ACS 2025 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

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Research In-Progress

Developing Surgical Simulation using a Rainforest Design: Balancing Resource Investment with Educational Impact

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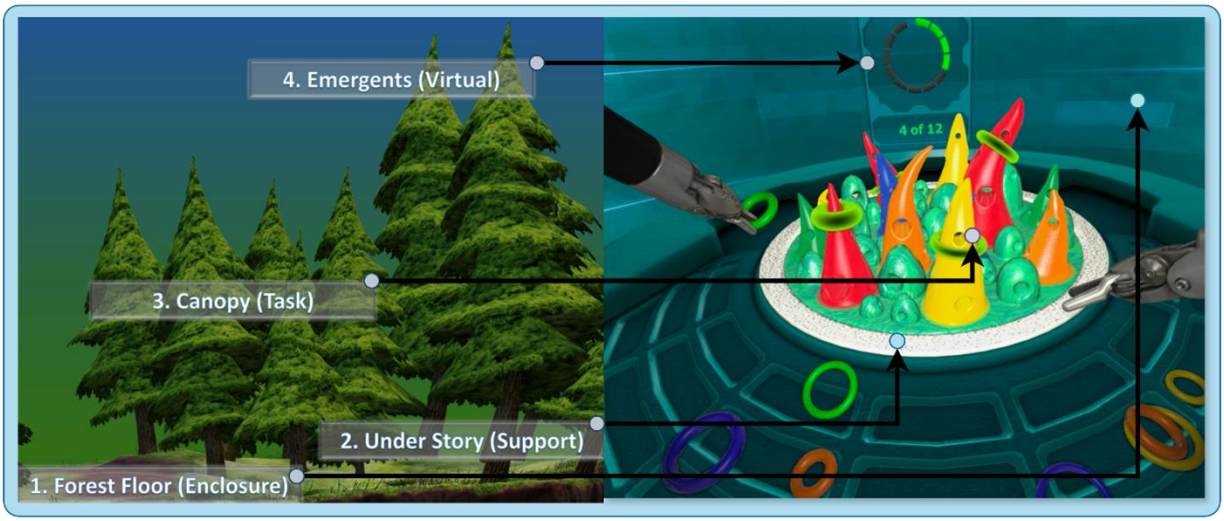
Introduction: We explore a novel approach to simulation training exercise design by structuring the simulation environment based on a four-layered rainforest-inspired model. The objective is to create an immersive, efficient, and effective training experience. This layered approach promotes a multi-disciplinary collaborative workflow across fields like engineering, art, interaction design and user feedback. This significantly reduces development dependency bottlenecks due to the loosely coupled functionality layers.

Methods: The simulation environment is divided into four distinct layers, each designed to contribute specific elements to the training scenario, balancing educational impact with resource investment (e.g. man-hour). Each layer and its components can be analogously mapped to a surgical component: 1. Forest Floor (Enclosure): This foundational layer includes the surrounding environment, such as floor and walls (e.g. abdominal cavity). 2. Understory (Support): This layer provides modular and flexible support (e.g., ligaments) structures that enhance the environmental context and supports the third layer, such as pillars and boxes. 3. Canpy (Task): The most critical layer for training, contains objects like buttons, cylinders (e.g., defects, dissectible tissue) to achieve the learning objective. 4. Emergents (Virtual): The topmost layer consists of game objects, such as messaging and visual effects (e.g., hemorrhage), which reinforce task-based learning.

Preliminary Results: Early testing indicates that the Canopy and Emergents layers, which require the highest resource investment, yield the most substantial improvements in learning outcomes. These layers focus on enhancing surgical task skills performance and engagement. The Forest Floor and Understory layers, while essential for providing structure and context, have an indirect effect on learning objectives and are resource-efficient.

Next Steps: We will perform user and functionality testing to assess the impact of the layers, particularly focusing on optimizing the Canopy and Emergents layers. Additionally, we will enhance the contextual role of the Forest Floor and Understory layers without increasing resource requirements.


4. Emergents (Virtual)
3. Canopy (Task)
2. Under Story (Support)
1. Forest Floor (Enclosure)
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