

Incentivizing Correct Waste Sorting by Game Design

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INTRODUCTION

The fight against climate change and for sustainability and recycling is one of the ongoing challenges of our society. With its plan to raise EU-wide recycling to 50% and decrease landfill use to 10% by 2020 (European Commission 2017), the European Union acknowledges the importance of waste management. However, the successful implementation of the plan is currently impeded by several factors. Domestic waste sorting depends on civic responsibility. Waste gets sorted to the best of one's knowledge and belief, resulting in unreliable results and leading to high amounts of unnecessarily burned waste (OECD 2015). Also, global measures like unified marketing campaigns that could raise awareness, are hindered by the fact that there is no uniform EU-wide recycling system. Each municipality has its own custom waste disposal and recycling plant system, often of different age and efficiency, resulting in equally different waste disposal systems with different assignments and names. However, achieving behavioral change in the community is unlikely to happen without fostering intrinsic motivation (Deci, Koestner, and Ryan 2001) as well as teaching necessary information to citizens. "Serious Games" or "Edu-Games" (Aldrich, 2009) have been established as tools for teaching and social education. These types of games have gained huge momentum in recent years, resulting in several outstandingly performing tools like *Ludwig* (ovos realtime3D GmbH 2010), an educational game to teach physics to children in the 7th and 8th grade, or *Papers Please* (Lucas Pope 2013), a serious game on the political and social issues of immigration. In the following work, we present the design and plans for further research for a serious game educational mobile game that teaches and motivates correct waste sorting.

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DESIGN OF AN EDUCATIONAL WASTE SORTING GAME

Identifying Requirements

We started our design process by identifying and understanding the different aspects of the problem by conducting a pre-study consisting of expert interviews with the local waste management institution (blinded) as well as a variety of members of the public. Resulting, we listed the following key problems that should be tackled by the game.

As mentioned in the introduction, correct waste sorting depends on the knowledge and willingness of the citizens. Resulting from the interviews we identified: 1) a lack of awareness (interviewees overwhelmingly claimed that they had little to no knowledge about their local waste-system), 2) lack of competence in correct waste sorting (in first pre-tests consisting of the top 50 controversial waste items as listed by the AfA, 72% of sampled waste items were sorted incorrectly (participants n=15)) and 3) lack of commitment (most interviewees stated that they worried a little to not at all about correctly sorting their domestic waste). 4) For an efficient learning effect, the brain must be exposed to the learning content for a certain amount of time before pushing learned information from the short-term to the long-term memory. While the amount differs between different people and topics, a certain amount of exposure must be ensured (Hintzman 1976). From these results we derived certain core design choices for the game: The game is designed to be enjoyable for children as well as adults (1). The game provides immediate feedback on the correctness of the behavior and allows for quick access to the necessary information. (2) It aims to foster empathy and a feeling of responsibility in order to establish commitment to the topic (3). Tackling long-term memory adaption, the game is designed to afford for long-term playability as well as flow (Csikszentmihalyi, Abuhamdeh, and Nakamura 2005) (see chapter “Game Design”) (4). To ensure accessibility, it is developed for mobile devices of all three major platforms (iOS, Android, Windows) and is downloadable free of charge. Furthermore, the game is adaptable to any waste sorting system and is localizable.

Game Design

The core gameplay consists of an abstraction of the waste sorting process itself (see Fig1). The players are asked to sort incoming waste into the correct bin. The waste spawns on the right side of the screen and moves along on a conveyor belt to the left, where it drops if it is not picked up and sorted in time. Correct sorting is positively reinforced (points, point combos when repeated, positive sound, happy character) while incorrect sorting or dropped waste is punished (point loss, negative sound, unhappy character, pollution of the world, game over risk).



Figure 1: Core Gameplay



Figure 2: Trashdex

At any point in the game, information on the items can be gathered with the “Trashdex” (a scrollable index that lists all the waste items discovered up to that point (see Fig2)). The game features characters, that are specifically designed to represent the real-life disposal or recycling process of their associated waste (see Fig3).

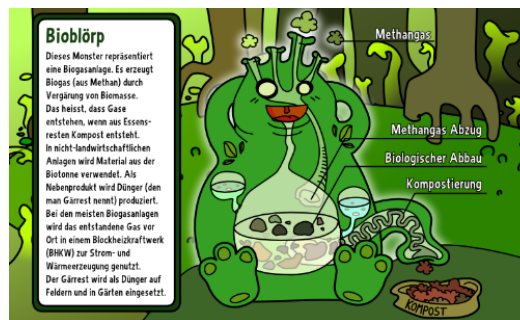


Figure 3: Bioblurp internal workings



Figure 4: Planet AfA-X

For incentivizing long-term interaction with the game, there is a whole storyline, complete with quests and minigames, that takes place on a fictional planet. The world design represents a metaphorical holistic view of the whole waste management process (see Fig4). The minigames target further aspects of municipal waste sorting (like teaching glass and battery recycling).

EVALUATION AND FUTURE RESEARCH

The game has been launched in a first version in November 2014 and has been updated to a full version in May 2015. Since then, the game has accumulated 7029 downloads (Android: 1980, iOS: 4390, Microsoft: 659). An extensive set of anonymized data has been collected for a dataset of n=5208. Our data shows that 44.40% of this subset of players continued to play after the onboarding phase. The average interaction timespan was 54.22 days.

These numbers lead us to believe that it is worthwhile to further investigate the connections between the different design choices and the ongoing motivation for players to interact with the game and thus the topic. This is currently achieved by quantitative analysis of the extended data-set that looks into in-game playing behavior in connection to the effectiveness of the different design elements. Furthermore, we are conducting qualitative analysis of the connection between in-game behavior and factors of personality. For future research we aim to investigate the success of our intended learning effect through an experiment and a supporting long-term study.

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