EcoBlue - Recycle The River Trash

An Educational Game

FirstName Surname†  
 Department Name  
 Institution/University Name  
 City State Country  
 email@email.com

Faizanshah Raouf Ansari  
 School of Computing  
 Newcastle University  
 Newcastle upon Tyne - UK  
 f.r.ansari2@newcastle.ac.uk

FirstName Surname  
 Department Name  
 Institution/University Name  
 City State Country  
 email@email.com

ABSTRACT

A serious game to ensure more people know about recycling rubbish. It teaches people how to identify and recycle trash flowing down a river. As rubbish passes, players must place it in the appropriate recycle bins. When players level up, it results in the river running faster. Rubbish piles up, and the game ends when it gets to a specific limit. In front of the river, people do activities such as cycling, which blocks up the view, so sometimes the player cannot see the river items (when levels get harder). If players get a fish by accident, points are deducted. Randomly, People will be throwing things into the river, and players can click on the person to stop them from throwing rubbish into the river and increase their reputation. Different structures such as farmland, household drainage and factory are present near the river and either affect or are affected by the river's pollution level. Children may cause the bin position to be changed; players must keep that in mind. At the end of every level, the rubbish collector collects the rubbish and says "THANKS!".

1 Introduction

Video Games capture a wide variety of audiences, with more than 2.5 billion gamers worldwide. That's a third of the world's population. Seventy-two per cent of the gamers are age 18 or older, with an average gamer being 34 years old [1]. These demographics show us that games are not only for teens though teens and vicenarians love them. Thus, when appropriately used, video games could prove a potent tool in educating and bringing world reforms.

1.1 What are Serious Games?

The term 'Serious Games' has developed because people wanted to distinguish between games for fun and entertainment to games that had a serious outcome, such as giving a social message or learning. A serious game from a learning perspective is a game that allows people to learn. Many people think that serious games originated in 2000 with the Serious Game initiative. If we go back in time to the 1970s, a man named Clarke C. Abt released a book called Serious Games. It even goes back way further. Games can give us non-linear experiences. We don't always have to go in order. We can think about the strategy differently. We can think about elements differently [2]. All these things are benefits of playing serious games.

1.2 How Serious is River Pollution Around the World?

Indonesia's Citarum River, which is relied upon by almost 19 million people, has been choked with chemicals and rubbish due to decades of pollution. Wastewater is introduced into the stream by about 3000 industries residing near the river. Residents have nowhere to dispose of trash, so they either burn it or throw it into the river. In 2013 Asian Development Bank found out that faecal coliform bacteria levels had shot through the roof, crossing 5,000 times the mandatory limits. Lead levels have become more than 1,000 times the US Environmental Protection Agency drinking water standard. Levels of other heavy metals such as Al, Fe and Mn are above the international average. People are suffering from dermatitis, contact rashes, intestinal problems, delays in child development, renal failure, chronic bronchitis, and a significant incidence of tumours. Contaminants are also ingested via the food, mainly rice, irrigated with water from factories and villages or the Citarum and its tributaries, affecting residents and nearby animal life [3].



Figure 1: The Citarum river near the village of Bojongsoang in Bandung, West Java, Indonesia

The mismanagement of plastic disposal has caused the chaotic spread of plastics in the environment and eventually led to the fragmentation of this substance into smaller particles, turning it into microplastics (MPs) that pollute the environment. Microplastics have been found in river water, sediments, ponds, and milkfish (Chanos chanos) downstream of the Citarum River. Based on the shapes, the microplastics found in the samples could be categorized into five types: a fragment, fibre, film, monofilament, and foam. The fragment was the most dominant shape of microplastics in both water and sediment samples. The most dominant polymers in the microplastics were polyethylene (PE) and polypropylene (PP) [4].

Antibiotic and metal resistance in sediments from the Ganges and Yamuna Rivers in India and streams in the River Tyne catchment were quantified by a collaborative effort of Newcastle University and the Indian Institute of Technology, Delhi. Their results showed that metal pollution also affected resident bacteria, with Firmicutes and Bacteroidetes being the most abundant species at sites with high metal pollution. These bacteria are common in metal-contaminated environments and are known to carry metal resistance genes (MRGs) and antibiotic resistance genes (ARGs) in groups in "gene cassettes", which causes antibiotic resistance.

The study showed that specific metal combinations that promote the most potent bacterial responses combined Cobalt with Nickel or Cobalt with Zinc and Cadmium [5].

1.3 River Cleaning Initiatives

#TeamSeas is a global campaign being led by famous YouTubers Mark (Rober), Jimmy (MrBeast) and Campaign Director Matt Fitzgerald (@fitz350) to raise $30M to remove 30M pounds of plastic and trash from the ocean, rivers and beaches. They have collaborated with The Ocean Cleanup and have developed technologies for river pollution called Interceptors, which have removed over 2 million pounds. It is solar-powered and can collect trash autonomously [6].

Canal & River Trust is a UK-based charity that looks after and brings 2,000 miles of waterways to life because they believe that life is better by water. Working with volunteers and communities across England and Wales, they help transform canals and rivers into spaces where local people want to spend time and feel better. They have started an initiative called #PlasticChallenge. They believe, "If every time someone visited our canals and rivers they picked up and disposed of just one piece of plastic, there could be no plastic left within a year." They provide a helpful guide for The Plastic Challenge, including safety tips such as: Do not reach into the water to collect any plastics or litter. Always stay away from the water's edge; Always use gloves, or a litter picker, to pick up plastics and litter and cover any cuts and grazes before you start [7].

Thus, the intricacies of the existing river problem and some of their implemented solutions are considered for gamification and exciting gameplay elements to make a safe, totally immersive and educative game.

2 Related Work

In this section, I will analyze the projects focused on serious games related to the environment.

2.1 SimBasin

This serious game focuses on communicating the complex relationships between different factors affecting river basins and enabling a dialogue between policymakers and scientists in the Magdalena-Cauca basin, Colombia. The game focuses on the elderly stakeholders responsible for policies and innovations [8]. But when it comes to on-ground implementation, the age group that needs to be targeted is much younger. Seventy-nine per cent of young people claim to be concerned about current environmental issues [9].

Aspects considered in this game are Flooding, Agriculture, Hydropower, River health, Forest remaining and Wetland remaining. The wide variety of focus forces oversimplification of core calculation logic of different aspects. For example, for river health, which has an important impact on ecosystems, two factors were combined: flow regime alteration and river network fragmentation. River alteration is considered a stochastic parameter. Flow regime alteration is expressed through mean "ecochange" over ten representative river reaches. Ecochange is the normalized area between the baseline flow-duration curve and the altered flow-duration curve in the reach. Quantifying ecological alteration of rivers is complex as evaluation of various flow components needs to be considered due to their differing impacts on riverine ecosystems. Therefore, total ecochange is not necessarily a good indicator of ecological alteration, as has been confirmed by studies [10] [8].

2.2 noPILLS jam (NPJ)

This is a European research project-based game jam focusing on the long-term aim of reducing pharmaceutical micro-pollutants in the water cycle. This was a two-day-long game jam consisting of 10 participants from which three games were produced; Sewer Sweeper, Polluted and Purity [11].

"Sewer Sweeper" is a first-person shooter aiming to teach generic nuances of water filtration. The player shoots at particles representative of micropollutant elements as they move continuously through the pipe environment and learns about these micropollutants through a quiz-like format as the level progresses.

Scores are calculated based on the number of particles shot and removed and the number of correct answers to the related questions [11]. Overall, the game is focused more on teaching theoretical aspects of water filtration than the practical process associated with it.

"Polluted" teaches young players that the fishes have been exposed to water pollution caused by irresponsible disposal methods of humans. The game drives the player to manoeuvre a small fish through the treacherous waters, taking shelter from waste materials under seaweed. Players must also avoid capsules within the water, which causes specific camera effects and control manipulation to make the objectives more difficult. Overall, the game presents a mixture of narratological and ludological stimuli and allows players to understand pollution's cause-and-effect realities on a sympathetic level [11].

"Purity" is a management simulation tool aimed to be used by professionals or final year University students to understand water treatment plants with a focus on filtration methods such as carbon filtration and UV treatment [11].

These prototypes, and noPILLS as a whole, have informed the development of a research project aiming to identify serious games as an effective method for engaging the public in social policy [11].

2.3 SEAJAM

This game jam was held from October 29th 2021 to November 29th 2021. It directed more people to the cause of the #TeamSeas campaign mentioned under the "River Cleaning Initiatives" section above. It was an online game jam which received 670 game entries by its end [12]. I will be discussing three games out of these entries: Pond Pirates, Beach Watch, and Team Oceans.

Pond Pirates is a game about two boys on a self-made pirate ship on a mission to clean the pond. The gameplay mechanics of the game consists of plastic spawn enemies (Plastic Bottles & Dorito Packets), A big boss fight, and Two sellers that help you get upgraded for the boss fight. One is a blobfish that eats up your plastic, and the other is a goose that rewards you for recycling enough plastic if your ship is below a certain plastic contamination level. Overall, the game balances fun, entertaining gameplay with a strong message.

BeachWatch is a game where the player must segregate items that end up at the shore into recycling bins. The player must align the trash in a specific orientation before disposal, and there is a time limit for executing these actions. The game does an excellent job of conveying the message of segregation and recycling, but it makes the gameplay a bit cumbersome. Players must type all their actions as well as the item's name. It would have been nice if players were allowed to use the mouse as one of the input methods.

Team Oceans is a game that teaches players to return the trash thrown at the shore to its owner and clean up the water by picking up trash. The player has to decide between rebounding the trash thrown & cleaning up the water body giving the game fascinating game mechanics. The player has two characters to control using WASD and Arrow Keys. The game provides many opportunities to mix and match tactics with each character. The sound effects are also well thought out.

Thus, we can see that exploration of the serious game under the game jam banner has been done on both levels Online Game Jam (Low Budget – Large Community) and Incentivised Game Jam (Large Budget – Small Community) [11].

The updated template, user manuals, samples, and required fonts, all are available at the URL <https://www.acm.org/publications/proceedings-template>. It contains said information for all three versions of MS Word (Windows and 2 versions of Mac). There are also separate links to the user guide, which can be referred to by the user. This URL also contains some useful video links, which describe how to add the template, structure the paper, and generate the layout, in different clips. **Display Formula with Number**

 (1)

**Continuation part of Paragraph Text** The user must style this paragraph in **ParaContinue** style, which follows immediately after the **DisplayFormula** (numbered equation). The **DisplayFormula** style is applied only in case of a numbered equation. A numbered equation always has a number to its right. Insert paragraph text here. **Display Formula without Number**



The **DisplayFormulaUnnum** style is applied only in case of an unnumbered equation. An unnumbered display equation never contains an equation number to its right, and this unique property distinguishes it from a numbered equation.



Figure 1: Figure Caption and Image above the caption [In draft mode, Image will not appear on the screen]

**Theorem/Proof/Lemma.** Insert text here for the enunciation or Math statement. Insert text here for the enunciation or Math statement. Insert text here for the enunciation or Math statement. Insert text here for the enunciation or Math statement. Insert text here for the enunciation or Math statement.

....Insert text here for the Quotation or Extract, Insert text here for the Quotation or Extract, Insert text here for the Quotation or Extract, Insert text here for the Quotation or Extract, Insert text here for the Quotation or Extract, Insert text here for the Quotation or Extract.

1.1 Heading Level 2

In the below paragraph, it is explained how alt-txt value is placed in **MS Word 2010**. To add alternative text to a picture in Word 2010, follow these steps:

1. In a Word 2010 document, insert a picture.
2. Right click on the inserted picture and select the **Format Picture** option.
3. Select the **Alt Txt** option from the left-side panel options.
4. In the "Title:" and "Description:" text boxes, type the text you want to represent the picture, and then click "Close".

Below are steps to place alt-txt value in **MS Word 2013/2016**. To add alternative text to a picture in Word 2013/2016, follow these steps:

1. In a Word 2013/2016 document, insert a picture.
2. Right click on the inserted picture and select the **Format Picture** option.
3. In the settings at the right side of the window, click on the "Layout & Properties" icon (3rd option).
4. Expand **Alt Txt** option.
5. In the "Title:" and "Description:" text boxes, type the text you want to represent the picture, and then click "Close".

*1.1.1 Heading Level 3.* Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here.

*1.1.1.1 Heading Level 4.*Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here.

ACKNOWLEDGMENTS

Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here.

REFERENCES

[1] Victor Yanev. 2022. Video Game Demographics - Who Plays Games in 2022. (May 2022). Retrieved May 30, 2022 from https://techjury.net/blog/video-game-demographics/#gref

[2] Carl Kapp, 2019. What Are Serious Games?. Video. (19 August 2019). Retrieved May 27, 2022 from https://youtu.be/JmG3fdptY\_k

[3] Andrea Carrubba. 2020. Rotten river: life on one of the world's most polluted waterways – photo essay. (November 2022). Retrieved May 31, 2022 from https://www.theguardian.com/global-development/2020/nov/02/rotten-river-life-on-one-of-the-worlds-most-polluted-waterways-photo-essay

[4] Sembiring, E., Fareza, A.A., Suendo, V. et al. The Presence of Microplastics in Water, Sediment, and Milkfish (Chanos chanos) at the Downstream Area of Citarum River, Indonesia. *Water Air Soil Pollut*ion 231, 355 (July 2020), 231-355. DOI: https://doi.org/10.1007/s11270-020-04710-y

[5] Sonia Gupta, David W. Graham, T.R. Sreekrishnan, Shaikh Ziauddin Ahammad. 2022. Effects of heavy metals pollution on the co-selection of metal and antibiotic resistance in urban rivers in UK and India. *Environmental Pollution* 306, 1, Article 119326 (April 2022), 11 pages. DOI: https://doi.org/10.1016/j.envpol.2022.119326

[6] Team Seas. 2022. #TEAMSEAS. Retrieved from https://teamseas.org/

[7] Canal & River Trust. 2022. Join our #PlasticChallenge. Retrieved from https://canalrivertrust.org.uk/news-and-views/features/plastic-and-litter-in-our-canals

[8] Joanne Craven, Hector Angarita, G.A. Corzo Perez and Daniel Vasquez. 2017. Development and testing of a river basin management simulation game for integrated management of the Magdalena-Cauca river basin. *Environmental Modelling & Software* 90, 1 (April. 2017), 78-88. DOI: https://doi.org/10.1016/j.envsoft.2017.01.002.

[9] 4 YOUTH. 2019. YOUNG PEOPLE AND THE ENVIRONMENT. Retrieved from https://www.uktribes.com/report/young-people-and-the-environment

[10] Yongxuan Gao, Richard M. Vogel, Charles N. Kroll, N. LeRoy Poff and Julian D. Olden. 2009. Development of representative indicators of hydrologic alteration. *Journal of Hydrology* 374, 1–2 (July 2009), 136-147. DOI: https://doi.org/10.1016/j.jhydrol.2009.06.009.

[11] Ramzan, R. and Reid, A. J. 2016. The Importance of Game Jams in Serious Games. In *Proceedings from the 10th. European Conference on Game-based Learning (ECGBL)*, October 6-7, 2016, Paisley, UK.

[12] SEAJAM. 2021. SEAJAM - #TeamSeas Game Jam. Retrieved from https://itch.io/jam/seajam.