Literature Review

User Analysis:

Serious games have gained popularity as educational tools across various domains, including higher education. They leverage the engaging elements of gaming to facilitate learning, skill development, and behavior change. However, applying serious games to the context of higher education students presents unique challenges related to engagement and accessibility.

Engagement Issues

- Motivation and Interest: Higher education students often have diverse interests and varying levels of intrinsic motivation. Serious games must be carefully designed to capture and maintain their interest. Research indicates that games need to be relevant to students' academic goals and personal interests to sustain engagement (Hamari et al., 2016). If the educational content is perceived as irrelevant or overly simplistic, students may quickly lose interest.
- Balance Between Education and Entertainment: One of the critical challenges is finding the right balance between educational content and entertainment. Games that are too focused on delivering information may fail to engage students, while those that prioritize entertainment might not achieve the desired educational outcomes (Wouters et al., 2013). The game design must integrate educational objectives seamlessly within engaging gameplay to maintain student interest.
- Complexity and Challenge: Higher education students generally prefer games that offer an appropriate level of challenge. If the game is too easy, it may be perceived as patronising; if it is too difficult, it could lead to frustration (Annetta et al., 2009). Designing adaptive difficulty levels that respond to individual players' skills can help maintain engagement by providing a tailored challenge.
- Feedback and Rewards: Immediate and meaningful feedback is crucial for maintaining engagement. Higher education students appreciate detailed feedback that helps them understand their mistakes and learn from them (Kapp, 2012). Additionally, a well-designed reward system that acknowledges achievements can motivate students to continue playing and learning.

Accessibility Issues

- Specific Learning Difficulties: The most common type of reported disability among higher education students in England was specific learning difficulties, such as dyslexia, dyspraxia, and ADHD (House of Commons Library, 2020). These students may struggle with games that rely heavily on text-based instructions or require rapid information processing.
- Mental Health Conditions: The second most common type of disability was mental health conditions (House of Commons Library, 2020). Students with anxiety, depression, or other mental health issues may find certain game elements, like timed challenges or competitive aspects, to be stress-inducing.
- Physical Disabilities: While not as common, physical disabilities can also impact game accessibility. Students with motor impairments might have difficulty with games that require precise or rapid movements.

- Diverse Learning Styles: Students in higher education come from varied academic backgrounds and possess different learning styles. Serious games need to accommodate these differences by offering multiple ways to engage with the content (Felder and Brent, 2005). This includes visual, auditory, and kinesthetic learning modalities.
- Technological Accessibility: Not all students have equal access to high-end gaming hardware or stable internet connections. Games that require significant technological resources may exclude some students (Beavis, Dezuanni and O'mara, 2017). Ensuring that serious games are accessible on a range of devices, including low-spec computers and mobile phones, is essential for inclusivity.
- Usability and User Interface: The usability of the game interface can significantly impact accessibility. Complex or unintuitive interfaces may hinder students' ability to engage with the game (Shneiderman et al., 2016). Ensuring that the game has a user-friendly design, with clear instructions and intuitive controls, is vital for accessibility.
- Cognitive Load: Higher education students are often juggling multiple academic responsibilities. A game that requires excessive cognitive load can become an additional source of stress rather than a learning tool (Sweller, 1988). Designing games that are easy to pick up and play, with clear objectives and minimal extraneous cognitive load, can enhance accessibility.
- Language Barriers: For international students or those who are non-native English speakers, language can be a barrier. Games that rely heavily on text or complex language can be less accessible (Gee, 2003). Including multilingual support and simplifying language can help make the game more inclusive.

Task Analysis:

- Engagement and Motivation: Educational games often struggle to balance educational content with engaging gameplay. A study highlights that games too focused on educational content can become tedious, reducing player motivation and engagement. Conversely, games that prioritise entertainment may fail to effectively convey educational messages (Annetta, Minogue, Holmes and Cheng, 2009).
- Complexity and Usability: The complexity of tasks in educational games can impact user experience significantly. Games that present overly complex tasks without adequate guidance can frustrate players, leading to disengagement. Kebritchi and Hirumi (2008) stress the importance of intuitive design and clear instructions to ensure players can navigate the game and understand their objectives without excessive cognitive load.
- Relevance to Real-World Applications: Many educational games fail to make a clear connection between in-game tasks and real-world applications. De Freitas and Oliver (2006) argue that for educational games to be effective, they must demonstrate how in-game actions relate to real-world scenarios. Without this connection, players may not see the value of what they are learning.
- Feedback and Assessment: Immediate and constructive feedback is crucial for learning, yet many educational games do not provide timely feedback. Gee (2003) emphasises that effective educational games should provide immediate, clear feedback to help players understand their mistakes and learn from them.

Environment Analysis:

The game is designed to be initially used on PCs in classrooms and during lectures but has the potential for cross-platform development to include mobile devices. Understanding the environment and hardware considerations is critical for ensuring the game's accessibility, usability, and effectiveness.

Classroom Environment

- Technical Infrastructure: Many educational institutions have varying levels of technical infrastructure, which can impact the smooth running of digital educational tools. A study by Johnson et al. (2016) found that inconsistent access to reliable hardware and internet connectivity can hinder the implementation of technology-enhanced learning. Ensuring the game runs efficiently on standard classroom PCs with moderate specifications is crucial.
- PCs and Software Compatibility: In a typical classroom setting, PCs may have different configurations and software versions. This diversity can lead to compatibility issues, where the game might not perform uniformly across all systems. Therefore, it is essential to develop a game that is compatible with various operating systems and software versions commonly used in educational settings (McFarlane, 2018).
- Accessibility Features: The classroom environment necessitates that educational games are accessible to all students, including those with disabilities. According to the UK Government (2010), educational institutions must provide equal access to learning resources. This includes ensuring the game supports accessibility features such as screen readers, alternative input methods, and customizable display settings to accommodate students with visual, auditory, and motor impairments.

Mobile Environment

- Device Variability: Students often use a wide range of mobile devices with different screen sizes, operating systems, and hardware capabilities. Developing a cross-platform game that runs smoothly on both Android and iOS devices, and across different screen sizes, is a significant challenge (Chen and Nath, 2016). Ensuring responsive design and scalable graphics is essential for providing a consistent user experience.
- Battery Life and Performance: Mobile games must be optimized to minimize battery consumption and ensure smooth performance on devices with lower processing power. Excessive battery drain can discourage students from using educational apps for extended periods (Hassenzahl and Tractinsky, 2006). Efficient coding practices and performance optimization are crucial for maintaining user engagement.
- Usability and Interaction: Mobile devices offer different interaction paradigms compared to PCs, such as touch inputs and accelerometer-based controls. The game design must account for these differences, providing intuitive and responsive touch interactions. Mobile usability requires clear and simple navigation, touch-friendly interfaces, and quick response times to keep users engaged.

Cross-Platform Development

- Development Frameworks: Utilising cross-platform development frameworks such as Unity or Unreal Engine can streamline the process of creating a game that works seamlessly on both PCs and mobile devices. These frameworks support multiple platforms and provide tools for optimising performance and ensuring compatibility.

Design Document

Game Overview

Our serious game, titled ‘Waste Sorting Game', is an interactive educational experience designed to raise awareness and promote understanding of environmental sustainability, waste management, and the process of recycling. Players are immersed in a virtual world where they are tasked with sorting various types of waste into the appropriate bins within a specified time limit. Through engaging drag-and-drop gameplay mechanics, players navigate through different levels, each presenting new challenges and opportunities to learn about recycling and proper waste disposal practices. With customisable controls, inclusive design features, and dynamic feedback mechanisms, the game offers an accessible and immersive learning experience for players of all backgrounds, aligning with the United Nations Sustainable Development Goals (SDGs), particularly goal number 12 (Responsible Consumption and Production) and the UNESCO ESD Competencies including critical thinking, integrated problem-solving, and systems thinking.

Core Objectives

Learning Objectives:

- Understanding Waste Classification: Players will learn to differentiate between different types of waste, including recyclables, food waste, and general waste. By sorting various items into the appropriate bins within the game, players develop an understanding of the importance of proper waste classification for effective recycling and waste reduction efforts.
- Promoting Recycling Practices: Our waste sorting game aims to promote recycling practices by educating players on the recyclability of common household items such as paper, plastic, glass, and metal. Through interactive sorting tasks and informative pop-ups, players learn about the environmental benefits of recycling and the impact of recycling on resource conservation and waste reduction.
- Encouraging Responsible Consumption: The game encourages players to consider their consumption habits and the lifecycle of products, from production to disposal. By highlighting the environmental need of avoiding excessive consumption and less waste generation, the project promotes responsible consumption behaviors such as reducing, reusing, and recycling materials to minimise environmental impact.
- Fostering Environmental Awareness: The project fosters environmental awareness by providing players with insights into the environmental challenges facing our planet and the importance of individual and collective action in addressing these challenges. Through informative content, players gain a deeper understanding of sustainability issues such as pollution and climate change, empowering them to make informed decisions and take positive environmental actions in their daily lives.

Player Objectives:

- Sort Waste Items: Players are tasked with sorting various types of waste items into the appropriate bins within a specified time limit. Using intuitive drag-and-drop mechanics, players must carefully consider the characteristics of each item and classify them as recyclables, food waste, or general waste. By actively sorting waste items, players develop a practical understanding of waste classification and recycling practices.

- Learn About Recycling: Throughout the game, players encounter informative pop-ups and educational content that provide insights into recycling practices and the environmental benefits of recycling. By interacting with these informative elements, players gain knowledge about the recyclability of common household items and the importance of recycling in conserving resources and reducing waste.
- Navigate Through Different Levels: The game features multiple levels, each presenting new challenges and opportunities to learn about sustainability. As players progress through the game, they encounter increasingly complex sorting tasks, time constraints, and environmental scenarios. By successfully completing each level, players advance in the game and reinforce their understanding of sustainability concepts.
- Achieve High Scores: Players have the opportunity to challenge themselves and strive for high scores as they progress through the game. By accurately sorting waste items, completing levels within the allotted time, and minimizing mistakes, players can earn points and improve their overall performance. The scoring system encourages players to focus on accuracy, efficiency, and environmental consciousness.
- Unlock Environmental Insights: Throughout their gameplay experience, players unlock environmental insights and tips that provide deeper context and understanding of sustainability issues. These insights offer valuable information about environmental challenges, such as pollution, resource depletion, and climate change, empowering players to make informed decisions and take positive actions in their daily lives.

Game Structure

Narrative and Progression:

In the game, the narrative structure and progression are designed to provide an engaging and educational experience that evolves with the player's growing understanding of waste management and sustainability practices. The game unfolds in a series of levels, each representing different environments and increasing challenges that align with the player's learning journey.

1. Introduction and Tutorial Levels (levels 1-3): The game begins with introductory levels that include a brief tutorial. Players are introduced to the three types of bins: recycling waste, general waste, and food waste. Simple items are presented with clear visual and textual cues to help players understand the sorting mechanics. The time limits are generous, allowing players to get accustomed to the gameplay.
2. Basic Sorting Challenges (levels 4-7): As players progress, the game introduces a greater variety of waste items and slightly reduces the time limits. This stage focuses on reinforcing the knowledge gained in the tutorial by presenting more items to sort within a moderate time frame. Players start to encounter common household waste and recyclables, learning about their proper disposal.
3. Intermediate Challenges and Increased Difficulty (levels 8-12): The game complexity increases by introducing mixed waste scenarios where players need to quickly identify and sort multiple items under stricter time constraints. Players also start to see the consequences of incorrect sorting, such as reduced points and environmental impact animations, which emphasize the importance of proper waste management.
4. Memory Challenge Levels (levels 13-17): A new mechanic is introduced where items are displayed for a brief period (5 seconds) before being covered with trash bags. Players must

rely on their memory to sort these items correctly. This stage challenges players' recall abilities and deepens their engagement by adding an additional cognitive layer to the gameplay.

5. Advanced Recycling Plant Levels (levels 18-20): The final levels take place in a virtual recycling plant. Here, players face complex sorting tasks that simulate real-world recycling processes. The time limits are tight, and the number of items is high, requiring quick thinking and precise actions. This stage aims to consolidate all the skills learned throughout the game and demonstrate the complexity and importance of recycling facilities.

Replayability:

The game is designed with high replayability in mind. Several features ensure that players can continually engage with the game and improve their skills:

- Scoring and Leaderboards: Players can aim to achieve higher scores by improving their sorting accuracy and speed. A global leaderboard encourages competition and motivates players to replay levels to beat their own or others' scores.
- Dynamic Difficulty Adjustment: The game can adjust difficulty based on player performance. This ensures that both new and experienced players find the game challenging and engaging, providing a reason to replay and improve.
- Variety of Items and Scenarios: Each playthrough can introduce different combinations of items and waste scenarios. This variability keeps the gameplay fresh and encourages players to return and experience new challenges.
- Unlockable Content and Achievements: Players can unlock new levels, special items, and achievements by reaching certain milestones. These rewards provide a sense of progression and accomplishment, motivating players to continue playing.
- Educational Updates: Periodic updates can introduce new content related to current environmental issues and recycling technologies, keeping the educational aspect of the game relevant and up to date.

Reward/Scoring Mechanism

In the game, the reward and scoring mechanisms are designed to incentivise correct choices and provide players with clear feedback on their performance. This system not only enhances engagement mot also reinforces the learning objectives by rewarding proper waste sorting and penalizing incorrect actions.

Scoring System

- Points for Correct Sorting:
  - Basic Points: Each correctly sorted item earns the player a base score, which varies depending on the item’s difficulty. For example, commonly known items (like plastic bottles) might be worth fewer points compared to less obvious items (like certain types of packaging).
  - Combo Bonuses: Consecutive correct sorts without mistakes trigger combo bonuses, increasing the points earned per item. This encourages players to focus and maintain a streak of accurate sorting.
- Time Bonuses:

- Quick Sorting: Players receive bonus points for sorting items quickly. The faster an item is sorted correctly, the higher the bonus points awarded. This encourages efficient sorting and helps players improve their speed and accuracy.
- Level Completion Time: Finishing a level with remaining time also grants bonus points. The more time left on the clock, the higher the bonus, incentivizing players to sort items swiftly.

Reward System

- Stars and Level Ratings:
  - Star Ratings: Each level can award up to three stars based on the player's performance. The star rating depends on the number of correctly sorted items, the time taken, and the combo streaks. Achieving higher star ratings motivates players to replay levels and improve their performance.
  - Unlocking Levels: Earning a certain number of stars across levels is required to unlock advanced levels. This progression system keeps players engaged and striving to achieve better results.
- Achievements and Badges:
  - Achievements: The game features various achievements for players to unlock, such as "Perfect Sorter" for completing a level without mistakes or "Speed Sorter" for finishing a level under a specific time. These achievements are displayed in the player's profile, providing a sense of accomplishment.
  - Badges: Players earn badges for significant milestones, like sorting 500 items correctly or reaching the final recycling plant levels. Badges serve as visual representations of the player's expertise and progress.
- In-Game Rewards:
  - Power-Ups: Players can earn power-ups as rewards for high performance, such as a temporary time extension or a hint system that highlights the correct bin. These power-ups can be strategically used in challenging levels to enhance gameplay.
  - Customizable Avatars: High scores and achievements unlock customization options for player avatars, allowing players to personalise their in-game representation as a reward for their efforts.

Feedback Mechanisms

- Immediate Feedback:
  - Correct and Incorrect Sorting: When an item is sorted correctly or incorrectly, the game provides immediate feedback through visual (via showing happiness/sadness in the face of a character) and auditory cues (via appropriate sound effects).
- End-of-Level Summary:
  - Performance Summary: At the end of each level, players receive a detailed summary of their performance, including how many correct and wrong attempts they had, the time left, the total points earned, combo streaks, time bonuses, and any achievements unlocked.

- Tips and Insights: The summary also provides tips for improvement and insights into common sorting mistakes made during the level, helping players learn and enhance their skills for future attempts.

Control and Interface Mechanism

In the project, the control mechanism is designed to be intuitive and accessible, ensuring that players can easily interact with the game and focus on the educational content. The primary control method for the game is the mouse, with additional keyboard shortcuts available to enhance usability and accessibility. The interface mechanism also is designed to provide a seamless and intuitive user experience, ensuring that players can easily interact with the game world and focus on the core educational objectives. Clear instructions and tutorials are available to guide players through the controls and gameplay mechanics, ensuring a smooth onboarding experience.

<u>Primary Control: Mouse</u>

- Drag and Drop: The core interaction in the game involves dragging waste items from a central area and dropping them into the correct bins (recycling waste bin, general waste bin, and food waste bin). Players click and hold the left mouse button to drag an item and release it over the appropriate bin to drop it. The mouse-based drag-and-drop mechanic is straightforward, requiring minimal learning curve, making the game accessible to players of all skill levels.
- Interface Navigation:
  - Menus and Buttons: Players navigate the game's menus, such as the main menu, level selection, and settings, using the mouse. Clicking on buttons and menu options allows players to start the game, access instructions, view their scores, and adjust settings.
  - Interactive Elements: Any interactive elements within the game, such as power-ups, tips, or educational pop-ups, are also activated by clicking with the mouse.

<u>Additional Control: Keyboard Shortcuts</u>

- Keyboard Shortcuts for Navigation:
  - Menu Navigation: For players who prefer using the keyboard, arrow keys can be used to navigate through menu options, with the Enter key to select an option.
  - Pause and Resume: The game can be paused and resumed using the keyboard. For instance, pressing the 'P' key pauses the game, and pressing it again resumes gameplay.
- Accessibility Considerations:
  - Customisability: Players can customise control settings, including mouse sensitivity and keyboard shortcuts, to suit their preferences. This ensures a comfortable and personalized gameplay experience.
  - Alternative Controls: To provide further accessibility features, it would be a good idea that the game supports alternative input devices such as trackpads, touchscreens, and adaptive controllers to accommodate a wider range of players, including those with physical disabilities.
  - Colourblind-Friendly Design: Relying solely on colour will be avoided in any part of the game and a combination of colour, shape, texture, and contrast will be used to

convey information. The game's colour combinations will be tested using colour-blind simulation tools. Furthermore, additional visual cues, such as icons, symbols, or text labels will be utilised. This ensures that players with color vision deficiencies can effectively sort items.

Buttons and Interactive Elements

- Menu and UI Buttons:
    - Main Menu: The game's main menu includes buttons for "Play", "How to Play", "About the Game", "Settings", and "Quit". These buttons are clickable using the mouse and can also be navigated using the keyboard.
    - In-Game Buttons: During gameplay, 'P' button (by default) on the keyboard can be used for pausing the game, accessing the help menu, and viewing achievements. This option is interactable with both the keyboard shortcut and the mouse (as a pause icon is also displayed on the screen).
- On-Screen Controls: Essential controls and commands are displayed on the screen, especially during the tutorial levels. For example, instructions for dragging and dropping items, using power-ups, and pausing the game are shown as on-screen prompts.
- Progress Indicators: A countdown timer is displayed to show the remaining time for the current level. Additionally, a score counter keeps players informed of their current points and performance.

Game-Play Theme

Setting

The game is set in an animated, cartoonish world that combines elements of both natural and industrial environments. The initial levels are set outdoors, under a bright blue sky with lush green grass, symbolizing sustainability and a clean environment. As players progress through the game, the setting transitions to a recycling plant, which maintains the cartoonish aesthetic but introduces more complex machinery and waste processing equipment.

Location

Initial Levels – Green Outdoor Setting: The game starts in a lush, green outdoor environment, where players sort various waste items into cartoonish bins. This setting includes elements such as clear skies and grassy fields, which help to convey a sense of sustainability and eco-friendliness.

Advanced Levels – Recycling Plant: The final levels take place in a cartoon-style recycling plant. This environment introduces more complex sorting tasks that mimic real-world recycling processes but in a visually simplified and engaging manner. This setting provides insight into the journey of waste beyond disposal, highlighting the importance of correct sorting for effective recycling.

Emotional Goals

- Surprise and Awareness: The game is designed to surprise players with how significant their daily decisions regarding waste disposal can be. By showing the consequences of correct and incorrect waste sorting, the game highlights the impact on the environment and the planet. This element of surprise is intended to make players more conscious of their actions in real life.

- Engagement and Motivation: The game aims to keep players engaged and motivated through its progressive challenges and appealing visual design. The increasing difficulty and varied locations maintain interest and encourage players to continue learning and improving their waste sorting skills.
- Achievement and Happiness: As players advance through the levels, they encounter increasingly challenging tasks that test their knowledge and skills in waste sorting. Successfully overcoming these challenges and progressing to higher levels, as well as immediate feedback and rewards that they receive for correct sorting, are designed to elicit feelings of happiness and satisfaction. This positive reinforcement encourages continued play and learning.
- Reflection and Critical Thinking: The engaging and visually appealing settings are designed to prompt reflection and critical thinking about waste management. Players should consider how their actions in the game translate to real-life behaviour and how they can contribute to sustainability goals in their own communities.
- Knowledge and Competence: The game aims to instill a sense of accomplishment and competence in players. By the end of the game, players should feel confident in their understanding of proper waste sorting and the recycling process. This knowledge is reinforced through the gameplay mechanics, educational content, and progressive difficulty, ensuring that players feel more informed and capable of making environmentally conscious decisions.

Other Design Content

- Storyline: Each level includes brief narratives or scenarios explaining the context, such as a community recycling initiative or a waste reduction campaign.
- Characters: NPCs (non-playable characters) like animated community members and recycling plant workers provide tips and information, adding depth to the educational content.

Game Features

Assets

Visual Assets:

The game will utilise vibrant, cartoon-style graphics to create an appealing and accessible visual environment. This includes:

- Backgrounds: Scenic outdoor settings with blue skies and green grass for initial levels, transitioning to detailed interiors of a recycling plant for advanced levels.
- Waste Items: A variety of waste items depicted in a cartoon style, including paper, plastics, food waste, and more.
- Bins: Color-coded bins (e.g., blue for recycling, green for general waste, black for food waste) with clear labels to guide players.
- Animations: Simple animations to show items being dragged and dropped, bins opening, and feedback for correct or incorrect sorting.

Audio Assets:

- Background Music: Cheerful, light-hearted music that maintains an engaging atmosphere.

- Sound Effects: Specific sounds for different actions, such as dragging and Dropping (sounds for picking up and placing items), feedback (Positive sounds for correct sorting and negative sounds for incorrect sorting), ambient Sounds (Background noises that enhance the setting, such as birds chirping in outdoor levels or machinery sounds in the recycling plant).

Textual Assets:

- Instructions and Tips: Clear, concise text instructions for gameplay, as well as tips from NPCs to provide educational content.
- Narrative Elements: Short narratives or scenarios explaining the context and importance of each level's tasks.

Gameplay Mechanics

Core Mechanics:

- Drag-and-Drop Interface: Players use the mouse to drag waste items and drop them into the correct bins within a specified time limit. This simple, intuitive mechanic ensures accessibility and ease of play.
- Timed Challenges: Each level has a time limit that requires players to sort items quickly and accurately, adding a layer of excitement and urgency.

Progression and Difficulty:

- Level Progression: Players advance through multiple levels, each with increasing difficulty. As they progress, the number of items to sort increases and the time limit decreases.
- Memory Challenge: From a certain level onwards, items are shown to players for about 5 seconds before being covered with trash bags, requiring players to use their memory to sort the items correctly.
- Recycling Plant Levels: The final levels are set in a recycling plant, introducing more complex sorting tasks and additional waste categories to challenge players' understanding and skills.

Feedback and Rewards:

- Immediate Feedback: Players receive instant feedback on their sorting choices with sound effects and visual cues (e.g., green check marks for correct sorting, red crosses for incorrect sorting).
- Score System: Players earn points for each correctly sorted item. A cumulative score is displayed at the end of each level, encouraging players to improve their performance.
- Progress Tracking: The game tracks players' highest level achieved and total score, motivating them to replay and beat their previous records.

Educational Content:

- Informative Pop-Ups: Periodic pop-ups provide educational content about waste management, recycling processes, and sustainability tips.
- Real-World Connections: Each level includes context-specific narratives or facts that link in-game actions to real-world environmental impact, enhancing the educational value of the game.

Design Matrix

Source	Observations	Requirement	Ideas
<u>Parallel Products</u>			
Peer Product Review, Literature Review	Lack of engagement (due to repetitive gameplay and lack of variety, or being more like a quiz rather than a game)	*The game must be engaging and try to interactively keep the players motivated.*	*Game will incorporate various game mechanics such as time limits and efficient feedback mechanism, and will introduce new challenges and obstacles as players go through it.*
	Having too many bins and options for sorting that is not close to everyday life and is not realistic.	*The game must seem close to real life and everyday use so that the player can learn from it an apply their learnings in their life.*	*Game will contain common household items and three waste bins that classify the main types of waste, as most resources suggest.*
	Overlooking accessibility features, especially colour blindness.	*Accessibility features must be considered in the game to ensure that all players can enjoy the game.*	*We will implement accessibility features such as colourblind-friendly visuals and using different languages in the game.*
	Not informing players about the types of the items that should go into each bin	*The game must provide instructions about how to sort the items in each bin.*	*Game will provide informative texts and instructions in the 'How to Play' section in order to prepare the players for the game.*
<u>Design Guidelines</u>			
Selected Guidelines and Notes, Literature Review	Remappable controls	*The game must provide remappable controls as much as possible.*	*The game will include Considerations such as cursor size and style, and mouse sensitivity adjustments which. It will also include clear visual and auditory feedback.*
	Text size and font considerations	*The size of the texts within the game must be customisable or large enough and the font also needs to be sans serif.*	*Using small texts in the game will be avoided, a large default size will be set, and the font of the texts will be a sans*

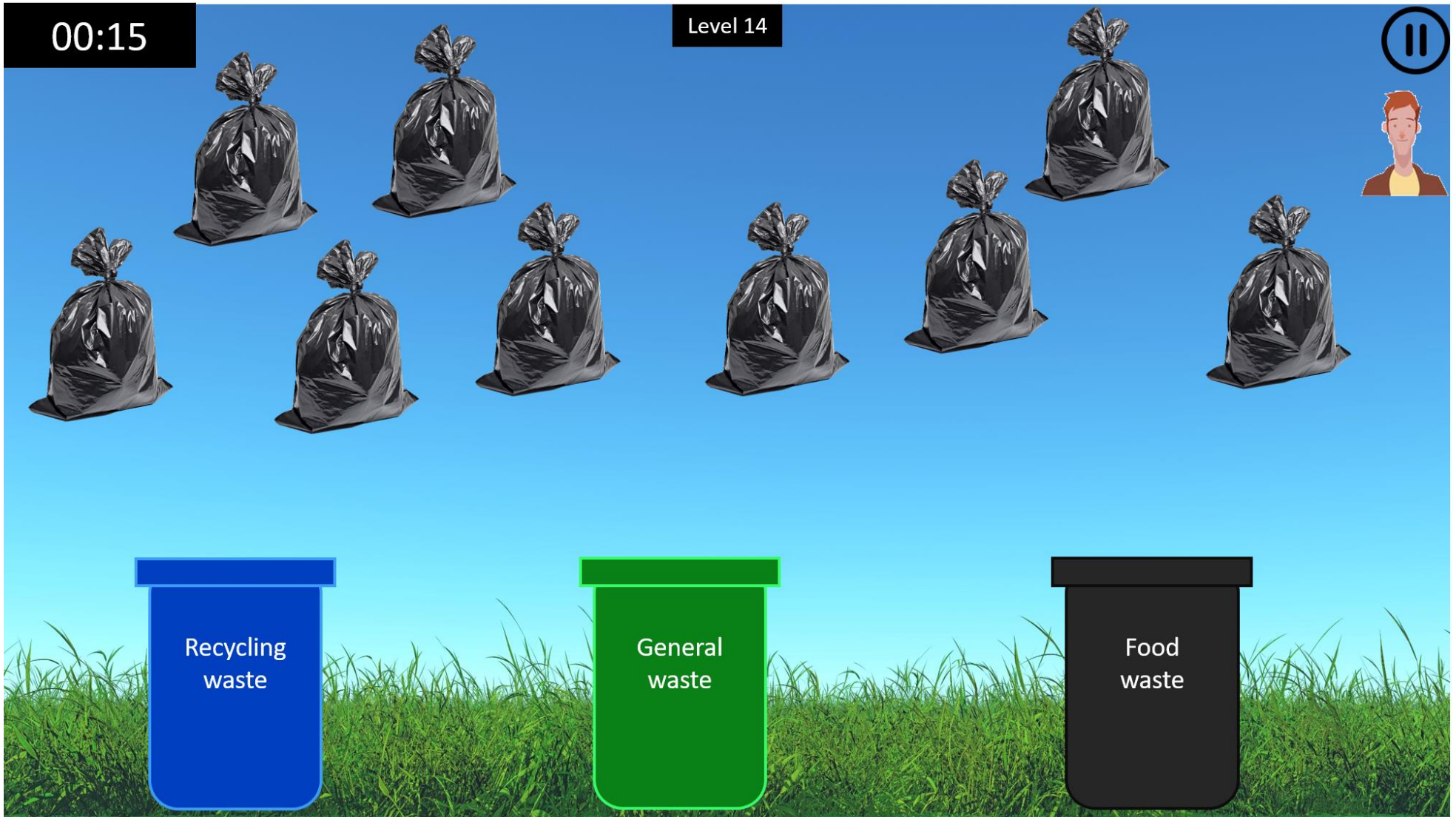
			serif font such as Verdana.
	Colour dependencies and the problem of colour-blindness	*The game must not have any colour dependencies and it should be colour-blind friendly.*	*A combination of colour, shape, texture, and contrast will be used to convey information. The game's colour combinations will be tested using colour-blind simulation tools. Furthermore, additional visual cues, such as icons, symbols, or text labels will be utilised.*
	Accessibility issues considering people with hearing impairments	*The game must be playable for people who have hearing impairments.*	*Game will provide visual cues and feedback to convey important audio information.*
<u>User Analysis</u>			
Literature Review, Module leader and module team feedback	Need for Balancing Education and Entertainment	*The game must have a balanced design that seamlessly integrates educational objectives within engaging gameplay.*	*The game will use elements such as points, badges, and leaderboards to make learning fun and engaging. It will Incorporate challenges that teach core concepts in an entertaining manner and it will Develop a compelling storyline.*
	Accessibility for Students with Specific Learning Difficulties (such as dyslexia, dyspraxia, and ADHD)	*The game must be accessible to students with specific learning difficulties by minimising text reliance and allowing flexible pacing.*	*The game will provide text-to-speech options and instructions through audio, visual aids, and interactive tutorials. It will allow players to control the pace of the game and will use simple, clear language.*
	Complex or unintuitive interfaces can hinder students' ability to engage with the game	*The game must have user-friendly interface with intuitive controls and clear instructions to enhance usability.*	*The game will use a clean and straightforward design with easily*

			navigable menus and clear icons.
	Users prefer games that offer an appropriate level of challenge and complexity	*The game must be neither too easy nor too difficult*	*The game will maintain a balanced level of difficulty with different types of challenges*
Task Analysis			
Literature Review, Parallel Products Review, Module leader and module team feedback	Relevance to Real-World Applications	*The game should demonstrate how in-game actions relate to real-world scenarios, making the educational content more relevant and impactful.*	*The game will Integrate real-world scenarios and case studies into the game's narrative. For example, after sorting waste in the game, show how proper recycling impacts the environment positively through animations or infographics.*
	Feedback and Assessment	*The game must provide immediate, clear, and constructive feedback to help players understand their mistakes and learn from them.*	*The game will use visual and auditory cues to highlight correct and incorrect choices, and provide explanations or additional information to reinforce learning.*
	Clarity and feasibility of tasks to be accomplished	*The game should have an intuitive design with clear instructions*	*The game will include a tutorial level that introduces players to the game mechanics gradually and will provide on-screen hints and support features to assist players when they encounter difficulties.*
Environment Analysis			
Literature Review, Module leader and module team feedback	Technical Infrastructure Variability	*The game must be designed to run efficiently on standard classroom PCs with moderate specifications.*	*Resource-intensive processes will be minimised and thorough testing on different hardware setups will be conducted to ensure compatibility.*
	Compatibility Across Different Systems	*The game should be compatible with*	*Cross-platform development tools*

		various operating systems and software versions commonly used in educational settings.	*such as Unity or Unreal Engine should be utilised.*
	Some students may prefer to play the game on their mobile devices	*Developing a cross-platform game that provides a consistent user experience on both PCs and mobile devices.*	*The game should be designed with a responsive interface that adapts to different screen sizes and resolutions. The game's performance should be optimised to ensure smooth operation on devices with varying hardware capabilities.*
<u>Client Consultation</u>			
Client, Module Leader, and Module Team Notes and Feedback	Adding more complexity in later levels or in how the game is used as prompt for class discussion	*The game must build in some more complexity and challenges*	*Further levels of the game are created in the setting of a recycling plant in order to show more about the lifecycle of the products and where our waste actually ends up.*
	Visual cues and feedback	*To show the results of the choices of the player in the game, a character can be used that reflects the results of the player's choices in their face.*	*As suggested, a character will be placed in the top-right corner of the screen that gets happy by correct choices and gets upset by incorrect choices.*
	Satisfaction with the feature with covering the trash with bags to make a memory game	*The mentioned feature should definitely be utilised in the game*	*In some certain levels, items are displayed for a brief period (5 seconds) before being covered with trash bags. Players must rely on their memory to sort these items correctly.*
	Satisfaction with the use of different languages	*The game should have the option to be played in some of the most spoken languages.*	*The language of the game will be customisable in English, French, German, and Spanish*

Low-fidelity Prototype (all created in PowerPoint)


00:19
Level 8
Note: Character giving feedback on correct/incorrect sorting
CRISPS
Recycling waste
General waste
Food waste


00:15
Level 14
Recycling waste
General waste
Food waste


00:21
Level 19
Note: Remaining items to be sorted
Paper
Plastic
Metal
Glass

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