



Summary

Serious games present the characteristics of reality through interactive and engaging medium, making them attractive for a wider audience. Serious games are typically developed for users to develop an understanding the complex interactions of the social, environmental, and economic factors related to certain challenges. This Tool provides the basic characteristics and mechanisms behind serious games and introduces different types of serious games as well as some of the most used serious games that were specifically developed for water resources management.

What are Serious Games?

Serious Games are defined as games that are explicitly and carefully developed for non-entertainment purposes (de Suarez, 2012). Serious games were initially used for military training but has now increasingly been used for decision making, capacity building, stakeholder engagement in businesses, sustainability projects and water resources management. Gamification refers to the transfer of game methodologies or elements to non-game applications and sectors, e.g., to water resources management processes. The gamification of water resources management offers a more attractive environment while also fostering active engagement and motivation amongst the players through a systems thinking approach (Aubert, 2018).

Serious games enable interactive storytelling and allow players to participate potential scenarios that require them to think critically and analyse issues from a new perspective, and to reconsider the roles they may take in the face of different situations (Marome, 2021). By participating in a game, the players are presented with a safe trial and error environment where they can experiment with alternative courses of actions while also exploring the consequences of their actions over time. This process allows for the transfer of knowledge amongst participants and from the game itself. In

some cases, the games support conflict management (Tool C6.03), negotiation (Tool C6.01) and facilitates future collaborations by developing understanding beyond the self-interest of each stakeholder (Marini, 2018).

Working Mechanisms of Serious Games

Serious games offer a series of loops where players face challenges and make choices between several action options. According to the action chosen, the game scenario will change to present the consequences of decisions to penalise or reward the player accordingly. The game scenario changes are commonly based on scientific understanding and robust modelling, which include may include random events based on external forces of politics, hydrology, or ecology. The game allows the users to understand a situation by thinking of it as a game rather than a real-world challenge and as players rather than competing stakeholders (Bathke, 2019). This can be considered as learning by playing (Figure 1).

Image

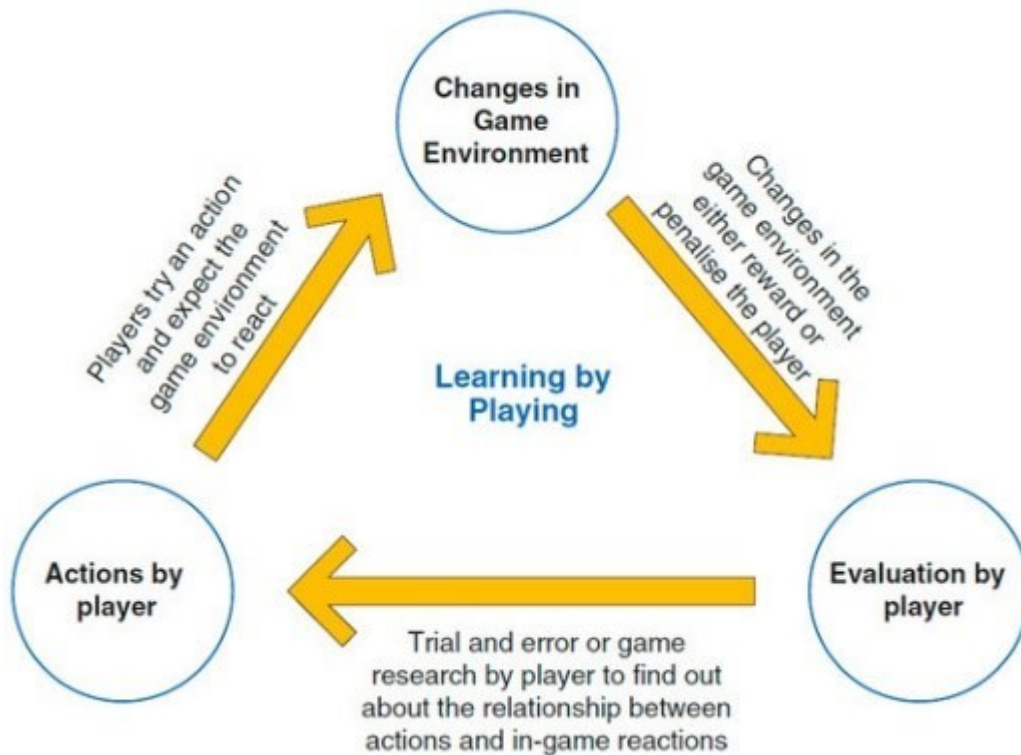


Figure 1. Serious Game Flowchart. Source: Sušnik (2018)

Serious games are developed through an iterative and player centric process (Duke, 1980). Interdisciplinary teams are preferred during game development to ensure that the complexities associated with water management and different stakeholders can be accounted. Furthermore, the games are tested, evaluated, and re-adjusted. Core principles of the games are grounded in game theory and psychological principles to integrate playing and learning (Dörner, 2016).

Types of Serious Games

Some games are focused on increasing awareness of participants which involves a one-way communication, i.e., for the purposes of sharing data and information. Other games are focused on exchanging information through two-way communication allowing spaces for alternative perspectives and development of multi-stakeholder partnerships to emerge (Tool B3.05). This moves from informing players to fostering collaboration and empowering them for taking collective decisions. The games can also support training and capacity building (Tools B4) in a safe fictional environment that is conducive to learning and experimentation.

There is a range of different mediums through which serious games are applied including: low-tech games involving boards, cards, roleplay, and high-tech games that rely on an IT interface, socio-hydrological modelling (Tool C2.05) and simulations (Aubert ,2018). In some cases, hybrid games have been developed that are low-tech but are supported by modelling simulations or real world data.

Opportunities and Considerations

Serious games have the potential to help address and integrate technical, physical, and social-political complexity while increasing knowledge uptake through an engaging medium (Medema, 2016). The key opportunities that serious games bring are:

- **Stakeholder engagement:** As a fun activity, serious games make the learning process more enjoyable and effective, while engaging a larger audience. The game design process must be targeted towards a specific audience, which can be identified through a stakeholder analysis (Tool C1.03). The analysis should also be conducted giving special consideration to marginalised and vulnerable groups. Design processes must also account for biases and power imbalances to ensure a level playing field. Some serious games themselves can be used for assessment of stakeholders' interests and roles. Furthermore, the games can stimulate discussion and learning among stakeholders enhancing social skills such as collaboration, negotiation, and shared decision-making. Other potential benefits of serious games include improved self-monitoring,

problem recognition and problem-solving and decision-making (Susi, 2007). Selection of an appropriate game depends on gaming objective (negotiation, optimization, collaboration), accessibility to data and modelling (software and modelling tools) and as well as stakeholder group (age, roles).

- **Knowledge sharing:** Serious games for water management work at the interface of science and policy by engaging stakeholders in a political process that is governed by hydrology and ecology. This supports improving the problem understanding as well as water knowledge. The games offer a graphical representation that makes information easy to comprehend as well as visually experience potential changes. At the end of games, a debrief session is commonly hosted through which stakeholders relate and discuss the fictional scenario in the real-world context. This helps in learning about decision context and clarifies different competing objectives as well as stakeholder perceptions. The games support transforming knowledge to action and action to knowledge in the process which induces behavioural communication change (Tool C5.02). The methodologies for measuring the impact of serious games are not very well established and the negative results and experiences with serious games are not reported (Medema, 2019).
- **Decision making:** Serious games can simulate decision-making spaces, where players use role-play to build negotiation skills before entering real-world negotiations. In this way, role-play can offer marginalised actors strategic support during the decision-making process (Gomes, 2018). For example, serious games can identify vulnerabilities and solutions for climate adaptation to increase preparedness by training participants, raising awareness, and clarifying roles and responsibilities, and improving interagency coordination. The games address conflicting objectives such as that of equity, environment, and economics to build consensus. The use of serious games as a decision-support tool can support agenda setting and help create a shared understanding of problems and potential solutions (Mayer, 2009). This brings the knowledge from the scientific community to stakeholders in the socio-political arena for decision making.

Serious Games for Water Management

The complexity of water resources planning and management makes it essential to bring multiple stakeholders together and provide them with the necessary data and information for making fair, efficient, and informed decisions through systems thinking. Furthermore, serious games deal with sustainable water use at different scales such as households, national watersheds, and transboundary watersheds fostering innovation and collaboration (Aubert, 2018). They have been applied dominantly to user resource conflicts and disasters such as floods, droughts, and pollution for different audiences such as stakeholders, practitioners, students, and experts. Some examples of serious games in water are as follows:

- Aqua Republica (UNEP DHI, 2021): This game allows players to make decisions regarding sustainable water management in a river basin in situations of scarcity and increasing demand. The game environment is based on hydrologic modelling from MIKE BASIN.

- Flood-WISE (INTEREG IVC, 2021): This game is based on cross-border flood risk management. The game can be classified as a diplomatic/political game where players role-play as different stakeholders to consult, collaborate and negotiate with one another to mitigate floods.
- Wat a Game (Abrami, 2012): Provides toolkits and methodological guidelines to spread awareness on hydrologic flows, through a participatory governance approach.
- Games at the World Water Day 2015 (IIASA and CSS, 2021): UN-Water supported the 2015 World Water Day by promoting and giving access to 20 serious games. They grasp a wide range of water and society linkages such as WASH, pollution, flood prevention or climate change.
- Sim4nexus (SIM4NEXUS, 2021): The game increases understanding of water management, food production and consumption, energy supply, land use policies and its interlinkages to climate action.



Thematic Tagging

Water services Youth

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