Chapter 2
Immersive Agricultural Education:
Gamifying Learning With Augmented Reality and Virtual Reality

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EXECUTIVE SUMMARY

This chapter introduces the exciting world of cutting-edge technologies in controlled environment agriculture (CEA) and their potential impact on high school education. The objective of this chapter is to establish the groundwork for transforming education through the creation of state-of-the-art augmented reality (AR) and virtual reality (VR) learning platforms, and research within the domain of CEA. These innovative technologies provide immersive learning experiences, allowing high school students and new entrepreneurs with diverse capabilities to explore new agricultural technologies in a virtual environment before implementing them in the world. While AR and VR technologies hold significant promise, there are notable challenges in effectively integrating AR and VR technologies within educational and CEA settings. These challenges highlight the need for thoughtful integration, aiming to enrich learning experiences. Through this chapter, the authors examine various

ideas that have successfully harnessed the benefits of AR and VR in education and discuss a proposed framework.

INTRODUCTION

Agriculture, one of the world's oldest industries, is experiencing a profound transformation due to advancements in technology. Among the most promising innovations are Augmented Reality (AR) and Virtual Reality (VR), which offer new ways to educate and train individuals in various agricultural practices. Controlled Environment Agriculture (CEA) is a multifaceted and complex field which involves growing crops in controlled environments such as greenhouses and indoor farms, and it particularly benefits from these advanced technologies.

The primary objective of this research is to establish CEA as a sustainable food production system capable of efficiently generating nutritious foods in a low-carbon economy. By seamlessly integrating agricultural practices with advanced AR and VR technologies, this initiative enhances high school students' and new entrepreneurs' understanding of STEM concepts within an educational setting. Aligned with the Individuals with Disabilities Education Act (IDEA), and Universal Design for Learning (UDL) Guidelines, the platform ensures equitable access to STEM education, fostering an inclusive environment for students of diverse abilities and learning styles. Furthermore, the research seeks to expand market opportunities for CEA farmers and entrepreneurs by providing them with cutting-edge technologies and comprehensive learning resources. To achieve the goals, the research focuses on three primary questions:

1. How effective are AR and VR learning modules and the greenhouse in enhancing understanding and use of CEA concepts aligned with Next Generation Science Standards (NGSS) for secondary school students?
2. How do gamified elements and dynamic stochastic gaming probabilistic concepts impact the engagement and learning experiences of students in CEA education?
3. How well do the developed learning modules cater to the diverse needs of learners, including those with disabilities, in alignment with Section 504 of the Rehabilitation Act of 1973, IDEA, and Universal Design for Learning Guidelines?

In the following chapter, we explore the integration of agricultural education and emerging technologies to foster high school students' understanding of sustainable food production in the literature review section. We begin by discussing the role of agricultural education and the technologies that support sustainable practices.

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