# Chapter 1

# Students' Perceptions of a 3D Virtual Environment Designed for Metacognitive and Self-Regulated Learning in Science

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## EXECUTIVE SUMMARY

*Immersive and 3D virtual environments have the potential to offer more authentic science inquiry learning that allows for metacognitive and self-regulated learning strategies. While metacognition and self-regulated learning are important for science inquiry learning, little research exists on linking these skills with students' experience in a 3D immersive environment designed to teach science inquiry. The authors conducted two studies to explore how curricula delivered via immersive technologies have the potential to create learning experiences that allow for authentic inquiry learning and enable metacognitive processes and self-regulated learning. In the first study, they examined the relationship between students' metacognition and their self-identified experience with the curriculum. The authors found a relationship between students' metacognition and feeling like a scientist and like they were participating in authentic science (conducting an experiment). These findings*

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*influenced the design of a treatment that contains embedded metacognitive and self-regulated learning scaffolds. In their second study, the authors examined the causal effect of the treatment on students' self-identified experience with the curriculum. They found that students who participated in the treatment identified with the role of a scientist and felt like they were doing authentic science.*

## INTRODUCTION

Immersive and 3D virtual environments enable authentic science experiences that empower students to become active agents in their learning. Such environments allow for the visualization of information and data that is typically not visible, capability to accelerate or rewind the passage of time, incorporate feedback, experimentation, and simulate authentic scenarios that are difficult to create in classroom face-to-face settings. For example, if a teacher wanted her biology class to study a disease out-break, it is difficult to create authentic experiences of epidemiologists and biologists in classroom settings that place students at the center of inquiry. As an alternative, bringing students to a local hospital to work with epidemiologists and doctors to study an outbreak of Whooping Cough might provide an authentic, meaningful, and motivating context for students to master scientific content and inquiry skills; yet, it is not feasible for a myriad of reasons. However, in a 3D virtual environment, it is possible to simulate a disease outbreak in a "virtual" city that students can then study. The immersive nature of the technology allows students to assume the role of a scientist and investigate the problem in the "virtual" city, on their own. The ability to control time allows students to explore the disease outbreak in a few classroom settings rather than the 6-8 week timeframe it may typically take. Visualizing data provides students with the means to better understand and grasp abstract or difficult concepts. Students are able to run tests and conduct their own experiments like real scientists. Scaffolds for metacognitive and self-regulated learning processes can be built into the environment to facilitate learning and transfer of knowledge. All these features contribute to authentic experiences that place students as active agents of their learning.

While research has indicated 3D immersive environments are promising for learning science, there is still a need to explore how they can support metacognitive and self-regulated learning strategies. In particular, while metacognition and self-regulated learning are important aspects of inquiry learning, little research exists on linking these skills with students experience and immersion in a 3D environment designed to teach science inquiry. Many studies have failed to include in their design all the relevant theory-based features of self-regulation (Zimmerman & Tsikalas, 2005). Further, there is a shortage of studies using experimental research design.

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