

# Playful Citizen Discussion Space to Help Steer Society Towards Water Security

Paul Watson<sup>1</sup>, Paul Hollins<sup>1</sup>, Rebecca Harris<sup>1</sup>, Simon Egenfeldt-Nielsen<sup>2</sup>, Katharina Koller<sup>3</sup>, Claudia Fabian<sup>3</sup> and Barbara Kieslinger<sup>3</sup>

<sup>1</sup>University of Greater Manchester, Bolton, UK

<sup>2</sup>Serious Games Interactive, Copenhagen, Denmark

<sup>3</sup>Centre for Social Innovation, Vienna, Austria

[p.a.hollins@bolton.ac.uk](mailto:p.a.hollins@bolton.ac.uk)

[r.harris@bolton.ac.uk](mailto:r.harris@bolton.ac.uk)

[simon@seriousgames.net](mailto:simon@seriousgames.net)

[kkoller@zsi.at](mailto:kkoller@zsi.at)

[fabian@zsi.at](mailto:fabian@zsi.at)

[kieslinger@zsi.at](mailto:kieslinger@zsi.at)

**Abstract:** In this paper, we explore the use of a playful dilemma activity, a survey and public data analysis to spark citizen awareness and reflection on water use within the UK. Water security ensures access to fresh water for survival and society's needs. There is significant citizen agency in water security that impacts the freshwater reserves. However, in many countries, water security is under-discussed. Encouraging spaces for individuals to assess their water use, identify waste, and adopt sustainable practices is key to sustaining freshwater resources for the future. We present a case study conducted as part of the GREAT project to stimulate citizen discussion on water use and its subsequent impact on the broader water system. Through a series of activities, citizens can reflect on their water use, consider the future forecast of water security within the UK, and experience a playful dilemma to save a city from the effects of drought. In this dilemma, players are part of an organisation tackling a city's water crisis. Faced with limited water resources, players analyse data on the population's usage and suggest behaviour changes to reduce consumption. The challenge lies in balancing the need for water conservation with the risk of proposing changes that are resisted by the population. The players must convince the facilitator of both the practicality and acceptability of their plans. Success restores water security, but failure reveals the consequences of inaction. Within this playful discussion space, we create an exchange for citizens to elicit attitudes and preferences on current water use and explore how individuals might be "nudged" into less wasteful behaviour. In this paper, we describe the co-design of this qualitative approach, share findings on attitudes and preferences elicited (n = 19), and reflect on this method as a tool for fostering awareness and meaningful citizen discussions.

**Keywords:** Dilemma game, Playful education, Climate conversation, Water sustainability

---

## 1. Background

Water security refers to society's access to fresh water for survival and sustainable continuation. Sustaining water systems amid climate change and population growth is complex, requiring infrastructure, industries, and agriculture to consider usage (He et al., 2021). Collectively, population habits significantly affect national reserves. For instance, daily domestic use per person is 379 litres in the US versus 147 in France (BSI, 2024, pp. 31–32). Despite citizen impact, water use remains underdiscussed (BSI, 2024), creating a disconnect between water security needs and public understanding of sustainable engagement.

To educate the public on climate issues, the traditional knowledge deficit model assumes lack of understanding is a barrier to action (Simis et al., 2016). While information is crucial, this model presumes people will adjust behaviour once informed. Yet, even when content is heard, personal beliefs, values, and circumstances shape climate engagement. Two-way discussion allows citizens to interpret and integrate new knowledge through these subjective lenses (Ettinger & Painter, 2023). Dialogue fosters shared understanding, opens diverse perspectives, and supports decision-making (Pröpper, et al., 2024). In short, safe spaces for climate discussion can aid interpretation and help overcome behavioural barriers.

Educational games support learning outcomes, though a tension often exists between subject depth and engaging gameplay. Playful learning occupies a middle ground between game-based learning and gamification (Plass et al., 2020). Game-based learning presents subjects as systems of rules, choices, and consequences, inviting experiential interaction (Perrotta et al., 2013). Gameplay becomes the learning process. For example, nursing students developed procedural knowledge of intravenous injections through a digital game requiring appropriate equipment selection, turning decision-making into learning (Hwang & Chang, 2023). Gamification applies specific game features, like points or achievements, to non-entertainment activities, enhancing motivation (Deterding et al., 2011). However, the learning content remains largely unchanged. A playful

approach subtly integrates game design principles into learning activities. These activities align meaningfully with game elements, moving beyond simple gamification. However, they are not full games (Plass et al., 2020, p. 5). For example, scripted narratives support hotel room design decisions (Hamalainen, 2008) or water management case work (Hummel et al., 2011). In these examples, interaction within the game world is limited to visualising information. The game world and narrative structure support the intended learning activities and outcomes.

Social dilemmas occur when short-term self-interest conflicts with long-term collective wellbeing (Van Lange et al., 2013). In sustainability contexts, this reflects how resource overuse today may compromise future societal needs. Social dilemma games often adopt a macro perspective to simulate how decisions benefiting one group can undermine broader systems (Druen & Zawadzki, 2021). Quick game rounds allow players to observe impacts, fostering empathy and showing how sustainable cooperation benefits all (Cerutti, 2017). These games introduce core concepts, prompting choice-making and experiential learning. When framed around local issues, dilemmas may engage communities in securing sustainable resources (Meinzen-Dick et al., 2018). Reflection on personal resource use is present but may not occur during gameplay due to the game's macro lens. Instead, it surfaces between rounds or afterward, when participants' energy may be too low for meaningful sensemaking (Cerutti, 2017; Liao et al., 2023).

Social dilemmas offer a helpful framework for participatory activities promoting discussion on resource norms and fairness. The dilemma becomes a focal point where diverse perspectives converge, and discussion fosters ideation (Janssen et al., 2023). Recent work has shown discussion can be a core mechanic shaping player choice. For example, Merry et al. (2025) presented a dilemma game on a "green roofs" initiative. It enabled role-play among housing stakeholders to explore policy compromises. Through dialogue, players engaged with the dilemma and diverse perspectives, advocating fairer policy details.

To contribute to water sustainability education, we employ a co-design methodology to develop a dilemma discussion as a concise, playful activity. Building on previous dilemma games, we utilise this playful approach not to understand the socio-economic dynamics of a broader water system, but rather to reflect on and engage with sensemaking on sustainable citizen water use, something that citizens have the power to adjust in their daily lives. Drawing on principles of collaborative game design (Wang & Huang, 2021), we utilise a shared space, narrative, cooperative goals, and social dilemma framing to incentivise sustainability discussions and sense-making that elicits reflection and attitudes towards individual water use. Through playful engagement, we look to draw out what reasonable citizen water use looks like and explore the impact of this approach on individual water behaviour.

## **2. Playful Dilemma Design**

This study presents initial work designing and implementing the "Save the City" playful dilemma. A collaboration with Waterwise (Waterwise 2025), a UK non-profit organisation that promote the "wise" use of water. We utilised the GREAT (Games Realising Effective and Affective Transformations) (Hollins *et al.*, 2023) co-design methodology to explore how game-based approaches can foster public discussion on reasonable citizen water use.

The GREAT methodology is an eight-step process for co-designing game-based activities that facilitate communication between citizens and policymakers. This approach facilitates a "dialogue through games" between these stakeholders, eliciting attitudes and preferences on climate issues. Steps one to three outline the policymaker's goals and explore how game-based activities can facilitate these goals. These steps culminate in the development of interactions and supporting artefacts. Step four focuses on engaging the target group with the designed approach. Steps five to eight involve evaluating the collected data with stakeholders, disseminating findings to a broader audience, and reflecting on what has been achieved and what can be improved. This paper covers the work completed in steps one to four.

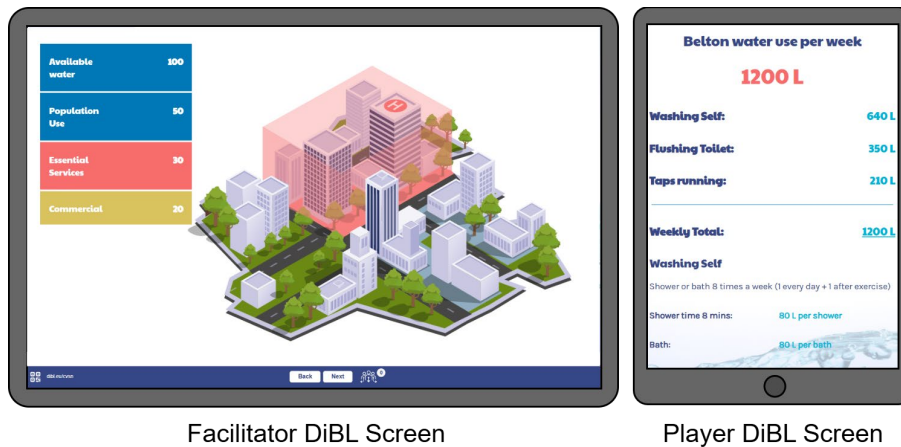
In step one workshops with Waterwise, two goals summarised what this case study should achieve:

- Improve public consideration towards water use
- Discuss with the public how they would be willing to achieve water sustainability in the UK

In the second step workshops, policymakers ideated game concepts aimed at achieving the goals established in the first step. The ideas that resonated with the workshop group included:

- Narrative of water use within the broader water system
- Activities that allowed players to calculate water consumption per day
- Scenarios involving personal water use and conflicts with the broader water system

In step three, industry partner Serious Games Interactive (SGI) engaged with the learning goals and how these could be represented on their Dilemma Based Learning (DiBL) platform (DiBL, 2025). On this platform, facilitators present discussion content on screen, while “players” join via PC or mobile to form teams, discuss, vote, and comment. The platform enables different media to be delivered to individual devices than what’s shown on the facilitator’s screen, supporting varied perspectives. The result is a set of interactive activities and dilemma scenarios, with votes and choices recorded through the platform.



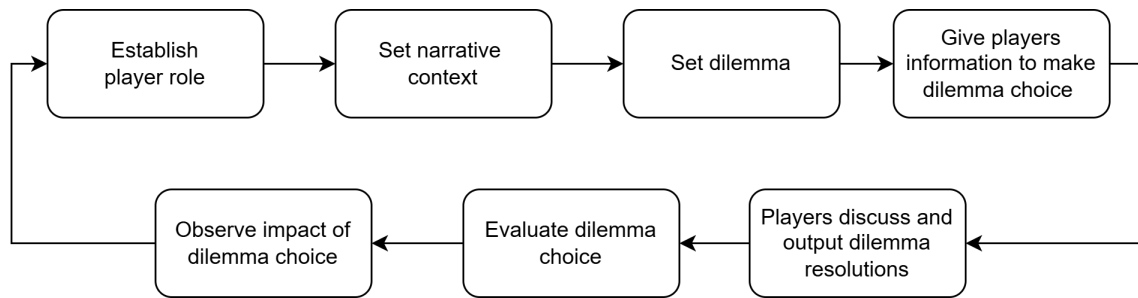
**Figure 1: Facilitator and player screen using the DiBL platform. Players can see both the facilitator screen and their own screen. Player screen can be used for text entry, voting, and information delivery**

Through a series of meetings with Waterwise, the following activities were chosen:

Activity 1: Water Use Survey: Players are surveyed on their current perception of water supply within the UK and asked questions about daily water use (Watson, 2025 S1). The result is an estimate of how much water each player uses each day. The results are private, a personal point of reflection and primer for examining water use information in the playful dilemma (Activity 3).

Activity 2: Data Exploration of Future Water Supply: Using two graphs (Watson, 2025 S2), players must view and discuss the data to create a title and tag line for a newspaper article on the outlook of water supply in the UK. This activity aims to ground players' views on water supply through data and the importance of considering water use.

Activity 3: Save the City Playful Dilemma: (See figure 2 for high-level flow) Players are informed that they are part of HYDRO, a group in charge of maintaining the water supply in the fictitious city, Belton. Belton is facing a water crisis, and HYDRO must consider the water behaviours that the population can reasonably change to halve bathroom water use. Participants collaboratively analyse citizen bathroom water use data (Watson, 2025 S4) to propose feasible behaviour-changes and supporting strategies. The shared platform and narrative provide a common space and context for discussions. The narrative is kept local to UK participants by using drought as the cause, and bathroom water use information similar to UK habits. The mission articulates the overarching goal, while the narrative structure introduces a dilemma regarding what water use should change and positions the group with a shared responsibility for resolving it. The players' actions are to deliberate and present plans to halve water use. These actions do not interact with the game world until a plan is formed. Like game-based learning, the actions of discussion and sensemaking are the required outcomes of this playful activity. Once plans have been submitted, players then vote on their preferred course of action. The facilitator evaluates the plan's impact: substantial savings result in the city's salvation, moderate success yields partial progress, and insufficient efforts lead to continued crisis. The resulting narrative is delivered to participants through the player and facilitator screens.



**Figure 2: Save the City playful activity core progression loop**

### 3. Pilot

A pilot was conducted using a convenience sample ( $n = 6$ ) to test timings and technology. A Game Experience Questionnaire (GEQ) (Ijsselstein et al., 2013) was administered to explore participants' perceptions of the playful dilemma experience. GEQ uses a series of 33, 5-point Likert scale questions (0 = not at all, 1 = slightly, 2 = moderately, 3 = fairly, 4 = extremely). A bug in the system interrupted the playful dilemma during this pilot, causing a period of inaction. From the GEQ (see Table 1), participants reported limited negative experiences during and after play. The positive experience was slight during play ( $M = 1.13$ ,  $SD = 1.02$ ), but the equivalent standard deviation suggests some variability in this. Positive experience after play was moderate. The game established a slight to moderate sense of flow and moderate immersion. Players found that the playful dilemma and supporting activities encouraged discussion on water use and enjoyed using data within the playful dilemma. Timings of all activities and worded content were adjusted based on feedback from this pilot.

**Table 1: GEQ core module descriptive statistics. 0 = "not at all", 1 = "slightly", 2 = "moderately", 3 = "fairly", and 4 = "extremely"**

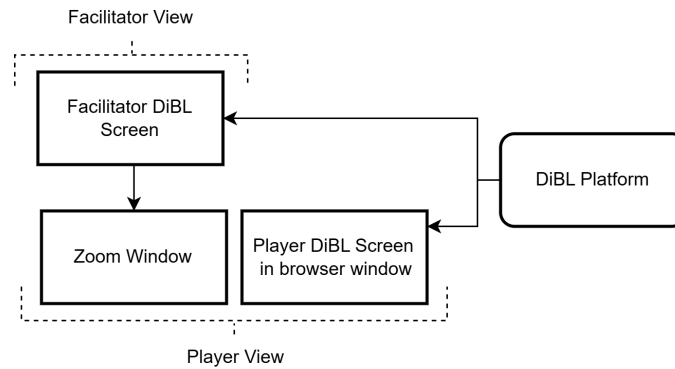
GEQ Category	Mean	SD	SE
Competence	1.63	0.98	0.40
Immersion	2.30	0.50	0.20
Flow	1.84	0.88	0.36
Tension/Annoyance:	0.33	0.52	0.21
Challenge	1.73	0.94	0.39
Positive affect	2.53	0.75	0.30
Negative affect	0.25	0.32	0.13
Positive Experience	1.13	1.02	0.42
Negative experience	0.47	0.25	0.10
Tiredness	0.33	0.52	0.21
Returning to Reality	0.28	0.33	0.13

## 4. Methods

In total, 19 participants (female = 10, mean age = 46, min age = 22, max age = 71) were recruited for the main trial. A participant call was placed through the communication channels (e.g., LinkedIn, Facebook) of Waterwise. The call explained that we are exploring playful approaches to discussing water use. Through the sign-up process, participants were screened to make sure they were over 18 and living in the UK. No incentives were offered to participants in this study.

### 4.1 Experimental Setup

Sessions took place between March and April 2025. Each session had 3-6 participants. All session discussions took place online through Zoom calls. This platform was chosen as it has the potential for a broad reach. The DiBL platform requires an open webpage to load the player screen. The facilitator delivers their screen through an online video format. Players will then have to engage with the facilitator screen and their own screen. The player screen can be accessed on a phone, tablet, or web browser. (See figure 4).



**Figure 4: Participants needed to navigate between the zoom discussion and their own webpage to take part in the sessions**

#### 4.2 Procedure

Participants would arrive online to the allocated Zoom session. The information sheet was discussed, and consent to take part was gathered (10 mins). Then followed facilitated activities. Activity one (10 mins), activity two (15 mins), and activity three (15 mins). A reflective survey was then given to the participants through the DiBL platform which asked about their experience (Watson, 2025 S4). During this reflective section, the text entry of what participants enjoyed the most and least appeared on screen to engage some final thoughts on this reflection (10 mins). One week later, a follow-up survey was sent to the participants, which asked the same questions from activity one, along with additional questions inquiring about any changes in behaviour (Watson, 2025 S6).

#### 4.3 Data capture

Video sessions and transcriptions were recorded through Zoom features. Transcriptions were checked and anonymised after sessions were completed. Transcripts were used for thematic analysis of discussions (Clarke & Braun, 2017). The themes explored were *Water Reduction Concepts*, the general areas where participants felt water savings could be made, *Water Reduction Ideas*, specific actions to reduce water use, and *Reasons Against*, which included reasons for disagreement with suggested ideas. Text entry and voting behaviour were recorded on the DiBL platform and received by the researcher after the sessions were conducted. Microsoft Forms were used for a follow-up survey and a sign-up survey. Through the sign-up survey, basic demographic data on age and gender were gathered.

### 5. Results

Through the follow-up survey, participants were asked if they had made any changes to their water use habits. Out of 19 participants, 16 responded. Eight stated no changes in water use. Four stated purposeful effort in turning off running taps, two stated taking shorter showers, one stated trying to generally be more water efficient, and two stated that they had made changes, but did not give details on what changes.

Participants were surveyed as part of activity one in the Zoom sessions, and one week later on their reported their water use. Although overall mean water use was reduced (756.59 L – 725.68 L), this was not significant (t(15) 0.61, p = 0.531) across the group.

**Table 2: The water reductions themes and ideas generated from the Save the City playful activity**

Water Reduction Concepts	Water Reduction Ideas	No. P's agree	Reasons Against
Reductions in shower time	Shower no more than 4- 5 per week	8	Vocation, family needs, skin conditions
	Reduce shower time to 4-6 mins	7	
Change in shower habits	Wash hair less	3	
Reduce Toilet flushing	If it is yellow, let it mellow (some of the time)	10	Considered unsanitary
Turn of taps	Brushing teeth	8	

Water Reduction Concepts	Water Reduction Ideas	No. P's agree	Reasons Against
<b>Bathroom hardware</b>	Install efficient devices	3	Expensive, should be government supported
	Maintenance and leakage	2	
	Subsidies for bathroom hardware	4	
<b>SMART metering</b>	Personal monitoring	5	No one should be penalised as water use is dynamic between households. Potential for state control effects
	Comparing to collective	7	
<b>Water awareness</b>	Promote benefits of less water use on self + collective + environment	5	
	Volume used + Water targets	8	
<b>Dynamic Pricing</b>	If use more water, you pay more	3	Not penalise certain family demographics and appreciate dynamic between households.
<b>Water recycling</b>	Rain catchers	6	
	Grey water use	1	

The follow-up survey included a 5-point Likert scale question (1 = strongly disagree, 5 = strongly agree) on whether they found themselves considering water use more, and if they had discussed water use more. The population sample was not normally distributed, so a one-sample Wilcoxon T-test was conducted on the median response against the mid-point of 3.00. A significant deviation below 3.00 would suggest a median disagreement with the statement, while a deviation above 3.00 would indicate agreement. There was a significant positive agreement that participants had been considering their water use more ( $V=105.50$ ,  $p=0.006$ ) with a large effect size (0.76). Discussions of water use were not significant ( $V=51.00$ ,  $p=0.685$ ) with a small effect size (0.13). This suggests a median neutral response.

Table 2 summarises the thematic analysis of the Save the City playful discussions. Participants commonly supported reducing shower time, toilet flushing, and turning off taps while brushing teeth. While it was considered that many could adopt these habits, barriers existed (e.g. family size, vocations, skin conditions). One participant opposed flushing reduction, citing hygiene concerns. Turning off taps was seen as easy and surprisingly impactful when they realised how much water runs through the tap each minute. Upgrading to water-efficient devices was well regarded, if subsidised. Otherwise, it was considered cost-prohibitive, despite its potential effectiveness.

When discussing supportive infrastructure for water use reduction, SMART metering was positively received for raising awareness of personal water use and leakages. However, concerns emerged around potential surveillance and micromanagement through the data generated. Participants saw value in comparing usage data with others, but only if anonymised. Identifiable data was viewed as a privacy violation. Through data, comparisons with anonymised collectives were viewed as motivating and helpful for understanding reasonable water use and a potential avenue for gamification and goal setting.

Participants welcomed information campaigns, noting the need for clearer guidance to support behavioural change. Ideas included health benefits of reduced washing, local water targets, and environmental impacts. Dynamic pricing was favourably received in one session, provided it didn't unfairly affect families or those with barriers to water efficiency. Suggestions for water recycling and greywater use emerged, although without concrete proposals. While participants believed UK rainfall could support non-drinking water reuse, practical implementation remained unclear.

Participants were asked to write one sentence on what they enjoyed the most and least. When reporting on what they enjoyed the most, eight participants mentioned group discussions and hearing others' points of view. Four specifically mentioned the Save the City exercise, one mentioned learning about their water use, one mentioned the computer game-style of the playful dilemma, and another mentioned that the activities used data. When reporting on what they enjoyed the least, two mentioned the article activity as it required creative thought, two mentioned seeing how much water they used, and one mentioned technical issues of logging in. When surveyed "How was your experience of the session (1=very negative and 5=very positive)", the average response was 4.32 ( $SD=0.58$ ). A Wilcoxon one-sample t-test against the middle value of 3 suggests a significant positive subjective affect in the sessions ( $p = p < .001$ ,  $v = 171$ ) with a large effect size (1.00).

## 6. Discussion

We explored the use of a playful dilemma and supporting activities to create a discussion space where citizens could reflect on and advise a path forward for reasonable water use at home.

Despite the short time given to these sessions, the playful dilemma prompted discussion on reasonable water reductions. Prior games emphasised stakeholder dynamics at a societal level, and as such, predominantly generate knowledge and concern within that framing (Cerutti, 2017; Cheng et al., 2019; Liao et al., 2023). Given the tighter focus on citizen water use, this playful dilemma was able to highlight sustainable and fair use of daily water habits. Self-washing routines became a dominant strategy due to the dilemma's focus on bathroom water use and equivalent real-world impact. Discussion shifted toward communicating these habits to Belton residents, with suggestions on promoting change through policy and infrastructure (e.g. SMART metering, dynamic pricing, informational tools). Two themes influenced the acceptance of such measures. First, participants valued insight into personal and collective water use to inform water behaviour. Second, there was concern about ensuring no demographic is unfairly penalised by rigid ideals of efficient water use.

Dilemma game studies have focused evaluations on how conceptual knowledge of a dilemma is developed through play and the ideas of awareness and concern that arise after playing the game (Cheng et al., 2019; Neset et al., 2020). Some assessment on how this experience may shape sustainable behaviour after play (Albertarelli et al., 2018). Our playful dilemma and supporting activities may aid general awareness and concern about water use, similar to full dilemma games. Participants reported they considered their water usage more. However, they were not found to discuss water behaviour more than normal, which might be expected if individuals were grappling with or more interested in the water habits. No significant reduction in overall reported water use was observed in the follow-up survey, but 8/16 participants who took part in the follow-up survey reported purposeful changes in their water use (shorter showers and turning off taps). This suggests that this approach may help nudge easily adjustable behaviours that have limited impact elsewhere in a citizen's behaviour.

GEQ scores from the pilot indicate a generally positive experience. However, flow and immersion were only moderate, suggesting that the activity functioned well as a discussion but less so as a game experience. Designed to prompt discourse and reflection on citizen water use, the narrative structure and shared goal effectively stimulated broad inquiry into responsible water practices. While the absence of game-world interactions facilitated immediate discussion, incorporating additional game elements, such as role-specific sub-goals aligned with a collective objective, could enhance engagement and foster deeper dialogue (Oksanen & Hämäläinen, 2014; Wang & Huang, 2021). Yet, introducing complex, non-discursive mechanics may shift focus toward gameplay navigation, potentially detracting from the intended sensemaking process (Liao et al., 2023).

The playful dilemma and the discussion it fostered were highlighted several times as the most enjoyable part of the session. This suggests that the format has the potential to engage a variety of perspectives in a water conversation. Slight delays in the network can foster awkward discussion moments where individuals talk over each other, and a gap in the discussion can seem more poignant than a real-world conversation. However, this did not halt discussion over the topics presented. Those who engaged with a mobile device needed to be *technologically savvy* to use both the Zoom application and DiBL player screen. However, with facilitation, the platform delivered data, surveys, game exposition, and consequences of dilemmas.

Limitations on the discussions should be noted. While the discussions drew on diverse perspectives, the group format may have subtly influenced the contributions. Social desirability bias, where responses align with perceived group norms, can distort sustainability discourse (Bergen & Labonté, 2020). We sought to mitigate this by facilitating discussions that encouraged divergent views and fostered rapport. Nonetheless, when interpreting consensus, it is essential to consider the influence of dominant narratives. Future research could strengthen findings by incorporating opportunities for anonymous reflection and individual input beyond group settings.

Limitations on how we measured behaviour change through self-reported water use are also susceptible to social desirability bias. It was impractical to gather actual water usage during the study. Improvements to this method could be made by finding independent water use observations to triangulate with self-reporting.

The participant pool must be considered. The call may have attracted citizens who are already interested in water sustainability, which could impact discussion and reported behaviour. Reproducing the approach across different demographics would help identify the type and mix of citizens this approach may or may not impact.

## 7. Conclusions

This study demonstrates the potential of playful dilemmas to foster meaningful reflection on sustainable water use at the household level. While participants reported increased awareness and some behavioural shifts, broader engagement with water habits remained limited. The activity functioned effectively as a discursive tool, with its narrative structure and shared goal prompting critical dialogue, although the game-like immersion was moderate. Social dynamics shaped the discourse, underscoring the need for future designs to support both individual expression and group exchange. With careful facilitation and targeted enhancements, such interventions could play a valuable role in changing low-barrier, sustainable behaviours.

## Acknowledgements

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.



UK Research  
and Innovation



Co-funded by  
the European Union

**Ethics Declaration:** This study received ethical approval from the University of Manchester Ethics Committee.

**AI Declaration:** AI tools were used to check grammar and help phrase some content.

## References

- Albertarelli, S., Fraternali, P., Herrera, S., Melenhorst, M., Novak, J., Pasini, C., Rizzoli, A.E. and Rottondi, C. (2018) A survey on the design of gamified systems for energy and water sustainability. *Games*, 9(3), p.38.
- Bergen, N. and Labonté, R. (2020) "Everything is perfect, and we have no problems": detecting and limiting social desirability bias in qualitative research. *Qualitative health research*, 30(5), pp.783-792.
- BSI (2024) *Thirst for Change: Accelerating Progress to a Water Secure World 2024*. rep. BSI Group. Available at: [https://www.bsigroup.com/siteassets/pdf/en/insights-and-media/campaigns/bsi\\_thirst\\_for\\_change\\_2024\\_final.pdf](https://www.bsigroup.com/siteassets/pdf/en/insights-and-media/campaigns/bsi_thirst_for_change_2024_final.pdf) (Accessed: 02 February 2025).
- Cerutti, N. (2017) Social dilemmas in environmental economics and policy considerations: A review. *Ethics in Progress*, 8(1), pp.156-173.
- Cheng, P.H., Yeh, T.K., Tsai, J.C., Lin, C.R. and Chang, C.Y. (2019) Development of an issue-situation-based board game: A systemic learning environment for water resource adaptation education. *Sustainability*, 11(5), p.1341.
- Clarke, V. and Braun, V. (2017). Thematic analysis. *The journal of positive psychology*, 12(3), pp.297-298.
- Druen, P.B. and Zawadzki, S.J. (2021) Escaping the Climate Trap: Participation in a Climate-Specific Social Dilemma Simulation Boosts Climate-Protective Motivation and Actions. *Sustainability*, 13(16), p.9438.
- DIBL (2025) *philosophy*. Available at: <https://dibl.eu/philosophy/> (Accessed: 05 March 2025).
- Ettinger, J. and Painter, J. (2023) The science of climate conversations. *Social Media+ Society*, 9(2), p.20563051231177930.
- Hamalainen, R. (2008) Designing and evaluating collaboration in a virtual game environment for vocational learning. *Computers & Education*, 50(1), pp.98-109.
- He, C., Liu, Z., Wu, J., Pan, X., Fang, Z., Li, J. and Bryan, B.A. (2021) Future global urban water scarcity and potential solutions. *Nature communications*, 12(1), p.4667.
- Hummel, H.G., Van Houcke, J., Nadolski, R.J., Van der Hiele, T., Kurvers, H. and Löhr, A. (2011) Scripted collaboration in serious gaming for complex learning: Effects of multiple perspectives when acquiring water management skills. *British Journal of Educational Technology*, 42(6), pp.1029-1041.
- Hollins, P., Ashby, L., Iwendi, C., McGhee, P., Ower, J., Drachsler, H., Burgos, D., Griffiths, D., Kieslinger, B., Egenfeldt, S. and Zachariou, A. (2023) October. The Application of Games to Engage Citizens in Climate Change Policy Development. In *European Conference on Games Based Learning* (pp. 887-XVIII). Academic Conferences International Limited. <https://zenodo.org/records/7802446>
- Janssen, M.A., Falk, T., Meinen-Dick, R. and Volla, B. (2023) Using games for social learning to promote self-governance. *Current Opinion in Environmental Sustainability*, 62, p.101289.
- Liao, K.H., Chiang, Y.S. and Chan, J.K.H. (2023) The levee dilemma game: A game experiment on flood management decision-making. *International journal of disaster risk reduction*, 90, p.103662.
- Meinen-Dick, R., Janssen, M.A., Kandikuppa, S., Chaturvedi, R., Rao, K. and Theis, S. (2018) Playing games to save water: Collective action games for groundwater management in Andhra Pradesh, India. *World Development*, 107, pp.40-53.
- Merry, A., Zachariou, A. and Yau, J. (2025) Exploring dilemma games in sustainable urban planning: A Cypriot case study on urban rooftop utilization for climate change. In *E3S Web of Conferences* (Vol. 608, p. 05010). EDP Sciences.

- Neset, T.S., Andersson, L., Uhrqvist, O. and Navarra, C. (2020) Serious gaming for climate adaptation—assessing the potential and challenges of a digital serious game for urban climate adaptation. *Sustainability*, 12(5), p.1789.
- Oksanen, K. and Hämäläinen, R. (2014) Game mechanics in the design of a collaborative 3D serious game. *Simulation & Gaming*, 45(2), pp.255-278.
- Pröpper, H.Y., van Eck, C.W. and Bakker, B.N. (2024) Climate Change Conversations Amongst Young Adults: On Conversational Safety and the Search for Consensus in Polarizing Interactions. *Environmental Communication*, pp.1-16.
- Simis, M.J., Madden, H., Cacciatore, M.A. and Yeo, S.K. (2016) The lure of rationality: Why does the deficit model persist in science communication?. *Public understanding of science*, 25(4), pp.400-414.
- Watson, P. (2025) "Supplementary Materials for 'Playful Citizen Discussion Space to Help Steer Society Towards Water Security' paper". Zenodo. [doi:10.5281/zenodo.16926830](https://doi.org/10.5281/zenodo.16926830).
- IJsselsteijn, W.A., De Kort, Y.A. and Poels, K. (2013) The game experience questionnaire.
- Waterwise (2025) *About Us*. Available at: <https://waterwise.org.uk/about-us/> (Accessed: 05 March 2025).
- Van Lange, P.A., Joireman, J., Parks, C.D. and Van Dijk, E. (2013) The psychology of social dilemmas: A review. *Organizational Behavior and Human Decision Processes*, 120(2), pp.125-141.
- Wang, C. and Huang, L. (2021) A Systematic Review of Serious Games for Collaborative Learning: Theoretical Framework, Game Mechanic and Efficiency Assessment. *International Journal of Emerging Technologies in Learning*, 16(6).