Can virtual reality simulations improve macrocognition?

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Simulation studies provide a unique opportunity to develop a deeper understanding of how healthcare workers manage risk in everyday care. In this issue of the journal, Mumma and colleagues[1] use a simulation design to analyse how nurses think during infection prevention and control practices and identify the cognitive skills that are associated with high performance.

Most nurse educators are familiar with the low-fidelity glow germ simulation intended to make nursing students and other health care providers aware of cross-contamination and the ubiquitous nature of microorganisms. Mumma *et al* have taken this exercise to another level by using actual microorganisms, thereby increasing the stakes of the simulated experience. The study has considerable methodological rigour and is an exciting way to highlight a unique use of simulation. Several important ideas and insights stem from reading this article.

The study looked at how 42 nurses provided care for two simulated patients (adult high-fidelity manikins). Several interventions had to be completed in an hour: dressing changes, line/tube insertions, assessments, medication administration and assistance with toileting. A specific focus was on how the nurses engaged in the interventions and their adherence to infection control practices. The nurses were categorised as high, medium and low performers based on the frequency with which they spread the surrogates for pathogens in the simulation. The nurses were then asked to reflect on what they were thinking as they watched a video of their performance. This allowed the research team to align how they thought about and approached caring for patients and their adherence to infection control practices.

Mumma *et al* found that high performers recognise risks as they unfold and mitigate those risks using both formal and informal rules. Medium performers engaged in future-oriented anticipation of risks and used preparing and planning mitigation strategies. Low performers engaged in more tracking of their activities and mitigation included more informal rules and sacrificing some tasks due to time constraints or other pressures. They also lacked situational awareness and proceeded cautiously in uncertain situations. It is important to acknowledge these thought processes as we look to support nurses in developing their skills and expertise specifically those related to cognition. Through reflection and feedback, nurses can learn ways to improve their care delivery and adherence to evidence-based practices.

This study also highlights the value of simulation in identifying skill gaps. In a realistic practice environment, simulations create a safe, controlled environment where learners can practice procedures and decision-making without real-world consequences. This enables them to encounter, recognise and correct errors in a learning-focused setting. One of the most significant advantages of simulation-based education is the opportunity for immediate, targeted feedback and reflective learning. There is evidence to suggest that some nurses do not retain the ability to perform critical psychomotor skills safely.[2] Deliberate feedback[3] during and after simulations helps learners recognise and understand their mistakes, leading to deeper learning and the development of critical thinking skills. By simulating real-world scenarios, educators can observe how learners apply both theoretical knowledge and practical skills and identify specific skill gaps, particularly in areas like infection control, where the consequences of errors can be severe. Simulation allows for the customisation of learning experiences to

address individual learner's strengths and weaknesses, enhancing the overall educational impact. In the study by Mumma *et al*, by reviewing the video of their practice and reflecting on it, nurses could see where they may have made errors or less-than-optimal decisions and what the direct impact was (transmission of infection) in a safe environment where they could learn and make changes. This skill transfer into the clinical environment can then improve patient safety and outcomes.

The correlation that exists between fluidity in psychomotor skills and competence is also highlighted by Mumma *et al*. Nurses with more confidence in their skills performed more confidently and had fewer instances of cross-contamination. Fluidity in performing psychomotor skills often indicates a level of mastery and comfort with the task.[4] This fluency indicates that the learner has moved beyond mere understanding to being able to apply skills efficiently and effectively in practice. Fluid psychomotor skills often result from repeated practice and reflect the internalisation of procedural knowledge. This internalisation is a critical aspect of developing competence. It is important to note that in high-stress or complex situations, even skilled practitioners may exhibit less fluidity. This does not necessarily indicate incompetence but might reflect the challenging nature of the task or environment. Competence in healthcare is multifaceted, encompassing cognitive (knowledge), affective (attitudes) and psychomotor (skills) domains. Fluidity in psychomotor skills is one aspect of this broader concept of competence.[5] Given differences in performance levels, it is important to know which learners need more and which require less training to attain proficiency. A pre-assessment may have helped in understanding the baseline knowledge of learners in the study by Mumma *et al* and might be a good topic for future research in this area.

As we understand more about how nurses approach caring for patients and mitigating safety risks such as infection transmission, it becomes clear that self-awareness is an important skill. The challenge is how to develop self-awareness—it is difficult to do this without feedback from others. Deliberate feedback in traditional simulation relies on others to provide that information by observing performance in a situation. This is an important part of learning and contributes to self-awareness as one moves forward and practices. Data on the outcome of our actions in a simulated experience such as being able to measure the transmission of infection then adds to that feedback.

The simulation by Mumma *et al* was resource-intensive and not likely to be replicable on a large scale. The challenge before us is, how to do this in an economically feasible and viable way. A logical step forward may be to explore the use of extended reality simulation, particularly immersive virtual reality (VR) and perhaps mixed reality. VR has developed sufficiently to allow healthcare workers to engage in simulations and receive targeted feedback immediately from the programme without requiring outside observations. Biometrics such as body motion and eye gaze add additional feedback.[6] The next logical step may be the use of VR to understand learner meta-cognition[7] and to provide training environments in which individuals can practice and receive real-time feedback.

How we use VR simulations to explore situational awareness and insight into our behaviours and performance is the next frontier in simulation. This is an exciting time to engage in educating our healthcare professionals, particularly in patient safety and quality care. The advances in technology such as VR can provide a way to allow our learners to practice with realistic situations and receive real-time targeted feedback.

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