Serious Games for Education and Training in Advanced Manufacturing

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Advanced design, material sciences, process engineering and manufacturing technologies are being increasingly applied across all industry sectors. This, combined with advances in emerging concepts such as the Industry Internet of Things (IIOT), Big Data, Machine Learning, and Cyber-physical systems, necessitates the use of a highly skilled workforce with the required knowledge, skills, and abilities to effectively utilize these state-of-the-art technologies. Given the unparalleled pace of technological advancements in this area also calls for a workforce with metacognitive skills and capabilities for learning to learn. To accommodate this need, we propose a lifecycle approach to education and advanced training that will recruit, reeducate, and retrain (Figure 1) members and potential members of the workforce spanning from K-12 and higher education all the way to the incumbent workforce.

Face-to-face and online/hybrid platforms can be useful to teach the requisite knowledge; however, the more of the modern workforce than ever before are connected to technology, such as social media, in some way. Every sixty seconds, over 500,000 comments are posted to Facebook, 300 hours of video are uploaded to YouTube, and 360,000 tweets are posted on Twitter. Globally speaking, people spend 3 billion hours per week playing video games. By delivering a targeted training regimen on these familiar platforms, we can help improve learning while maximizing engagement with training modules.

Imparting the requisite skills to work in highly interconnected and technology-driven environments using modern human-machine interfaces will require developing new and innovative learning environments. The use of advanced computer serious games (games or virtual environments designed for education, training, or business applications) coupled with virtual reality and augmented reality technologies grounded in a thorough understanding of pedagogical requirements has the potential to transform how we approach training the 21st century workforce (Figure 2).

The use of advanced technologies in gaming as well as augmented and virtual reality give us the ability to utilize an epistemic framework founded upon simulating real-world situations and providing instruction on how to navigate them based on data generated on the job (Figure 3).

The goal of the proposed activities is to prepare/train the technology-adept and data capable future manufacturing workforce. Our team will achieve this by developing advanced computer serious games using virtual and augmented reality technologies to simulate various design and manufacturing activities to (re)train the future workforce and attract young people into careers in advanced manufacturing.

Figure 1: Education & Training Lifecycle (Badurdeen & Jawahir, 2016).
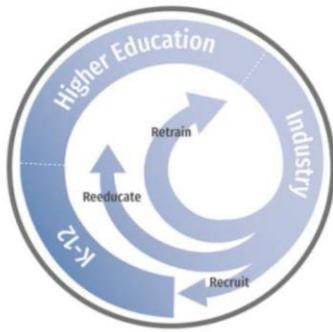
Figure 2: Serious games development requires a team to successfully fuse learning sciences, subject matter expertise with creative designs and the latest technologies.

Figure 3: Scenario Based Simulation and Training System for Advanced Manufacturing.

Epistemic Framework for Manufacturing
    Engineers and Technicians
Orientation-Overview
    Where do I fit in the business?
Technical Training
    Launch the real tools
    Use the real data
    Use the latest technologies
    Refresh and rehearsal
Decision Support and Control System
    What-if scenarios
    Multiple simulations
    Design and Process Optimization Exercises
Accessible via Web Browser on Multiple
Devices
    Cloud Based
    Customizable and Scalable