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From Abstract to Concrete: How Immersive Virtual Reality (VR) Technology Enhances Teaching of Complex Paradigms

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Abstract. In this paper we wish to demonstrate how complex and abstract topics in undergraduate psychology, specifically developmental psychology, can be taught in immersive VR. We use three well known concepts in developmental psychology: the perspective taking task, the conservation task and the False Belief task, which are regularly taught in undergraduate psychology courses. We will briefly outline each task, present our version of the task in immersive VR (using the Edify VR platform) and discuss the benefits of immersive VR technology for complex and abstract concept teaching. We will also suggest further recommendations and best-practice tips.

Keywords: Immersive Education, Abstract Concepts, Psychology

1 Background

Immersive virtual reality (VR) learning environments have already been shown to provide a powerful alignment of learner engagement and knowledge retention[1]. The shift toward active learner engagement pedagogies is motivated by the realization that active engagement outperforms passive observation, resulting in new experience-based learning methodologies for students. The use of technology in education has primarily aimed at making information more accessible and interactive[2]. VR takes this a step further, potentially improving learning experiences through innovative, more naturalistic information presentation and manipulation of the learner's cognitive load[3]. As a result, teaching must adapt to this novel medium and shift from an abstract 2D to a practical 3D pedagogy.

2 Illustrative Example

We present three illustrative examples of how VR can be used to teach developmental psychology at the K-12 and undergraduate levels. After careful consideration of the pedagogical design, we outline the steps for creating these lessons. The purpose of these illustrative examples is to show how abstract concepts like perspective taking, conservation, and Theory of Mind can be taught in VR, to improve students' understanding of developmental psychology.

2.1. Perspective Taking Task

The Perspective Taking Task is a psychological paradigm that was developed to assess egocentrism[4]. There have been no attempts to create a VR version of this task to our knowledge, and, given the three-dimensional nature of the task, it seems appropriate to investigate it using immersive technology.

Lesson setup is straightforward and requires an immersive teaching platform, such as Edify (edify.ac), as well as several free three-dimensional models available online. These concepts can be taught remotely and actively allow students to take on different perspectives, making them suitable for blended or remote learning. Furthermore, if appropriate VR equipment is available, students can enter the three-dimensional lesson and actively explore by “teleporting” or simply moving around in the scene (Figure 1).

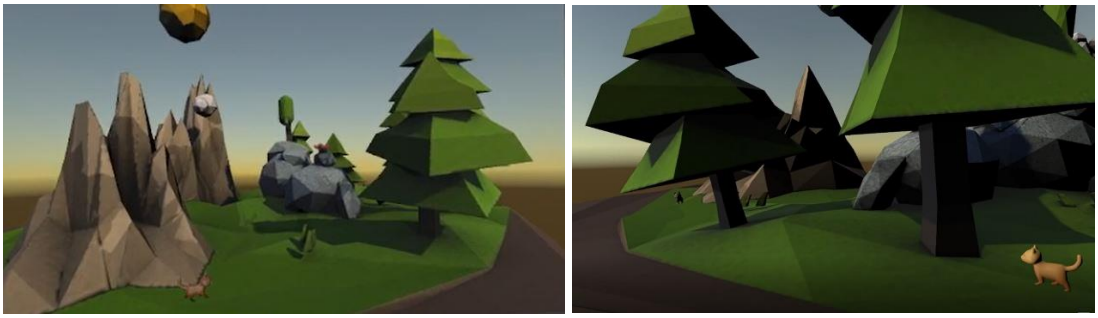

Fig. 1. VR Perspective Taking Task task set up. Two screenshots show different viewpoints and where the characters were placed on the island.

2.1. Conservation Task

Another classic test in Piagetian developmental psychology is the Conservation Task. Children are asked in one version of the task if two aligned rows of objects have the same number of objects or if one of the rows has more [5]. After the child agrees that the lines are the same, the experimenter lengthens one of the lines and asks the child whether the two rows have the same number of objects or if one of the rows has more. When asked again, pre-operational-aged children (roughly ages four to seven years old) typically respond that the longer row has more.

We created two scenarios for our Virtual Reality Conservation Task (VR-CT) (Figure 2). The first was an Edify coliseum environment in which we placed three-dimensional coins while performing the classical number conservation task. The widely dispersed display and the initial display appear the same when coins are carefully placed in three dimensions. Along with the traditional way of describing this task, VR-CT has the potential to spark critical thinking by providing more options to explore and a wider range of presentation options. It could also be extended to experimental applications.

Fig. 2. VR-CT set up. The top screenshot shows the gallery environment and golf balls arrangement (camera is also visible to demonstrate how it is viewed from the teacher's perspective in "VR-by-proxy" mode, a method for viewing VR content via video conferencing software). The lower image shows coin placement in the coliseum environment in Edify.

2.1. False Belief Task

The False Belief Task is a traditional method for assessing Theory of Mind (ToM). The Sally-Anne task is one of the most well-known variations of the False Belief Task[6]. The experimenter presents Sally and Anne as puppets in this scenario, and the child (or adult, depending on the experimental setup) acts as an observer. Sally leaves after placing a marble in a basket. The marble is removed from the basket and placed in a box by Anne. The experimenter then asks the participant where Sally will look for her marble when she returns. A fully developed ToM participant will deduce what Sally is thinking and that she did not see the marble being placed in the box, and will say that Sally will look for the marble in the basket where she left it before leaving. However, a child under a certain age (the exact age varies) or some neurodivergent individuals (e.g., autistic) may not have a fully developed ToM and, as a result, will say that Sally will look for the marble in the box, because that is where the marble actually is.

Fig. 3. VR-False Belief Task set up.

We used another Edify environment (Da Vinci Lab) for our Virtual Reality False Belief Task (VR-FBT), which has a realistic room set-up with tables, a bed, chairs, and windows (Figure 3).Learners can enter the three-dimensional virtual environment, move the objects around, and try to explain the concept to themselves. Alternatively, the teacher can move the figures while describing the False Belief (or Sally-Anne) task using the "VR-by-proxy" method ("VR-by-proxy" is a method for viewing VR content via video conferencing software like Zoom and Microsoft Teams).

3 Conclusion

To summarise, VR has enormous potential for teaching a wide range of subjects, but it must also be evaluated responsibly. Technology is taking over our daily lives: we have smart phones, smart TVs, and artificial intelligence (AI) technology to help us navigate the world more efficiently. Researchers and educators are frequently enticed by the flashy promise of these technologies and their educational benefits. We must always be critical of what new technologies bring to our existing pedagogical frameworks and determine whether they truly aid learning, rather than hinder it. Our three examples from developmental psychology show how carefully chosen tools can shift our perspective and help us re-evaluate active learning methodologies.

References

[1] De Freitas, S., Rebolledo-Mendez, G., Liarokapis, F., Magoulas, G., & Poulovassilis, A. (2010). Learning as immersive experiences: Using the four-dimensional framework for designing and evaluating immersive learning experiences in a virtual world. *British Journal of Educational Technology*, *41*(1), 69-85.

[2]Mesa-Gresa, P., Gil-Gómez, H., Lozano-Quilis, J. A., & Gil-Gómez, J. A. (2018). Effectiveness of virtual reality for children and adolescents with autism spectrum disorder: an evidence-based systematic review. *Sensors*, *18*(8), 2486.

[3]Andersen, S. A. W., Frendø, M., & Sørensen, M. S. (2020). Effects on cognitive load of tutoring in virtual reality simulation training. *MedEdPublish*, *9*(51), 51.

[4]Kesselring, T., & Müller, U. (2011). The concept of egocentrism in the context of Piaget's theory. *New ideas in psychology*, *29*(3), 327-345.

[5]Piaget, J., & Cook, M. T. (1952). The origins of intelligence in children.

[6]Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a "theory of mind"?. *Cognition*, *21*(1), 37-46.