dragan Savić identified in 2016 the categories shown in Table 1.

Table 1. Classification of water-related serious games by Savić et al. (2016)

Feature	Options
Application area	River basin management, urban water management.
Goals	Specific, unspecific
Initialisation of the game	Facilitation required, facilitation unrequired
Number and type of players	Multi-player, single-player. Water professionals, businesses, academics a.o.
User interface	Board-based, computer-based, hybrid
Type of simulation model	A wide range of simulation tools from simple to complex
Realism of the game	Degrees of reality simplification
Performance feedback	Instant feedback to players, intermediary needed to provide feedback
Progress monitoring	Capability or not of saving intermediate game results
Game portability	On-line, off-line

Meanwhile, Alice Aubert (2018), discussing and analysing a wide range of water-related serious games like SmartH2O, Irrigania or Reef game, put forward the classification shown in Table 2.

Let's take an example to dive into game features a bit further. The serious game Aqua Republica offers a virtual world that allows participants to develop a river basin and visualize the consequences of their decisions. Aqua Republica could be described in many different ways. According to Savić criteria, it is a game focused on river basin management with three main goals: promote sustainable water resources management by sharing knowledge, raise awareness and build capacity in some of the most critical issues in water

Table 2. Classification of water-related serious games by Aubert (2018)

Feature	Options
Purpose	Broadcast a message, exchange information or training
Water issue	Integrated water resource management
Target players	Water experts, decision-makers, non-expert in water issues
Technology used	Information technology (IT), hybrid (IT + broad game), broad game, low tech (no/few paraphernalia).
Number of players	Single player, single player with online community, multiplayer
Fun-serious degree	Gamified application, serious game based on scientific model and real-world data, serious game based on simplified model and real-world data, fully-fledged games)
Game place	Online, meeting room (or classroom), other

resources management. The gameplay is not very intuitive so an introduction prepared by an expert is required to start playing. However, a facilitator is not needed during the game as players can learn by playing. This single player game is mainly geared to water professionals and decision-makers that can interact with an online community. The game is computer-based and shows players all consequences of their decisions with the water allocation model MIKE HYDRO Basin. It creates a simplification of reality building a hypothetical scenario that can provide continuous feedback on the player's performance in the game letting players save the game results. To be played, players need a computer with web connection. According to Aubert criteria, Aqua Republica can be defined as an integrated water resource management game addressed to water experts and decision-makers that wants to broadcast a message. It uses Information Technology and is played by one single player with all the online community. It is a serious game based on scientific model and real-world data that must be played online.

Below, we explore how water-related serious games can be analysed according to its application during each Design Thinking step. But, first of all, what is Design Thinking?

Design Thinking

Design Thinking combines creative strategies that designers utilise during the process of designing. Moreover, it is an approach that can be used to select and (re)define the questions for which solutions will be designed. As such, it can be applied not just during the professional design process but also in business or social issues.
The 'double diamond' is a young but already classical diagram used to describe the Design Thinking process (Fig. 1). Elaborated in 2005 by the Design Council, it consists of consecutive 'diamonds' that represent the process divergent thinking (exploring an issue more widely) followed by convergent thinking (focusing, narrowing down, selecting).

Typically, a process will consist of two diamonds, the first covering problem definition (including phases (1) **discover** and (2) **define**), the second covering solution design (including phases (3) **develop** and (4) **deliver**). Let's take a further look at the four phases mentioned.

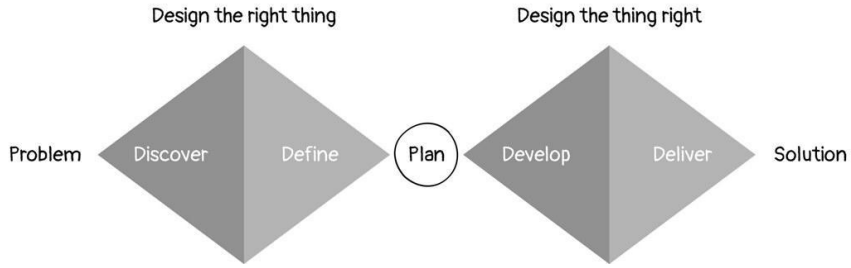

Figure 1. The `double diamond` structure

The *discovery phase* allows people to better understand the problem, in essence by speaking with the other participants and empathizing with them. In the course of the *definition phase*, participants can interpret the insights gathered from the discovery phase and produce a concrete definition of the problem which will help to focus on the most relevant issues.

The first two steps give you the problem. The last two steps focus on the solution. The *development phase* encourages people to provide a wide range of solutions to a clearly defined problem stablished in the defining phase by ideating them discussing and sharing ideas with many different kinds of people. Finally, in the *delivery phase* people can test out the different solutions obtained in the development phase and select the ones that could work better and improve them. At the same time, they can reject the ones that are not useful for the selected problem.

Water-related serious games analysed according to their application in each Design Thinking phase

A Design Thinking approach can be useful to co-create a water management policy, as it was applied, for example, in the Dutch province of Noord-Brabant. In order to explore serious games as tools that can be used during a Design Thinking process, bellow a sample set of water-related and critical thinking games will be analysed according to their applications in each Design Thinking phase.

This new approach to describe water-related games according to its use during the discovery, definition, development and delivery phases also contains classification items previously mentioned by Savić and Aubert. Thus, the way to describe the goal of the game is inspired by Savić's work and the way to analyse the number of players, the target

audience[2] and the game place is inspired by the research carried out by Aubert. These four features have been selected to provide supplementary information of the games in addition to its use during the Design Thinking process. Although most of the games could be interesting in more than one Design Thinking phase, we will just point out the strengths that make them especially effective for a specific phase.

Discovery phase

The serious games listed in this phase give an overview of water-related problems by using different strategies (Table 3). As a first example, Wat a Game will be mentioned. This game is an open toolkit to promote a debate regarding water policies showing daily water-related problems (e.g. how water flows or how it is polluted).

Table 3. Water-related serious games useful in the discovery phase

Game title	**Goals**	**No. of players**	**Target**	**Play setting**	**Application in the *discovery phase***
Wat a Game	Explore water management strategies and discuss water policies	Multi	Decision-makers, non-experts	Meeting room	Visualizing physically water management problems that different actors involved have in their daily life
WATERSTORY	Discover Milwaukee's citizens stories about water and complete site challenges	Multi	Water experts, decision-makers and non-experts	Outside with the Urban Adventure App	Getting in touch with six real stories from Milwaukee sites and explore the challenges that they hide.
Paying for Predictions	Identify the concept of climate-based disaster risk reduction and reflect on decision-making under high uncertainty	Multi	Decision-makers, non-experts	Meeting room	Experimenting complex and uncertain forecast problems and seeing the advantages of being able to predict them

[2] The target audiences selected for each game are inspired by the review of water-related serious games elaborated by Aubert et al (2016) and also for the Waag Commons Lab research. However, most of the games can be adapted to a wider range of audiences.

Definition phase

The games we identify for the *definition phase* help participants to interpret a wide range of water-related problems and focus on the most important ones (Table 4). All games analysed show different methods of interpreting problems. For example, the game Invitational Drought Tournament converts science information into synthetized content concerning different water-related fields.

Table 4. Water-related serious games useful in the definition phase

Game title	**Goals**	**No. of players**	**Target**	**Play setting**	**Application in the *definition phase***
The Invitational Drought Tournament	Enhance discussions between stakeholders from different specialties on proactive drought management policies	Multi	Water experts and decision-makers	Room with tables	Presenting physical science information to decision makers in a way that allows players to integrate it into economic, policy and institutional framework for peer-to-peer education and synthesis
Eau durable[3]	Allow a collective and engaging discussion between different actors around water management	Multi	Water experts, decision-makers and non-experts	Room with a stage	Providing a shared diagnosis of water-related problems
Story Puzzles	Consciously decide on what parts of the problem you want to focus through puzzle pieces with multi-interpretable icons on them	Multi	Water experts, decision-makers and non-experts	Room with tables	Getting a shared understanding of a problem and creating a storyline of a selected problem by groups

[3] It is not technically a game but a legislative theatre experience. However, this role-playing strategy can be adapted to a serious game to meet the goals of the definition phase.

Development phase

The water-related serious games useful in the third phase of the Design Thinking process find a wide range of solutions to solve complex problems (Table 5). For instance, the Sustainable Delta Game explores a set of possible policy solutions for an uncertain future.

Table 5. Water-related serious games useful in the development phase

Game title	**Goals**	**No. of players**	**Target**	**Play setting**	**Application in the *development phase***
Sustainable Delta Game	Understand water systems and reflect on how to take smarter investment decisions for an uncertain future	Multi (in two teams)	Water experts, decision-makers and non-experts	Meeting room (IT + board game)	Exploring sustainable water management policy options for an uncertain future
Catchment Detox	Manage a river catchment so that after 100 years you have a healthy economy and a healthy environment	1 + the online community	Water experts, decision-makers and non-experts	Room with a computer	Finding multiple innovative solutions to river management to create a sustainable thriving river catchment
River Basin Game	Achieve the highest net benefit possible so that you can maintain your family (water is the limiting factor).	1 + the online community	Water experts, decision-makers and non-experts	Room with a computer	Exploring different solutions to tackle the problems that take place when people use water in a river basin

Delivery phase

Many serious games can be effective to select collectively the most optimal solution to face a water-problem (Table 6). Some of them can help participants to reach an agreement and some others can ensure that players improve a selected solution. A relevant example of the first option is the Play Decide game as it promotes an informed social debate and helps to achieve group consensus.

Table 6. Water-related serious games useful in the delivery phase

Game title	**Goals**	**No. of players**	**Target**	**Play setting**	**Application in the *delivery phase***
Play Decide	Promote informed social debates	Multi (4-8)	Non-experts, decision-makers	Room with tables	Reaching an agreement through group consensus
Nexus! Challenge	Stand in the shoes of politicians and CEOs who jointly shape an economy that has to provide energy, water and food to its cities	Multi (around 12)	Water experts, decision-makers and non-experts	Room with tables	Showing the importance of collaborating to tackle challenges
The "Water Message" game	Decide the governance of a shared water body by communicating with each other through messages written on paper	Multi (ideally 10 people divided in two groups)	Water experts and decision-makers	Room with tables	Agree on a solution between two groups to tackle a water management conflict

Conclusion

How does one identify and select serious games when engaged in a water management project and considering engaging, participatory tools to further your goals? We mapped different games onto the Design Thinking framework so as to assist conscientious selection. The categories developed by Savić (2016) and Aubert (2018) to describe water-related games have enriched our analysis. Many strategies have been highlighted in this essay to use gamification for water management in order to achieve progress and 'get unstuck' – such as to empathise with real stories to explore existing problems, create a storyline with groups to focus in a concrete problem, find multiple solutions to real existing problems by tackling virtual challenges or reach an agreement through the co-creation of informed social debates. However, finding the right game can be a challenge when lacking a discovery and selection procedure. The approach used above can be useful for all who want to tackle water challenges through a Design Thinking strategy and consider to use games or gamification tools during the discovery, definition, development or delivery phase. For those interested in gamification as a participatory tool to manage shared resources in general (not just the water-related ones), we created a commons-related serious games repository. It is based on *functional*, *contextual* and *gameplay* criteria.

Design Thinking and serious games are being used around the world to find collectively water systems planning and management solutions. The sum of both strategies working together needs to be more explored as a tool to discuss and reach agreements regarding environmental actions. This essay can be a start to explore this intersection more in-depth in further investigations and can inspire new ways to describe water-related games.

References

Abrami, G., et al. (2012). Wat-A-Game, a toolkit for building role-playing games about integrated water management. IEMSS.

Abt, C. (1970). Serious Games, The Viking Press, New York, USA.

Aubert, A. H., Bauer, R., & Lienert, J. (2018). A review of water-related serious games to specify use in environmental Multi-Criteria Decision Analysis. *Environmental Modelling & Software*, *105*, 64-78.

Savić, D., Morley, M. S. and Khoury, M., (2016). Serious Game Approach to Water Distribution System Design and Rehabilitation Problems.