Chapter 14
Transformative Innovation in Course Design for STEM-Based E-Learning

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ABSTRACT

Students today are the workers and leaders of tomorrow. It is, therefore, essential to future-proof education against serious disruptions to ensure continued socioeconomic development in the world. The distant learning format is, as yet, largely uncharted in several parts of the world. But it is set to revolutionize teaching and learning in the years to come. By leveraging the pandemic circumstances that disrupted in-person, face-to-face instruction, the author recommends a set of fundamental solutions to bring the complexities of STEM learning back on course. Redefining the strategy to render education remotely, effectively, and at scale, he emphasizes the need for a transformative initiative to improve teaching objectives and learning outcomes. The focus, he believes, should be an integrated approach for a comprehensive experience through the use of immersive technologies, including augmented reality (AR), virtual reality (VR), and the metaverse.

INTRODUCTION

Experts agree that Science, Technology, Engineering, and Mathematics (STEM) play a key role in the sustained progress of the world. The focus on logic and critical thinking skills in STEM education instils a passion for innovation that can grow the economy and drive the future. A World Economic Forum report (WEF, 2020) mentions problem solving, critical thinking, and analysis to be among the top skills for 2025, with the mounting need for more resources in these areas.

However, there has been a noticeable global decline in the number of students pursuing STEM education since the start of the millennium. European countries, for instance, have seen a decline in STEM graduates from 12% to 9% since 2000 (Henriksen et al., 2015). In the United States, there has

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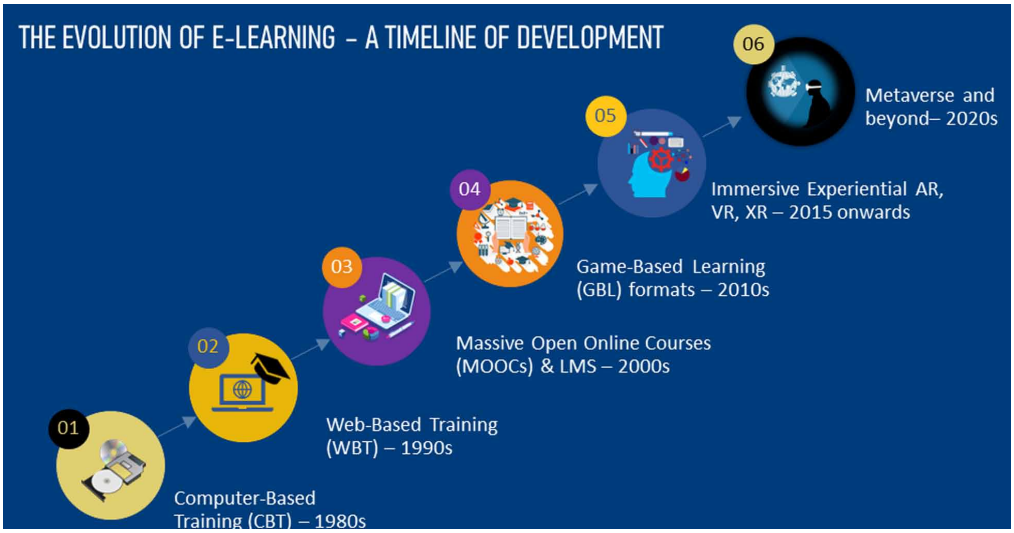
Figure 1. A timeline of the evolution of e-learning, reaching the metaverse boom.
Image by the author.



been a continual drop in youngsters in STEM right from the 1970s (OECD, 2006; NSB, NSF, 2003). With students in the US presenting poor performance in Science and Mathematics, graduation rates in STEM-related fields have been on the wane (NSF, 2010). Crucially, new research (UN, 2021) reveals that COVID-19 decimated 20 years of educational gains across the world in under two years.

It is time to act on the criticality of the STEM education scenario. Keeping STEM education thriving through the circumstances of future pandemics and other interruptions also means it can never reach a point of completion or total achievement. Ever-evolving, STEM is the basis of almost every aspect of living and life, making it more important to keep STEM education as updated as the technology used to deliver it. The key to future-proofing STEM education can, therefore, only be through constant innovation.

As a bridge between knowledge acquisition and learning agility, technology-driven innovation in STEM education can be the quickest way to drive global development. Education technology may have been around since before the pandemic wiped the boards clean, but there has since been a dramatic rise in e-learning and digital platforms, including the massive boom in immersive technology with Cross Reality (XR) and the metaverse. Figure 1 depicts the timeline of e-learning and the path it has traversed, from being computer-based to the explosion of the metaverse.

In this chapter, the author highlights the importance of innovation in distance education in STEM in creating tomorrow's leaders, problem-solvers, and visionaries. While our current, almost-irrelevant model of education is built on calibrated standardization prioritized over perspicacity and intellectual acumen, the author proposes a catalytic upgrade to more skills-focused, capability-based learning using advanced technology and e-learning.

The author explains the importance of the Integrated STEM (iSTEM) framework, where the four subjects are combined in meaningful contexts, establishing connections between concepts and real-world applications. When STEM subjects are taught in a disjointed manner in silos, it can lead to greater fragmentation of knowledge and misperception of application. The iSTEM learning model helps inspire genuine passion for engineering or technology programs and career orientation (Tsai et al., 2018) as it