# DROP and FUNERGY: Two Gamified Learning Projects for Water and Energy Conservation

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**Abstract:** DROP! is a card game developed by the SmartH2O research consortium, funded by the European FP7 Program. Its goal is to engage people in using a gamified platform which offers a wide set of activities aimed at triggering water saving actions. The game has not been designed as a learning tool but a sort of "fun bridge" to enter the SmartH2O gamified portal and discover how to reduce our daily water consumption. Based on the water saving results achieved with SmartH2O (up to 21% reduction in the case study performed in the city of Valencia) the transfer of the successful approach to the energy domain is being undertaken in a new European project named enCOMPASS, which aims at developing solutions that enable users to save energy without causing a negative impact on their daily quality of life. The project is developing new tools to collect and visualize energy consumption data and to provide personalized recommendations for energy saving in test areas involving schools and public buildings. In conjunction to the tools, a game will also be developed: FUNERGY. In this contribution we present the game concept and lessons learned from the DROP! game for water saving and the first ideas for its adaptation to the energy domain.

**Keywords:** card game, water conservation, energy conservation, gamified web portal

## 1. Introduction

Gamified approaches to engage people by using game concepts in non-game contexts are gaining popularity, but are often considered as "reward systems" similar to video game leaderboards and badges. Actually, gamified frameworks may involve a wide variety of tools, ranging from physical games to mobile applications and websites, which require a much more sophisticated interaction between people and technology.

In such frameworks, a board game has a pivotal role: differently from videogames, board games create an immediate interaction between the players around the table and introduce specific rules and ways to communicate. While having a learning purpose, the game concept must be perceived as funny and the learning process must be as indirect as possible, especially if it mainly targets children: a reward system based on knowledge is perfectly fine, but only if it is not the only way for winning.

Based on these design principles, the SmartH2O European project (Rizzoli. et al., 2014) exploited the above mentioned synergy between a card-based board game, a gamified online portal and a mobile application to trigger behavioral changes in the water conservation attitudes of users. In this paper, after a brief literature review (Section 2) we describe the integration of the board game DROP! In the SmartH2O framework (Section 3) and then discuss how the know-how acquired during the project development will be transferred in the field of energy consumption in a new EU funded project named enCOMPASS (Section 4).

## 2. Related work

A number of serious games addressing smart electricity and water grid scenarios have recently been proposed (see (Savic, et al., 2016) for a comprehensive review on serious gaming for water systems management). In (Bourazeri & Pitt, 2013) a game platform for demand side management in smart grids is described. The game applies a self-organized approach to regulate the overall energy consumption using a set of social rules and principles and is implemented through individual or group challenges, where players are rewarded in case of

achievement of given objectives. Similar challenge-based approaches are adopted in (Gustafsson, et al., 2009), which presents a game aimed at reducing domestic energy usage and proposes team challenges where groups of users compete in achieving the lowest team-aggregated consumption.

The SmartH2O and enCOMPASS projects (Fraternali, et al., 2017) propose a more complex game mechanism that involves a gamified utility portal connected with a card game and its digital extension: the portal allows users to monitor the water consumption within their household and implements an awarding system that combines points and badges to reward water saving behaviors. The SmartH2O associated game ("DROP! The question") combines a card game and a mobile quiz game to raise awareness about the importance of water conservation within the household in a playful way. The game interaction feeds into the gamified portal by transferring user achievements from the game into points in the utility portal.

## 3. Game description

"DROP! The question" is a hybrid physical-digital card game for 3-6 players mainly targeting children of primary school age and both genders, but suited for the whole family, without any requirements on specific cultural/educational backgrounds. It is based on the story of Lily, a little girl who knows everything about the proper use of water, and her bungling monster friend, who clumsily mimics her actions. Players take turns in drawing cards: Lily cards provide points, whereas monster cards cause points deductions. At the end of the game players may access the SmartH2O platform (Figure 1) after scanning a QR-code on the monster card (Figure 2) by means of a mobile application especially designed to complement the game (though they are free to play also without this feature): this way, points can be recovered by correctly answering questions related to water consumption.

Exploiting the motivational effect of the card game on the children, parents are also incentivized to use the SmartH2O, portal because correctly answered questions in the mobile app yield points on the portal. Moreover, users consulting the gamified water portal can monitor their water consumption, activities and choices thanks to immediately comprehensible visualization mechanisms borrowed from the gaming field. Virtual game results can also be translated in redeemable rewards such as museum tickets or smart devices to improve efficient water usage.
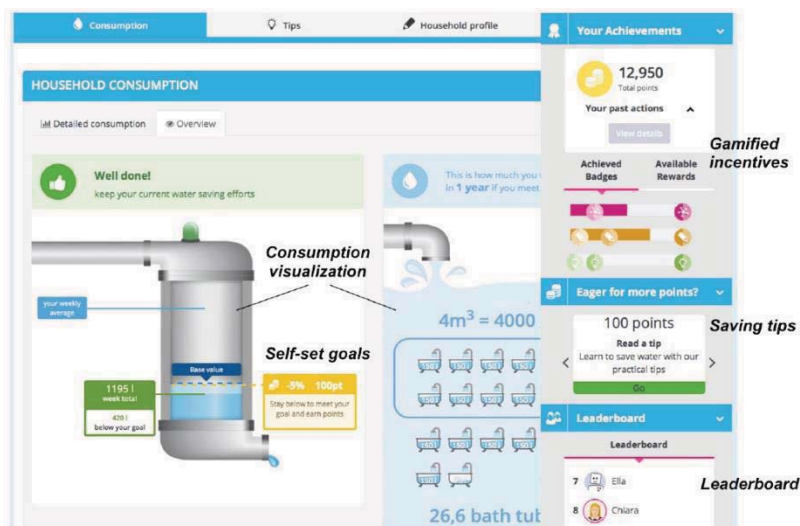


**Figure 1**: Implementation of the SmartH2O gamified portal (Novak et al., 2016)

To assess technology acceptance of the game, we apply the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, et al., 2003). Each indicator is evaluated with a subset of standardized questionnaire items using a 5-point Likert scale. As reported in Figure 3, most respondents assess the ease of use positively to very positively. Only 2 users are undecided about the ease to become skillful at playing the game. All the respondents consider the game easy to play, understandable, and easy to learn. On attitude towards using the technology, most respondents also express a positive attitude towards using the application, while the rest remains neutral and only 1 disagrees with having fun with the game, which shows that the design of the game mechanics are successful and that the game is generally perceived as entertaining. Moreover, most respondents think that the application makes water conservation more interesting and all of them consider playing with the app a good

idea in general, which indicates that the game accomplished the objectives of creating user engagement and raising awareness of water conservation. These results confirm that gamified learning activities can significantly increase learners' level of engagement, interest and intrinsic motivation (Kang & Tan, 2014).
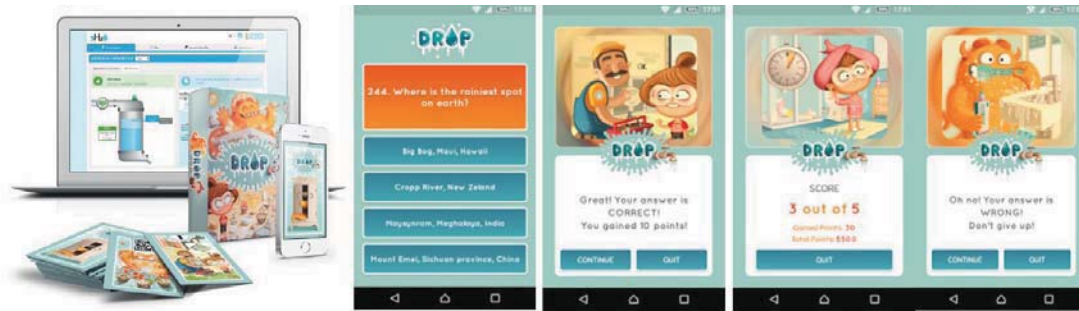


**Figure 2**: The Drop! game integrating a physical card game and a mobile game (Drop!TheQuestion)
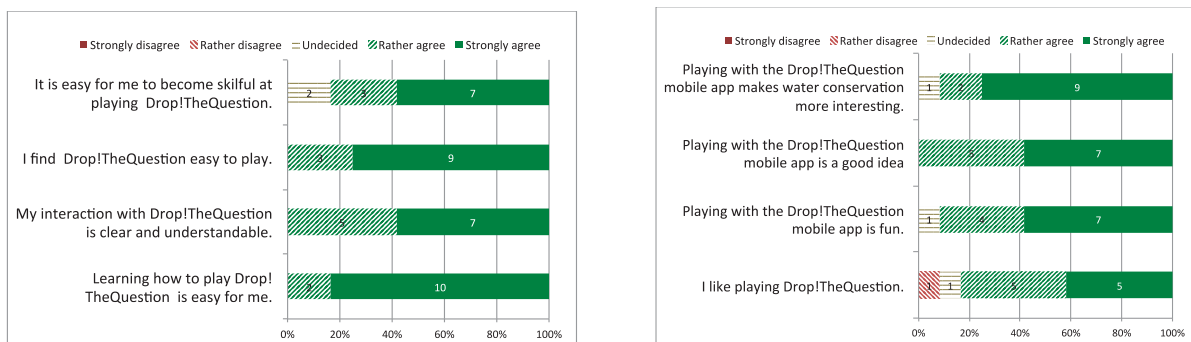


**Figure 3**: Effort expectancy (left) and attitude towards using the technology (right) for the mobile version of DROP!
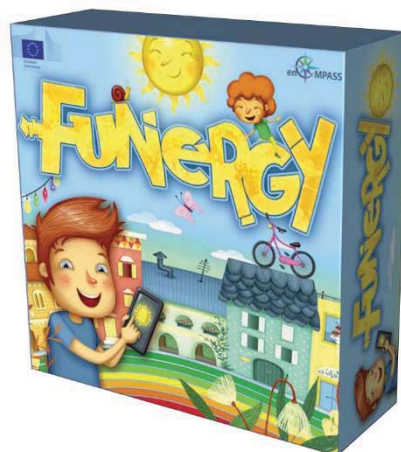
## 4. Knowledge transfer to the enCOMPASS project



**Figure 4**: FUNERGY game integrating physical card game and mobile game

The know-how acquired during the SmartH2O experience is being transferred to the enCOMPASS project with the development of a new game, called FUNERGY (see Figure 4). It is designed as a simple *cooperative* game (players try to reach the best possible final score collaborating with each other) teaching two simple concepts: 1) saving energy is something that concerns all of us, and 2) though we do not want to sacrifice our everyday comfort level to save energy, we must understand that the amount of energy we can use is limited and depends on where we live.

The game is divided in rounds. During every round the players must reach an "energy level value" by playing their cards. Let us say the first level ("G") is reached at 45 points. Every turn, players they play cards adding the value of the last played card to a common total. If they manage to score exactly 45 points, a new "energy level

token" is obtained. The game starts with the "G" value and the best score is the "A+++" level, in analogy with the energy efficiency scales used to rate electric devices.

The cards are "wild", i.e. they have a range of values (e.g., 6-9) and a QR code. The ranges are essential to reach the precise common score since players can pick in the range the value they need to get to that score. Players can expand this range, thus increasing their chances to get to the fixed score they need, answering a question with four possible choices. The question is provided by the associated mobile App and it is issued by scanning the QR code on the card. If the player answers correctly at the first attempt the range becomes 1-9, at the second attempt it becomes 3-9, and 5-9 after the third one.

Again, players are engaged in a learning process that can continue on the enCOMPASS gamified portal (an adapted and enhanced version of the SmartH2O portal), where they can find the answers to many of the questions as "energy saving tips". By perusing the portal, users learn about energy saving and conservation and will be able to increase the accuracy of their answers during the game. Moreover, as in SmartH2O, user achievements from the game are converted into points in the utility portal which will eventually enable the players to redeem concrete rewards.

## 5. Conclusions

In the SmartH2O project, the integration of a board game, a mobile application and a website to trigger behavioral changes in the water conservation attitudes of the users has proved to be a very effective way to engaging method to teach them important concepts in a playful way. The enCOMPASS project will bring the same concept to the energy domain, targeting not only households but also consumers in public buildings and schools. In such a scenario, the educational value of a "sustainability game", which retains a high entertainment effect, while providing useful insight into energy consumption, may prove effective in triggering individual and collective awareness on the importance of energy preservation.

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