Waddle: using virtual penguin embodiment as a vehicle for empathy and informal learning

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Figure 1: Shows various aspects of the virtual penguin experience. From left to right, the user sees themselves as a penguin in a mirror, picks up rocks with their beak to build a nest, does a matting dance and defends the nest from a Skua attack.

ABSTRACT

This paper presents, Waddle, a virtual experience to promote informal learning by embodying the user as an Adélie Penguin to partake in a narrative-based virtual reality application that shares the story of the lives of these unique animals. We test the effects of this experience on informal learning and empathy, an important component for fostering social engagement with ecology. The research demonstrates that the developed experience is able to support informal learning, virtual embodiment, and is able to create a positive change in empathy.

KEYWORDS

Virtual Embodiment, Empathy, Informal Learning

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1 INTRODUCTION

Recent research into embodied learning demonstrates significant promise for teaching complex STEM topics [5], as well as increasing empathy and perspective-taking [3]. Previous work has also explored the use of virtual reality (VR) for facilitating embodied learning experiences with animals, but have often failed to do so, citing a lack of visuomotor alignment between the animal and the learner's experience [7]. In this research project, we leverage this work to design a new VR experience with intentional gesture congruence and visuomotor synchrony, in which the learner takes on the body of an Adélie penguin living in Antarctica. This experience is used as a vehicle to empirically explore how high-level learning, embodiment and empathy are facilitated and related.

Based on the results of Krekhov, et al. we hypothesized that the user would be able to accept themselves as an Adélie Penguin [4]. Based on the results of Ahn, et. al, we hypothesized that virtual embodiment would enhance learning outcomes [1] and that this learning would translate to informal learning environments [9]. Additionally, we hypothesized that virtual embodiment would produce an increased empathy for creature that the participant embodies [6].

2 METHODS

The VR experience, entitled Waddle, is a 20-minute Virtual Reality experience that demonstrates visuomotor congruence with an Adélie penguin. Hand tracking mode was utilized, which uses outward facing cameras on the Quest 2 to identify and track the user's

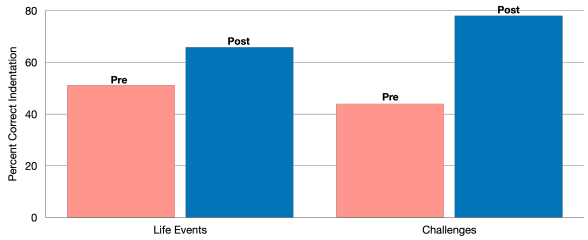

Figure 2: Shows the average for participants ability to identify major life events and challenges for Adélie penguins pre and post their virtual experience.

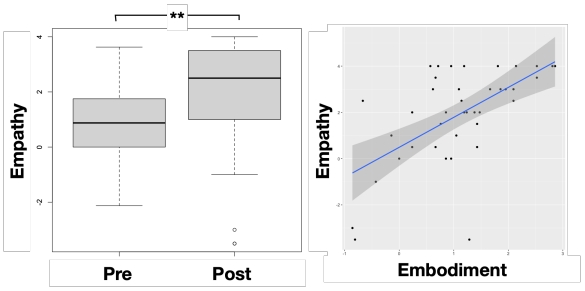

Figure 3: (Left) Shows the significant change in empathy pre and post experience. (Right) Shows the significant correlation between empathy and embodiment.

hand positions without using additional hand controllers. The experience was developed in consultation with a team of educational game designers, VR researchers, and research scientists.

The experience begins with a series of interactions that are designed to orientate the user to the system. Upon putting on the headset, the user sees a snowy scene. Their perspective is approximately 0.5 meters above the snowy floor and they see a beak extending forward where their nose should be. Looking down, they see their white belly and flippers instead of arms. To one side is an icy stone obstacle that acts as a mirror, showing a reflection of the Adélie penguin avatar they inhabit and control. Over the course of the virtual experience the user experiences major aspects of a penguin's life including building a nest, finding a mate and defending and egg from attack (Figure 1).

The study collected data from forty-three grade 3 through 8 (age 8 through 13) students, in groups of 10-20 from different informal learning organizations, attending a science festival on a major university campus. Empathy was measured using the Dispositional Empathy with Nature scale [8], consisting of nine Likert-scale questions. Embodiment was measured using a variation of the Avatar Embodiment Questionnaire [2], consisting of 23 Likert-scale questions. Informal learning was gathered using two opened ended question related to describing life events for an Adélie penguin and the challenges that these creatures face during their lifetime. Empathy and Embodiment scores were gathered by averaging scores across the questions, scaled from -4 to 4. Pre and Post test conditions were tested using a paired t-test and regressions were performed using Pearson's product-moment correlation.

3 RESULTS

The virtual experience did show gains in learning as shown in Figure 2. The data also provided support to creating embodiment. From the range of -4 to 4, the mean overall embodiment score was 0.9860627 with a standard deviation of 0.965754. A significant change was between the empathy ratings pre-experience (M = 0.85 , SD = 1.20) and the ratings post-experience (M = 1.65 , SD = 1.36) $t(40) = -2.95$, $p = 0.005$. A significant correlation was also found between the embodiment and the post-experience empathy ratings, $r(39) = 0.53$, $p<.001$ (Figure 3).

4 CONCLUSION

This research indicate that direct embodiment of a penguin may be possible in VR, as shown by an overall positive score for this construct. Additionally, this research demonstrates that the developed virtual experience is able to provide a significant change in empathy and a positive impact on informal learning. As the work demonstrates a significant correlation between embodiment and empathy, virtual embodiment of non-human characters may provide a powerful tool for both education and appreciation of other creatures. Future work will aim to better understand what aspects of this experience provide support for embodiment and empathy and how these constructs relate to and support informal learning.

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