# THE RIVER CLEAN-UP

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# Abstract

This research project focuses on the development of a user experience (UX) and user interface (UI) educational experience aimed at raising awareness for river clean-up and environmental education among young people in education (ages 11-16). Inspired by the work of "The Ocean Cleanup" and "River Cleanup" organizations, the project aims to create an immersive and engaging educational experience with a strong emphasis on UX and UI design. The outcome of the project is a Unity engine implementation that incorporates the developed experience and user interface, utilizing practice-based research methods.

The research process commenced with a comprehensive literature review, which encompassed topics such as user experience, user interface, iterative design, gamification, and learning theories. Multiple iterations of user experience and user interface prototypes were then designed and refined throughout the development cycle. The evaluation and analysis of the project's development were conducted through a post-mortem assessment.

In conclusion, it is evident that there is a significant need for educational games and applications that offer tangible benefits to young learners. The adoption of constructivist learning principles, which enable students to apply their knowledge in real-world scenarios, proves to be a highly effective approach in enhancing the user experience. Additionally, the incorporation of an intuitive and user-friendly interface facilitates seamless navigation and management of the educational experience. The implementation of intrinsic rewards further promotes learning through positive reinforcement and enables learners and educators to monitor progress and identify areas requiring additional attention.

While this project primarily focuses on environmental learning, the insights and frameworks discussed in this report can serve as a valuable starting point for designing educational experiences for children. The project's potential for further development lies in the exploration of specialized eLearning content development by collaborating with experts in the field.

# 1. Introduction

## 1.1. Topic

This research project is about developing a UX/UI educational experience aimed at raising awareness for river clean-up and environmental education for young people in education (ages 11-16). This project is inspired by the work of "The Ocean Cleanup" and "River Cleanup" organizations. There is a limited availability of existing environmental educational games and apps in the market, presenting an opportunity to create an educational experience with a focus on the user experience and interface design. The final artefact will be a Unity engine implementation of the developed experience and user interface developed through practice-based research methods. The project commenced with a literature review, identifying relevant sources about user experience, user interface, iterative design, gamification and learning theories. The next stage focused on designing multiple user experience and user interface prototypes through the iterative development cycle. Finally, concluding with a review of the development of this project through a post-mortem.

## 1.2. Research Questions

1. How can the User Experience/User Interface be improved for younger audiences?
2. How can the User Experiences/User Interface aid in effective education?
3. Explore User Experience/User Interface Design for young people in education.
4. How can Environmental theming be implemented into a User Interface?
5. What makes a good User Experience/User Interface?

## 1.3. Aims & Objectives

Aims:

The aim of my research project is to investigate how the user experience and user interface can be improved for young people in education (11-16).

Objectives:

1. Literature Review – Undertake UX/UI research to help inform me of good/bad UX/UI design. Identify what the current trends are and how to onboard, balance cognitive load and how to keep users motivated/engaged to achieve their goals.

2. Game Analysis - Undertake game analysis to develop an understanding of pre-existing game/apps user flows and user interfaces.
3. Practical Development – Based on research develop low-fidelity Adobe XD wireframes, high-fidelity Adobe XD wireframes and implement into unity engine. Using the iterative design process to conceptualize, prototype, test and evaluate my project.
4. Post-Mortem – Conduct a post-mortem on all aspects of the project work covering the above objectives.

## 1.4. Methods

1. Literature Review: Conducting research from academic and authoritative sources to build foundational knowledge in UX/UI design, game design, and iterative design processes.
2. Game Analysis: Undertaking an analysis of games/apps to understand user flows, trends, and good user interfaces.
3. Practical Development: Developing a hypothetical game design document and creating low-fidelity prototypes in Adobe XD, followed by a high-fidelity version of the user interface in Adobe XD and a final prototype in Unity engine. Adapting the iterative design process, which includes conceptualization, prototyping, testing, and evaluation, to allow for failure to succeed and improve the final product.
4. Post-Mortem: Evaluating the development of the project, discussing the different iterations, evaluating what was learned, what went well, what went wrong, and what could have been improved. Evaluating the design process and techniques used, as well as the playtests and user feedback, and how they could be improved in the future.

# 2. Project Report

## 2.1. UX/UI Design

### 2.1.1. UX Principles

User Experience Design (UXD) encompasses several principles and considerations that directly impact the user experience (UX) and user interface (UI) of a digital product. 101 UX Principles covers a lot of both UX and UI elements. One crucial principle emphasizes the avoidance of inventing new controls, as designers already possess a vast array of controls to choose from. Reinventing the UI can impede new users' learning process (Grant, 2022). Users form mental models of how they expect a user interface to function based on their past experiences with similar products, and they want the user interface to align with their mental model, as this enhances understanding and navigation (Butow, 2007). The significance of clear and definitive language cannot be overstated, as it prevents user confusion. Sanusi highlights examples where the use of similar words obscures the "yes/no" choices in certain games and apps (Sanusi, 2017). Therefore, striving for simplicity and avoiding jargon is essential (Grant, 2022).

While the book primarily addresses web design, it offers relevant insights applicable to game design, such as the design of buttons, sliders, and search options. These elements hold substantial importance and should prioritize ease of use. Another crucial aspect is the concealment of advanced options, as most users do not require access to them. Grouping settings together enhances navigation and reduces cognitive load. Consistency and cohesiveness play a pivotal role across iconography, typography spacing and colours. These rules apply for this research project, ensuring any use of icons are up-to date with modern standards, whilst utilizing legible fonts, and maintaining consistency in colours and spacing across different scenes significantly enhancing the user experience (Grant, 2022).

Research is paramount to designing a user experience. Evaluating and understanding existing products within the same domain enables the identification of problem areas, facilitating the avoidance of such issues in the design process. Additionally, mapping the players journey is helpful to you as a designer, as it puts you in the players perspective to understand motives. Wireframing serves as a crucial technique for developing low, mid, and

high-fidelity versions of the product. It allows designers to showcase various product states and establish the intended visual language for the final product (Paul Rybicki, 2017).

### 2.1.2. Human Centred Design

Human Centred Design (HCD) is designing to accommodate people's needs, capabilities, and behaviours. Effective HCD requires good visual communication, enabling users to comprehend the available actions and the outcomes associated with executing those actions. Having a good understanding of the people you are designing for is vital, this can be achieved through observation as you can discover new needs and address those needs through iteration, eventually achieving the true needs of the people you are designing for (Norman, 2013).

### 2.1.3. Iterative Design

Iterative design can be broken down into four stages: conceptualization, prototyping, playtesting, and evaluation. Each complete cycle of this process is referred to as an iteration, and each new iteration will produce new and unique challenges. Through successive iterations, a fully realized product will be produced (Macklin and Sharp, 2016). Iterations can be split into set sprints, typically spanning a few weeks. At the end of each sprint, the work produced is evaluated to ensure alignment with the intended player experience goals. By employing iterative cycles, the number of issues encountered during the production phase should decrease, as major problems are identified and addressed during the prototyping phases. Gathering player feedback throughout the entire development cycle is crucial, as it allows for a comprehensive understanding of the players' needs, capabilities, and behaviours. Without playtesting and obtaining player feedback, the focus on the player's requirements may be lost (Fullerton, 2019, pp 21).

### 2.1.4. Typography

The significance of typography is explored in the book Why Fonts Matter. The chapter on typefaces discusses their use cases and highlights their time-saving benefits. Certain brand typefaces are also recognized for their distinctiveness. An example shown is road sign typefaces and how they are presented, as users need to be able see them at a glance. These typefaces are designed to be legible at a distance and through testing found that differing word capitalisation were more distinguishable from a distance (Hyndman, 2016). This design choice also contributes to establishing an information hierarchy (Grant, 2022).

The book further emphasizes the functionality of typefaces, noting that typefaces function as a carrier of words and they need to display the words efficiently to enable effortless reading and navigation. Typefaces should also be “invisible” meaning to not hinder the visual experience (Hyndman, 2016).

Furthermore, the emotional range of typography is discussed, showcasing how to effectively convey emotion through typefaces, for example sharp and jagged shapes convey anger, while curves and soft shapes convey a friendly emotion. Conveying emotion is important to get across as using the wrong typeface can affect the conveyed emotion you want the end user to experience (Hyndman, 2016). In 101 UX Principles it is recommended to use no more than two typefaces: one for headings and one for body text, using the font family’s weights and italics where needed. Using the two-typeface method helps to reduce visual noise and cognitive load for users. Grant says an important feature to give the user is the ability to adjust the scale of the typeface and offering high-contrast colours (Grant, 2022).

### 2.1.5. Representation

In the book Values at Play, they explore the concept of representation, highlighting the significant impact of gender differences in game characters and says, “whether game characters are male or female is a huge marker of difference” (Flanagan and Nissenbaum, Pg.113, 2014). For this research project, representation comes in the form of abstract player icons, locations, and nicknames. Samay’s findings indicate that when they added profile customization to their application, they saw an increase in people adapting their application full time (Samay, 2018). Flanagan and Nissenbaum conducted experiments using abstract-shape characters and found that many of the users perceived the shapes as male or “not cool enough”. To address these issues, improved shape expressions and the use of colours can be employed to signify male and female characters (Flanagan and Nissenbaum, 2014). In this project, abstract shape characters are utilized, but they are not the focus or attraction and serve as a minimal form of visual representation. As for location representation, the project is based on real-world settings, although these locations may not be portrayed in the most positive light.

## 2.2. Gamification

In the context of gamification, Burke challenges a common misconception by stating “Gamification is not about fun” (Burke, Pt.1, Ch.2, 2014). He emphasizes that gamification is

about motivating individuals to achieve their own goals. This can be accomplished through challenges that encourage users to become emotionally invested in their progress towards their own goals (Burke, 2014). Something games do well is allowing the player to make progress towards an end goal; GMT discusses how Stardew Valley has short term goals and smaller rewards to encourage the player to keep going to achieve the main end goal (Game Maker's Toolkit, 2018).

Davidson discusses the act of giving “aid” to players. As players want to succeed and ultimately have fun, it is crucial to consider how different educational levels may affect the overall challenge of the lessons and therefore attention is needed to not over-simplify the challenges and thus ruin the game part of the experience for those with higher educational levels. Alternatively, if the challenge is too difficult this can cause frustration for the user, especially those on the lower levels of education. Challenge is a balancing act, and it is key to keeping players engaged (Fullerton, 2019, pp 39). This can be accomplished by a simple tutorial to the lesson, this can be used to introduce players of all educational levels to the lesson on hand but avoid the overuse of a guide, avoiding handing the answer to the player allowing for a more equal starting ground. This allows learners at different levels to play the same lessons while accommodating those who may require additional support (Davidson, 2008). However, it is essential to be mindful of how tutorials are implemented, as Samay found that when they added a tutorial to their application, the kids disliked it as they saw it as a “parents’ product,” so they removed the tutorial and just let the kids play (Samay, 2018). A fitting form of challenge lies in "Mental Stimulation," where experiences challenge users' problem-solving skills and decision-making abilities rather than relying solely on skill checks and reflexes (Game Maker’s Toolkit, 2018).

Motivation can be fostered using intrinsic and or extrinsic rewards. Burke states that intrinsic rewards provide a more meaningful experience for users as they engage individuals at an emotional level. However, the emotional impact a user experience can vary, and it may not always align with the intended outcome. For example, if a user receives a lower reward than expected, they may experience a negative emotion and dissatisfaction. In such cases, providing positive feedback and reassurance can encourage users to improve and reshape their emotional experience. Intrinsic rewards can include badges, leader boards and point systems, but they should have emotional significance and serve as visible signs of progression.

In this project, the use of badges can be implemented to showcase learners' progress as they acquire new knowledge and complete lessons (Burke, 2014).

Intrinsic motivators, as discussed by Burke, can be further categorized into three essential elements:

1. Autonomy—the desire to direct our own lives.
2. Mastery—the urge to make progress and get better at something that matters.
3. Purpose—the yearning to do what we do in service of something larger than ourselves.

It is important to note that while video games are primarily designed for entertainment, gamification aims to engage players on a deeper emotional level to keep them motivated and invested in the experience (Burke, 2014). By incorporating elements of autonomy, mastery, and purpose into gamification design, the goal is to tap into these intrinsic motivators and provide a more meaningful and fulfilling user experience.

## 2.3. Rote Learning & Constructive Learning

### 2.3.1. Rote Learning

In their work, Mayer presents various examples of learning, in the rote learning example the learner can remember the information, however, unlike the constructive learner, they are not able to solve the problems at hand. Rote learning is the act of adding new information to their already existing memories, whereas constructive learning engages the student in active cognitive processing, this allows the learner to integrate the incoming information with existing knowledge (Mayer, 2010). Similarly, Bada and Olusegun refers to rote learning as “traditional learning”, where learning is a fixed curriculum and learning is based upon repetition, while constructive learning is interactive and builds upon the student's prior knowledge. Additionally, Bada and Olusegun introduces the concept of passive and active learning. Passive learning is the act of transferring information along from one person to another, whereas active learning is confronting their understanding based on what new information they learn (Bada and Olusegun, 2015).

Understanding the differences between these learning approaches is essential when designing educational experiences. By incorporating principles of constructive and active

learning, designers can create engaging and interactive learning environments that promote deeper understanding and knowledge integration.

### 2.3.2. Constructivist Learning

Bada and Olusegun say, “Constructivism represents one of the big ideas in education” (Bada and Olusegun, Pg.66, 2015). Constructivism is a teaching and learning approach where the learner can fit new information together with their existing knowledge. In the context of education, constructivism promotes learning through hands-on experiences, experiments, and real-world problem-solving activities (Bada and Olusegun, 2015). For this project, learners are encouraged to engage in active learning by experimenting and discovering potential solutions to real-world problems.

Mayer refers to constructive learning as “meaningful learning”. According to Mayer, meaningful learning occurs when learners construct the knowledge and cognitive processes necessary for successful problem-solving (Mayer, 2010). In the context of constructivism, two important concepts are accommodation and assimilation. Assimilation involves integrating new experiences into existing knowledge, while accommodation involves reframing the learner's worldview and incorporating new experiences into their mental capacity (Bada and Olusegun, 2015).

Bada and Olusegun showcases a list by Tam of four key characteristics of constructive learning. Three of these characteristics are relevant to this project: knowledge sharing between the teacher and the students, shared authority between teachers and students, and the teacher is to only act as the facilitator/guide (Bada and Olusegun, 2015). In this project, the digital learning platform "Glow" enables teachers to monitor students' performance and progress.

Constructivism places the learner at the centre of the design, allowing for them to determine how they learn best. It promotes the provision of multiple solutions to learning challenges, presenting realistic concepts, and employing various formats such as video, audio, and text to ensure accessibility. Learners are actively encouraged to participate in their own learning process.

# 3. Post-mortem

## 3.1. UX/UI Design

*The River Cleanup* (TRC) is a UX/UI experience developed as a solo practitioner. It is an educational experience for kids aged 11-16. It has been developed in Figma, Adobe XD and Unity Engine, the goal of the project is to investigate ways of improving the user experience and user interface for educational apps/games whilst also raising awareness for river pollution. My research involves UX/UI principles, iterative design, gamification and learning theories.

### 3.1.1. Game Analysis

During the development phase, I conducted a comprehensive game analysis, examining various kids' games available on CBBC. CBBC offers a range of games and quizzes targeted at a younger audience, allowing me to gain valuable insights into both rote and constructivist learning styles. Although these apps cater to a different age group than my intended target audience, they provided valuable knowledge on user experience, user interface design, and general lesson design.

In addition to the CBBC games, I revisited my pre-production game analysis, focusing specifically on Duolingo, Minecraft Education, and Terra Nil. These applications played a crucial role in shaping the design of my user interfaces, particularly Terra Nil, which served as a notable source of inspiration for the world map featured in my project. Studying these applications enabled me to draw valuable insights and incorporate effective design elements into my own project.

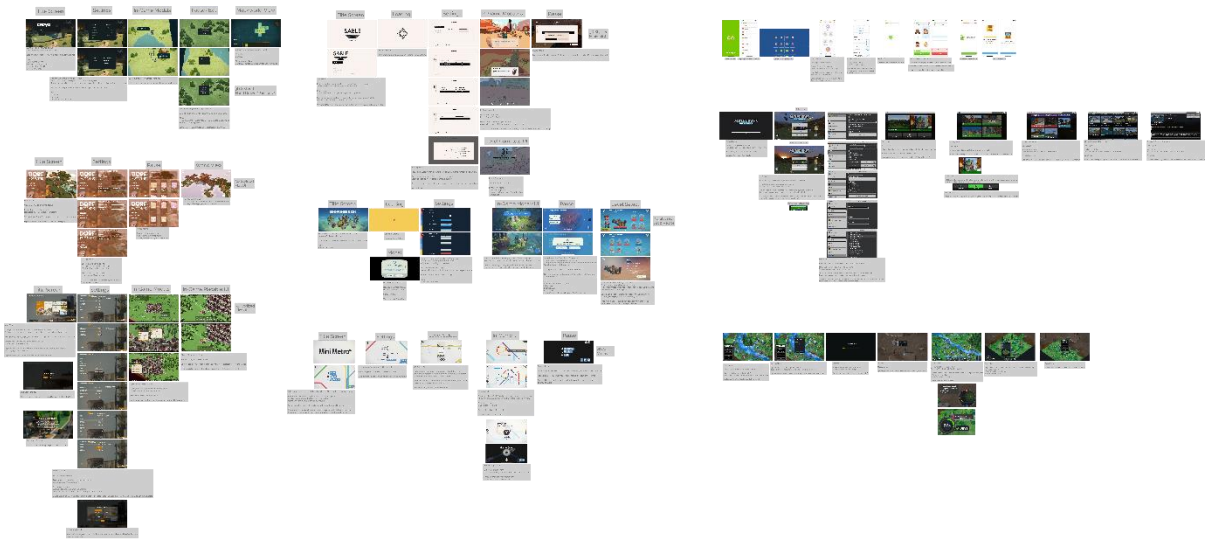

*Figure 1 Pre-production Game Analysis*

### 3.1.2. Wireframing

*Figure 2 Figma Low-Fidelity Wireframes*

The figure above illustrates my exploration of various user interface designs for the project prototype. These designs were based on the findings from my game analysis conducted during the pre-production phase, as well as the insights gained from my paper prototypes. To facilitate testing, I translated these designs into Figma, enabling me to assess their usability and flow more effectively.

I conducted user testing with multiple participants, presenting them with the different interface options. It is worth noting that a significant majority of the participants preferred the Flow 01 wireframe, as depicted in Figure 1. They indicated that this interface provided the most interactive experience and effectively incorporated environmental theming through the inclusion of a world map. The world map allowed users to visually comprehend their location within the virtual world.

Considering the positive feedback received, I decided to proceed with the development of Flow 01 as the primary interface layout for the project. I further refined this design by creating a high-fidelity version using Adobe XD, and subsequently implemented it within the Unity Engine for the final implementation stage.

### 3.1.3. Representation and Customization

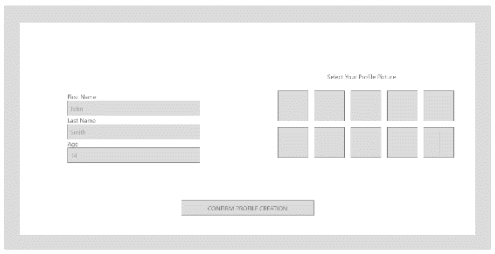

*Figure 3 Figma Low Fidelity Profile Customization Layout 1*

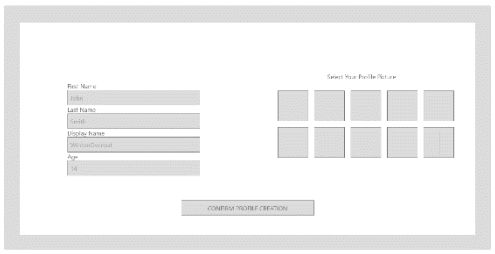

*Figure 4 Figma Low Fidelity Profile Customization Layout 2*

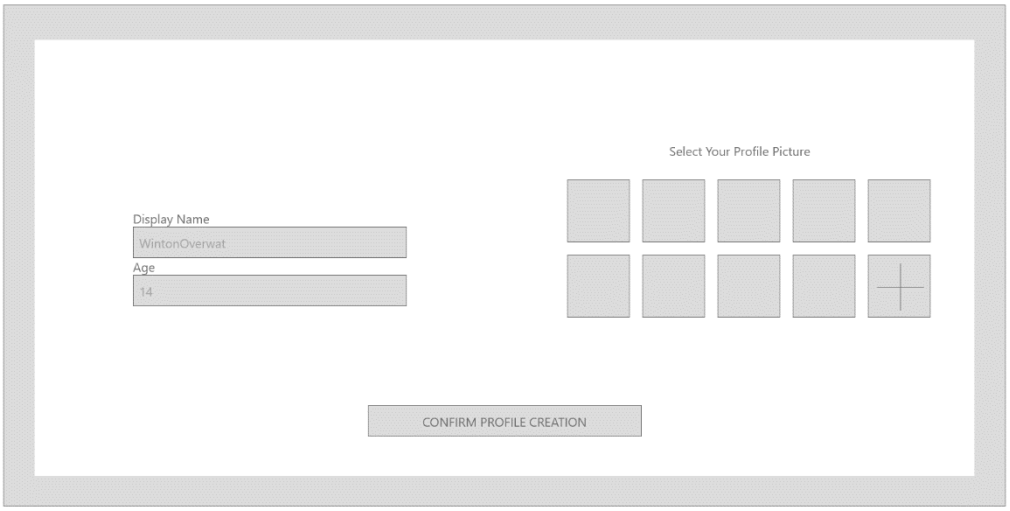


*Figure 5 Figma Low Fidelity Profile Customization Layout 3*

During the early stages of development, I conducted experiments to explore the inclusion of user profiles in the project. Based on Samay's recommendations, the purpose of these profiles was primarily to "put a face on it." After multiple iterations, I finalized the user profile design as depicted in the Adobe XD High Fidelity version below.

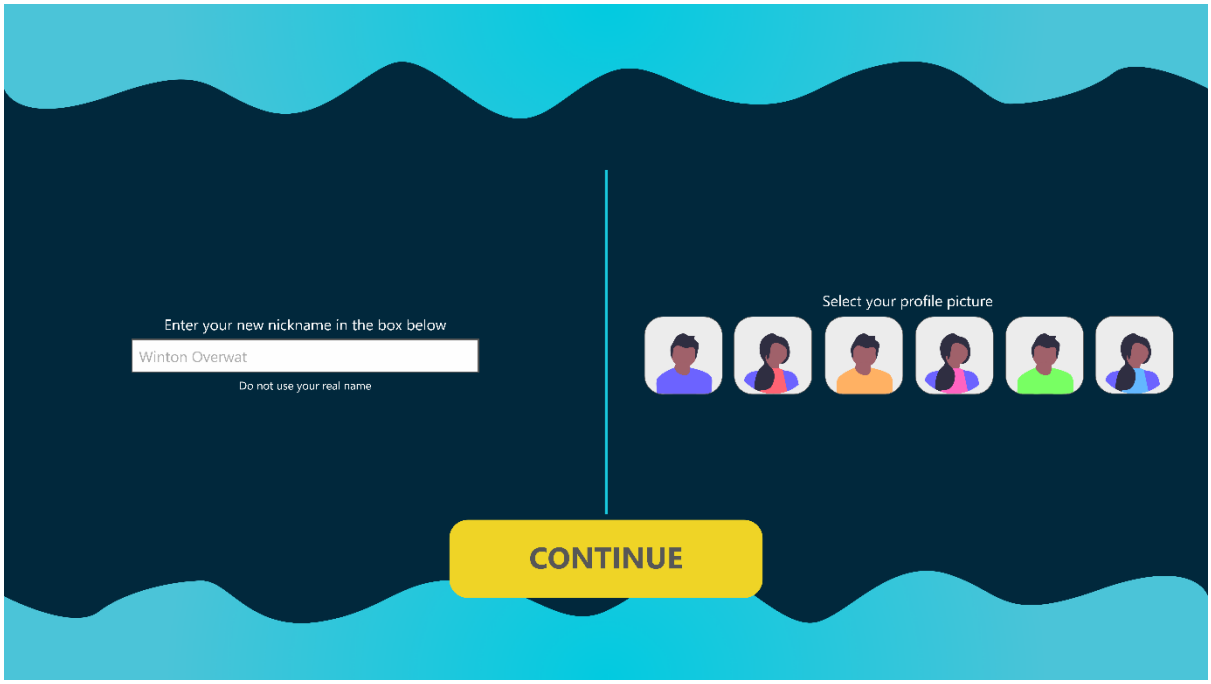


*Figure 6 High Fidelity Adobe XD Profile Customization*

In the final design, I decided to remove the "Age" option as it did not contribute significantly or provide any substantial value. Instead, I opted to retain only the use of a nickname, as in future iterations of the project, the user can be referred to by their chosen nickname.


*Figure 7 High Fidelity Adobe XD Profile Customization Icons*




*Figure 8 High Fidelity Adobe XD Profile Customization Nickname*

The intended user experience allows users to customize both their nickname and profile icon. This can be done by accessing the user profile menu, as shown in the figures above. By providing this functionality, users have more control over how they are identified and represented within the virtual experience. It's important to note that due to limitations in the project's current implementation, these changes are not saved. Nevertheless, the interaction serves to demonstrate the intended use case.

Furthermore, the figures above highlight the effective use of typography within Adobe XD. I adhered to the 2-type rule, creating a clear visual hierarchy by using one font for headings and another font for body text. The reception to the chosen fonts has been positive among users.

In addition to the typographic choices, the design of the figures aligns with the project's environmental theming. The inclusion of water ripples/waves that outline the scenes at the top and bottom enhances the overall thematic consistency of the interface.

### 3.1.4. Unity Implementation

To complete my project, I implemented the user interface into the Unity Engine using their new UI System. This decision was motivated by my desire to enhance my own skills, as this new system is expected to replace Unity's old UI system. The new UI System in Unity functions similarly to web-based interface design, utilizing a custom version of HTML and CSS.

The new system has pros and cons associated with it. On the positive side, I was able to create reusable buttons, icons, and layouts quickly by leveraging the Unity Style Sheets system (USS). This allowed for consistent styling throughout the project and facilitated efficient development. A limitation became evident in the implementation of my world map. The current system does not support dragging functionality, which posed a challenge. As a workaround, I had to incorporate scrollbars to navigate the map, but this compromised the user experience and the overall cohesive look of the project, as shown in the figures below.


*Figure 9 Adobe XD World Map*


*Figure 10 Unity Engine World Map*

## 3.2. Gamification

The below figure showcases the personas I created during the pre-production phase. As I delved into the topic of gamification, I revisited these personas to explore how each one could benefit from the application of gamification in my project.

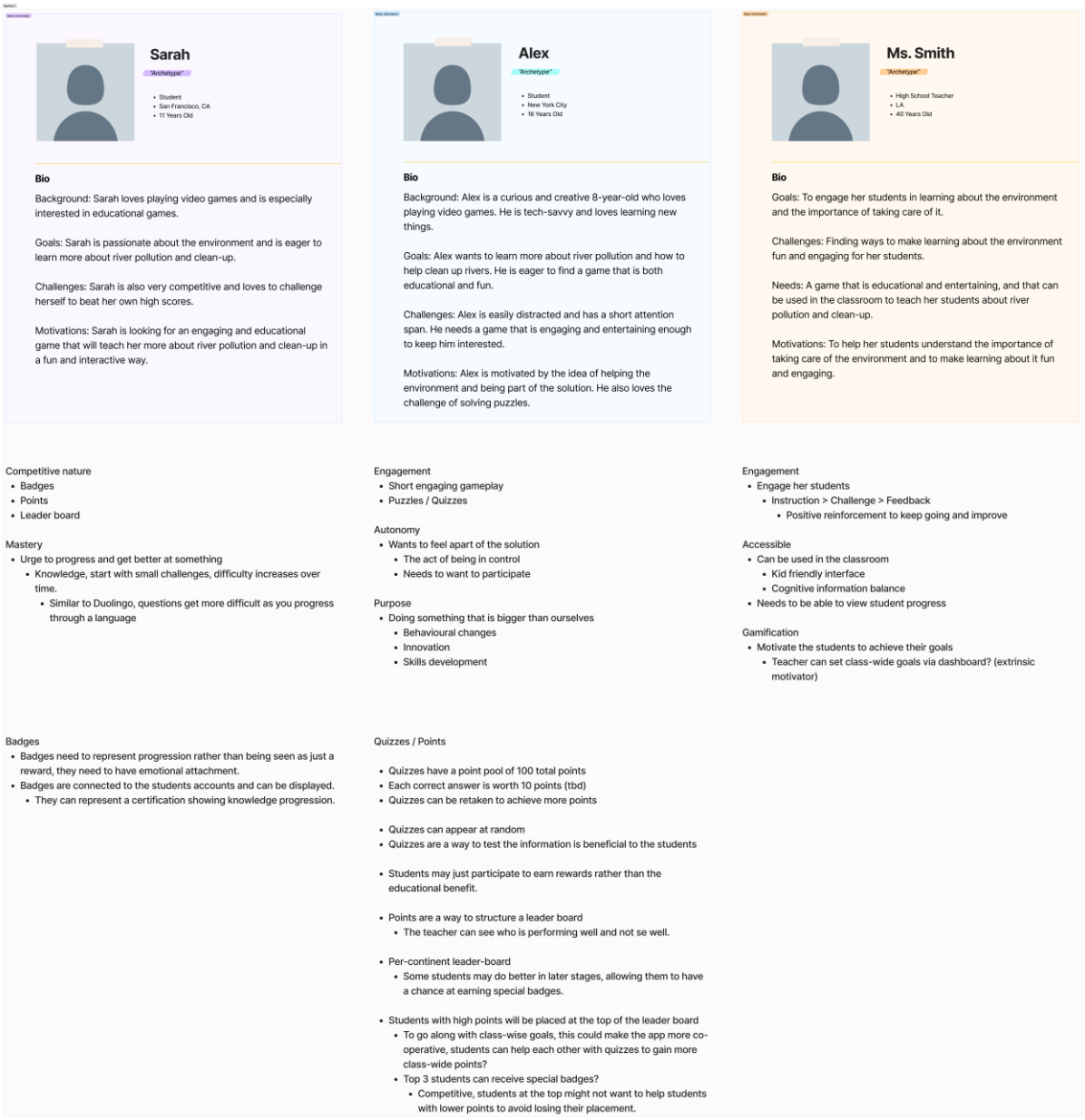


*Figure 11 User Personas*

Through my analysis, I found several commonalities across the personas, which led me to break down the gamification principles of Mastery, Autonomy, and Purpose for easier understanding and application in my project. These principles align with the desire to master a topic, feel a sense of autonomy and control, and contribute to something larger than oneself

through constructivist learning. I decided that short and engaging gameplay would be the best way to address this, as my target audience is young.

In line with the motivation and engagement aspect of gamification, I decided to incorporate badges as a reward system. These badges server only as visual indicators of progress and are only used as a form of intrinsic motivation. Rather than relying on a point and leader board system, which would have been more applicable to rote learning, I opted for badges as a better indicator within the constructivist learning approach. Utilizing badges as a motivational tool, I aimed to enhance user engagement, foster a sense of accomplishment, and promote a meaningful learning experience for my target audience.

## 3.3. Rote Learning & Constructive Learning

### 3.3.1. Rote Learning

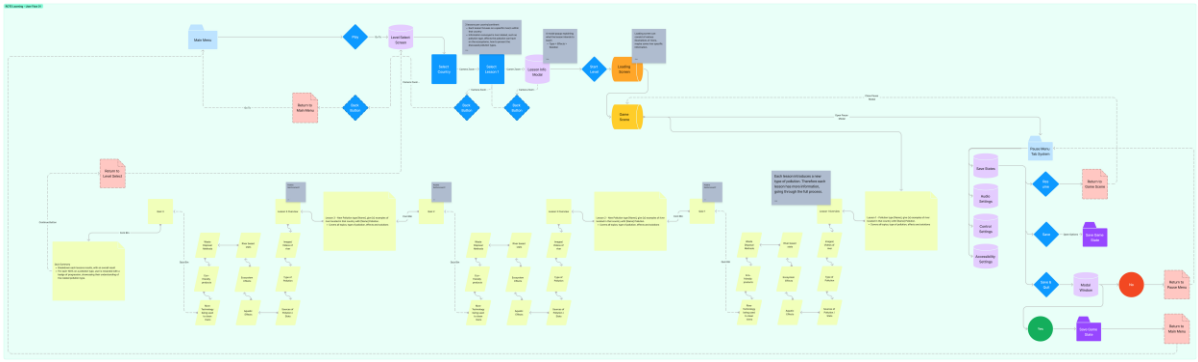

*Figure 12 Rote Learning Flow Chart 1*

The above figure showcases a user flow chart designed for rote learning. This flow's goal is to introduce the player to a new pollution type each individual lesson for a total of 3 lessons. At the end of each lesson the user then takes a quiz to gauge how much of the information they have processed. This structure of learning means each lesson has more information for the end user to consume and memorise before taking the quiz. However, an alternative approach, as shown in the figure below, splits a single pollution type across three lessons, reducing the cognitive load for the user. Breaking the goal down into smaller chunks makes it easier for the user to process and memorize the content.

These lessons are structured as follows:

1. Pollution introduction
    - Images/Video covering a single river.
    - Pollution type.
    - River statistics.
2. Pollution Effects
    - Aquatic effects.
    - Ecosystem effects.
    - River statistics.
3. Pollution Solutions
    - Disposal methods.
    - Eco-friendly products
    - River technology.

Rote learning offers benefits such as the ability to quickly learn facts and statistics through memorization and repetition. In the context of this project, rote learning could have been implemented through quizzes that test the user's knowledge of facts and statistics.

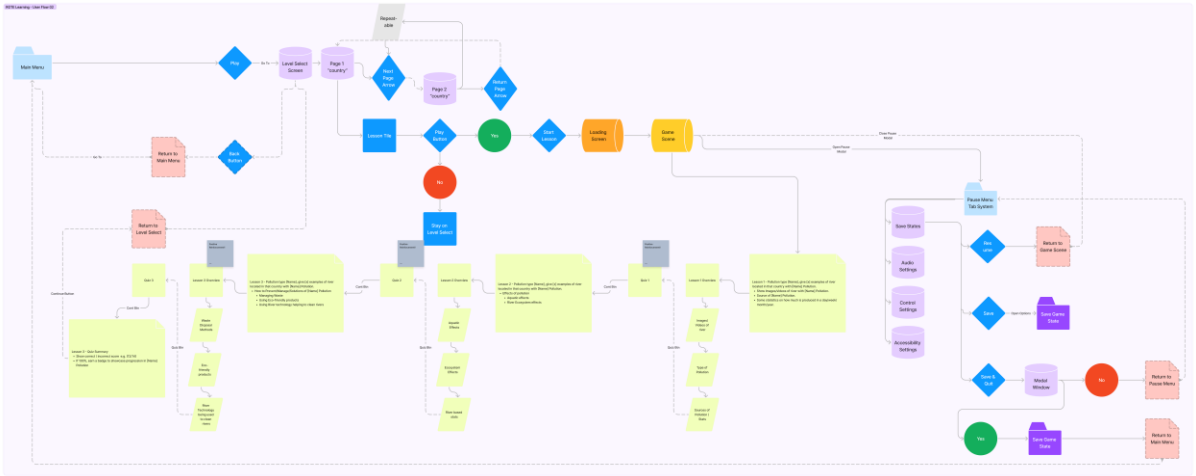

*Figure 13 Rote Learning Flow Chart 2*

### 3.3.2. Constructivist Learning

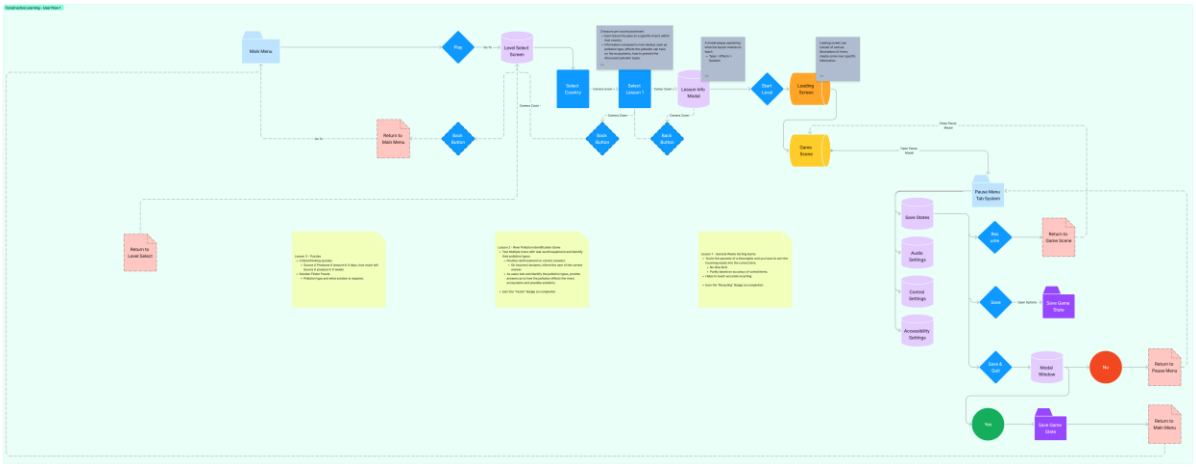

*Figure 14 Constructivist Learning Flow Chart*

The above figure showcases a user flow chart based on constructivist learning, which differs significantly from rote learning. Constructivist learning is centred around learning by doing and being able to apply knowledge in real-world contexts. After conducting research and considering feedback, I have concluded that constructivist learning is the most suitable approach for this project.

Under the constructivist learning framework, each lesson would be a mini game, where the user gets to interact and learn. These lessons can range from simple activities like sorting recyclables to more advanced gameplay, such as identifying types of pollution by testing a virtual river with real-world technologies. This approach promotes active thinking and problem-solving, allowing users to actively engage with the content.

I strongly believe that constructivist learning is the appropriate method to address my second research question. By implementing constructivist learning in the eLearning experience, we can enhance the overall learning experience for the user. This approach keeps users actively involved and constantly thinking, enabling them to apply the information they learn rather than passively absorbing it.

# 4. Conclusion

Based on the analysis and findings presented in the preceding sections to enhance the user experience, it is crucial to adopt a constructivist learning approach, which allows children to not only acquire knowledge but also apply it in real-world scenarios. Additionally, an intuitive and user-friendly interface is essential to facilitate learning and enable children to navigate and manage their educational experience effectively.

The incorporation of intrinsic rewards, such as badges, proves to be a valuable choice as it promotes learning through positive reinforcement. These rewards also provide a means for learners and teachers to track progress and identify areas that require further attention.

It is important to note that the project's success may not be universal, as its focus is specifically tailored to environmental learning. However, the elements discussed throughout this report can guide the development of a solid foundation when designing for children and educational contexts.

Moving forward, there is potential for further development in this project. One area that requires additional exploration and refinement is the design and development of the lessons themselves. Collaborating with eLearning specialists would be beneficial in creating well-developed and engaging lessons that align with educational standards and best practices.

In conclusion, this project highlights the significance of incorporating constructivist learning, intuitive user interfaces, and intrinsic rewards to enhance the educational experiences of children. While there is room for further improvement and development, the findings and insights gained from this research project provide valuable insights for future endeavours in designing educational applications for children.

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