Enhancing Learning through conversational AI: An Approach to Ocean Conservation and Recycling Education

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Abstract. Conversational AI is poised to play an increasingly prominent role in shaping the future of immersive learning application design, offering personalized, immersive, and collaborative learning experiences that enhance engagement, motivation, and knowledge acquisition. This project utilizes conversational AI technology to develop an immersive application educating users about the significance of conserving marine resources, aligning with the United Nations' sustainability goals. This is achieved through the development of a 3D game that engages users in activities such as ocean cleanup, recycling, and marine life rescue, facilitated by conversational AI that provides educational content on ocean preservation. This collaborative research, conducted by students from the University of Westminster and UAS BFI Vienna, assesses the educational impact of interactive simulations in fostering awareness and motivating sustainable behavior among the public. The findings of this project showcase the potential of gamified learning in promoting environmental responsibility and contributing to global sustainability efforts. Through this initiative, the team aims to contribute to global sustainability efforts while learning about educational technology practices.

Keywords: Environmental Education, Sustainable Practices, Ocean Life, Conversational AI.

1   Introduction

The vital role of conversational AI in educational application design, particularly in augmenting interaction, communication, collaboration, and user engagement has been highlighted for almost two decades now [2]. Studies have highlighted the effectiveness of conversational AI in delivering personalized and adaptive content, catering to individual learners' needs and preferences [6]. By simulating natural conversations and interactions, conversational AI promotes engagement, motivation, and knowledge retention [1]. Research also shown that VR conversational AI facilitates active learning by immersing learners in realistic virtual environments where they can engage in hands-on exploration and experimentation [4]. This interactive approach enhances comprehension, problem-solving skills, and critical thinking abilities. Additionally, the collaborative nature of VR experiences fosters social learning, teamwork, and knowledge sharing among learners.

Furthermore, studies have demonstrated the accessibility and inclusivity of conversational AI, as they transcend geographical barriers and provide remote access to educational content [13]. This aspect is particularly beneficial for distance learning, remote collaboration, and inclusive education initiatives, ensuring that education is accessible to all learners regardless of their location.

Moreover, literature emphasizes the potential of conversational AI to support various educational goals and subjects, ranging from STEM (science, technology, engineering, and mathematics) education [10] to language learning [11] and soft skills development [5]. Their versatility and adaptability make them valuable tools for educators across diverse disciplines.

The integration of conversational AI also referred as AI enabled non-playable characters in game engines like Unity, enable the development of immersive interactive application that hold significant promise for advancing public education and engagement across critical domains like ocean conservation, sustainability, and conscientious consumption. Conversational AI plays a pivotal role in creating language-based frameworks that enables smooth user experience [8]. This paper presents a collaborative endeavour that harness the capabilities of conversational AI to develop an educational immersive gamified application raising awareness on sustainable practices, underscoring the paramount importance of preserving marine resources in alignment with the United Nations' sustainability goals. We focus on the following main considerations: environmental design, aiming to immerse users in ocean life; game design and the strategic placement of a conversational AI that plays the role of a guide, delivering educational content on ocean preservation and facilitating human-like conversations between users and the system [3][7] to engage players; educational approach integrating learning theories to ensure effective learning. This project actively engages users in dynamic activities, such as ocean cleanup, recycling, and the rescue of marine life within the environment. Through this process, we seek not only to educate but also to inspire users to contribute to the global sustainability agenda actively.

2 Purpose and Objectives

2.1 Purpose

The objective of this project is to engage users in activities such as ocean cleanup and recycling, to gain insights into sustainable practices, discover organisations dedicated to maintaining the cleanliness of ocean life, learn about recycling initiatives, and much more. It achieves this by integrating Convai, a conversational AI extension, that enables the integration of human like, in terms of appearance and motion conversational agents in an immersive environments capable of engaging in natural language conversations with humans. These systems, often referred to as chatbots or conversational agents, use techniques from natural language processing (NLP), machine learning, and other AI disciplines to understand and generate human-like responses in text or speech. Convai research aims to develop AI systems that can effectively communicate, understand context, and provide meaningful responses in a wide range of conversational scenarios, including customer service, education, entertainment, and more.

The collaboration between students from the University of Westminster and UAS BFI Vienna conducted a comprehensive assessment of the game's educational impact. Ultimately, the project seeks to not only foster environmental responsibility but also actively contribute to global sustainability efforts. Through the integration of Convai extension, this initiative aims to create an educational gaming experience that not only informs but also inspires positive actions towards preserving our oceans and promoting a sustainable future.

2.2 Target Audience

The educational application we present in this paper primarily targets pupils, students, and the general public, including visitors of museums and aquariums, with the aim of exhibiting, studying, and promoting the conservation of aquatic life. It serves to educate and inspire visitors about marine ecosystems, complemented by interactive activities and conversations with a conversational AI. These interactions emphasize critical issues facing our oceans and the importance of sustainability, designed to leave a lasting impression on users. The game's design emphasizes simplicity and ease of use, allowing seamless integration into museum and aquarium exhibits. It requires minimal setup and intuitively game play and interaction, suitable for all ages and prior gaming experience. This level of accessibility broadens the game's reach, making environmental education more inclusive and engaging for a diverse audience [1].

Furthermore, integrating conversational AI to guide users through the game adds a personalized touch, thereby enhancing engagement and the overall effectiveness of the learning experience. By engaging with this game, young visitors are provided with a memorable and meaningful experience that emphasises the importance of marine conservation in an accessible and enjoyable manner. The interactive nature of the game, combined with the educational content delivered in a fun and engaging way, is likely to resonate deeply with younger audiences, inspiring them to learn more about sustainability and take action in their daily lives. This approach not only educates but also empowers the next generation to become advocates for the environment, using the power of interactive learning to impose a deeper understanding and commitment to conserving the oceans.

2.3   Game Objectives

The motivation behind the game originates from the urgent need to address the escalating crisis of plastic pollution in oceans, as highlighted by the UN Environment Programme (UNEP) report [12]. With plastic pollution poised to more than double by 2030, impacting health, biodiversity, the economy, and climate, the game aims to educate and engage players in the fight against this. By simulating the challenges and solutions related to marine litter and plastic pollution, the game seeks to inspire collective action and impose a sense of responsibility among players to protect and restore our oceans. The game objectives can be summarised as follows:

- Educating users on sustainable practices and emphasizing the importance of preserving marine resources.
- Increasing user interaction and commitment to ocean conservation by integrating conversational AI for a more immersive and informative experience.
- Cultivating awareness and inspiring sustainable behaviors among the public to foster a collective commitment to environmental stewardship.
- Actively contributing to global sustainability efforts by advocating and promoting a sense of environmental responsibility.

3   Game Design

This project aims to seamlessly blend educational and entertaining elements, emphasising ocean preservation and sustainable practices. The gameplay mechanics are intricately designed to offer players an immersive experience as they embark on a journey. Beginning at a research station in the ocean, players undertake various missions to restore the marine environment. As they navigate the underwater world, users engage in meaningful conversations with their AI companion and interact with a diverse array of non-playable characters, enhancing the overall depth and engagement of the gaming experience.

The application is designed using Unity, a popular cross-platform game engine for creating video games, simulations, interactive experiences, and other applications across various platforms, including mobile devices, consoles, computers, and augmented reality (AR) or virtual reality (VR) devices. Unity provides a comprehensive suite of tools for game development, including a powerful rendering engine, physics engine, animation system, audio mixer, and scripting capabilities. It is widely known for its user-friendly interface, flexibility, and extensive asset store, which offers a wide range of pre-made assets, plugins, and tools to enhance development workflows.

3.1   Integration of Artificial Intelligence

A pivotal aspect of this project involves harnessing AI to enhance the learning experience and introduce a fresh educational paradigm for future generations. In this endeavour, Convai conversational AI extension, assumes a central role in shaping the player's companion. The conversational AI (dolphin – see Figure 1& 2) distinctive characteristics and narrative background contribute significantly to upholding a consistent and unified theme throughout the game. Figure 1 below depicts a scene featuring the integration of Convai AI in the highlighting its role in conducting a smooth, realistic educational experience.

3.2   Game Level Design

In shaping the game design, our primary focus revolves around two distinct areas: the research station (see Figure 2) and the Ocean (see Figure 3 and 6). The research station boasts a futuristic environment, inviting players to explore its intricate design. Here, the NPCs from Convai, diligently collect data aligned with the player's goals, providing valuable information and presenting engaging mini-games. The hub is a pivotal space, acting as the player's home base, where they return to deliver collected ocean trash, gather information, and receive quests.

In the oceanic realm, our emphasis is on portraying marine life as accurately as possible, leveraging the capabilities of our conversational AI companion to offer real-life information about the underwater world. The ocean features vibrant areas, encouraging players to explore, undertake quests, or observe the captivating marine ecosystem. Envisioned as a central locale inspired by the Pacific Ocean, particularly the northern area near Japan and the U.S states of Hawaii and California, known as the Pacific trash vortex due to the high amount of litter accumulated in that region [9], the game unfolds amidst a backdrop dominated by nature, the futuristic hub, and the vast ocean life awaiting assistance and conservation.

Fig. 1. Conversational Convai AI in Unity.

Fig. 2. Game Prototype - The Research Station (Central Hub).

3.3 Game UI Design

We strive to uphold a clean and minimalist design in crafting the game's UI. Figure 6 below illustrates our dedication to simplicity, with essential information strategically placed at the top part of the screen to enhance the user experience. At the top left, prominently displayed in red, is the player's Oxygen level. Directly beneath this, the tally of collected trash, a crucial metric tracked before delivery to the research station, can be found. On the top right is an indicator of the ocean's happiness/health. As players complete actions and quests, this bar ascends, reflecting the positive impact of their efforts. Such actions include completing quests, aiding ocean life, or engaging with marine creatures. Adjacent to this is the quest area, which visually represents tasks currently in progress. This feature allows players to monitor their objectives seamlessly. Additionally, the game provides flexibility with a pause function, enabling players to adjust settings or conveniently return to the main menu.

However, it is essential to note that this is still a prototype. While the main mechanics remain unchanged, the visual representation will undergo refinement to become more indicative, simpler, and easier to understand. Our commitment is to provide a polished and user-friendly UI that enhances the gaming experience.

3.4 Game Mechanics

The game's mechanics focus on two primary environments: the ocean (see Figure 6), where the player explores the environment, and the research station (see Figures 2, 4, 5), which acts as a central hub, providing the following activities:

- Interaction with conversational AI: Players engage in meaningful conversations with non-playable characters (NPCs), fostering a dynamic narrative that sheds light on the game's challenges, objectives, and accurate life information.
- Tasks/Quest management: Players receive assignments, monitor their progress, and strategically plan their efforts to contribute to the restoration of the ocean's environment.
- Sort the Rubbish: A mini-game introduces interactive elements to waste management, challenging players to tackle the issue engagingly.

The underwater realm offers players the following:

- Exploration: Players navigate by swimming, uncovering diverse ecosystems, discovering marine life, and locating collectables contributing to their in-game collection.
- Environmental challenges: Players address issues like assisting stuck fish, collecting plastic pollution, and completing other tasks aligned with their assignments, actively participating in preserving the virtual marine environment.
- Interacting with ocean life: The player interacts with specific species in the ocean (see Figure 3 & 6).

In both situations, the player have a companion (the Dolphin – see Figures 1, 2 & 3) who plays a crucial role in:

- Collecting Information: The companion aids the player in gathering more information about specific species, enhancing the educational aspect by incorporating real-life data into the gaming experience.
- Assistance: The companion serves as a guide, assisting the player in achieving the game's objectives.
- Collect Real-Life Information: The companion assists in providing real-life information about organisations or groups dedicated to reducing pollution in the ocean and how important it is to recycle, giving a light insight into the ongoing efforts of such organisations in the real world.
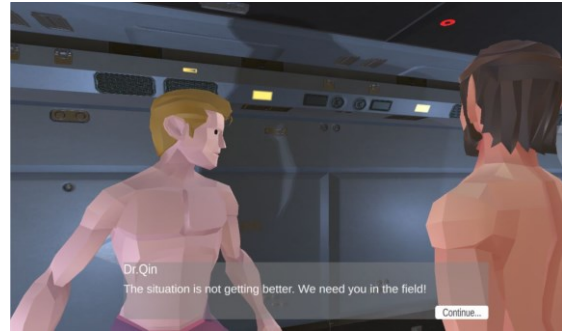
Fig. 3. Game Prototype – Interactions.

Fig. 4. Game Prototype - NPC interaction.

Fig. 5. Game Prototype - Mini-game.

Fig. 6. Game Prototype – Ocean exploration and Trash Collectables.

3.5   Deployment and Evaluation

The Alpha version of the game will be released online via the itch.io database and reviewed by selected students and experts in Phase 1, aiming to gather user experience information. This data will then be utilized to revise the application. Following this, a revised beta version will be launched and evaluated with schools in Phase 2. This evaluation will involve gathering quantitative measures to assess the game's impact on students' perceptions and learning outcomes.

4   Discussion

Integrating conversational AI into the project about ocean sustainability provides great potential in effectively engaging the public in conversation over environmental issues and environmental sustainability. By using AI driven dialogue systems, the project aims to make learning about ocean health an interactive and personalised experience.

Conversational AI can guide users through complex topics, such as the effects of plastic pollution, overfishing, and climate change on marine ecosystems. Furthermore, this integration could offer practical advice that users can take to reduce their environmental footprint.

Moreover, the collaboration between students from the University of Westminster and UAS BFI Vienna enriches the project with diverse perspectives but also highlights the importance of collaborative efforts in addressing issues of environmental sustainability. Such collaborations can serve as a model for future projects, emphasising the value of combining expertise from different fields to create more holistic and impactful solutions.

In conclusion, by integrating AI into the ocean's sustainability project, the initiative not only educates but also engages users in a dialogue about the ocean's future. It shows a shift into more interactive ways of education, where technology plays a key role. This project could serve as a case study on how technology, and specifically AI, can be used to create a deeper connection between people and the environment.

Acknowledgements

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