COMPARING VIRTUAL REALITY TO PC SIMULATIONS IN PHYSICS EDUCATION

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At ACSME 2021 (Debs 2021), we presented clear evidence of how immersive virtual reality (VR) software can help correct student misconceptions related to Newton's laws. Inspired by questions from the Force Concept Inventory (FCI) (Hestenes, et al.,1992), our VR experience asks students to play with a basketball and decide which forces act on the ball. They are presented with the world that represents their choices, and therefore manifests their misconceptions. A narrator guides them with feedback to reconsider and reflect on their choices until they choose the correct answer. While all students on average have learning gains in their post vs. pre FCI tests, we had previously shown that student who use our VR app (n=156) increase their FCI scores by a further 13% compared to those who did not use VR (n=352). The result was statistically significant, with a p-value <<0.05.

However, one possibility is that VR itself is not novel, and simply the well-designed and engaging simulation is the valuable experience. To test this, we have created a PC-port of the VR app, which is identical in design, gameplay, and graphics, with the only difference being a PC screen and typical first-person gaming controls with a keyboard and mouse. This has been utilised in the same course, via the same methodology as the VR intervention with n=86 students across two years. We find that while the PC group mean is higher by 4% than the non-intervention group, this is not statistically significant. The VR group, however, is still statically significantly different from the PC group. Further trials, and with them, increased statistical power is needed to verify if the PC experience can still lead to notable learning gains, however this result is strongly suggestive that immersive VR itself has a unique effect on experiential learning, at least for the understanding of science concepts. Figure 1 summarises these data.

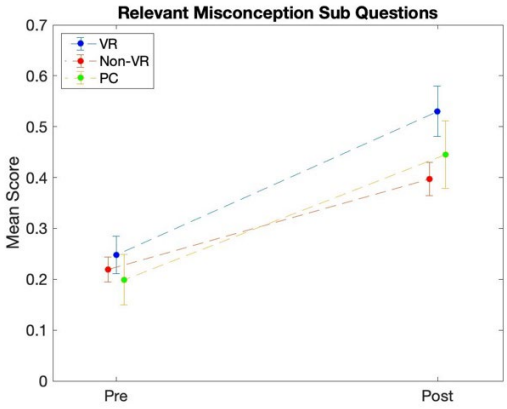

Figure 1. *Means for non-intervention, PC-intervention, and VR-intervention group in pre and post FCI test scores, in a first-year non-calculus Physics unit. Error bars represent 95% confidence intervals.*

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