Applying Educational Theory to Simulation-Based Training and Assessment in Surgery

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KEYWORDS

- Simulation-based training • Instructional design • Assessment
- Educational learning theory

KEY POINTS

- To optimize effective, cost-efficient use of simulation, good alignment among learning objectives, teacher and learner features, fidelity and replicability of simulators and simulation environment, and assessment processes is necessary.
- Consider the level of the learners, prior knowledge and experiences, and targeted learning outcomes and be judicious in determining the appropriate level of fidelity and complexity for simulation.
- To achieve mastery, learners must first learn fundamental knowledge and skills, then practice integrating them until fluent and automatic, and finally, learn when and how to apply what they learned appropriately in various contexts.
- Establishing evidence of validity and reliability is never finished and requires diligence in examining how assessment measures and processes interact with assessment situations across time, individuals, settings, and purposes to produce data.
- The selection and preparation of assessors are critical to the validity and reliability of data, because an assessment is only as good as the person doing it.

INTRODUCTION

Considerable progress has been made regarding the range of simulator technologies and simulation formats. Similarly, results from research in human learning and behavior have facilitated the development of best practices in simulation-based training (SBT) and surgical education.[1–4] Today, SBT routinely complements actual clinical learning and patient care experiences in surgical education.

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Beginning with important considerations for selecting appropriate forms of simulation, several relevant educational theories of learning are described, followed by a practical overview of the ADDIE model that offers a systematic approach to curriculum and instructional design.[5–7] Definitions of key terms and important principles provide guidance for designing and using assessments. Additional key resources are identified and referenced for further reading and application in designing effective SBT and assessment in surgical education.

SIMULATORS AND SIMULATION

McGaghie[8(p9)] offers a useful definition for simulation:

> In broad, simple terms, a simulation is a person, device, or set of conditions that attempts to present (education and) evaluation problems authentically. Students or trainees are required to respond to the problems as they would under natural circumstances. Frequently, a trainee receives performance feedback as if in a real situation.

McGaghie also notes commonalities between simulation-based teaching and assessment methods (**Box 1**).

Simulation refers to the design and process of teacher and learner interaction. *Simulator* refers to the actual device, object, or person used to mimic the relevant real-life elements in a simulation-based instructional or assessment activity. A simulator could be a paper case, a role-play exercise, or a teacher's use of "what if" questions in the discussion of a real patient case. A more complex simulation might involve the single or combined use of other types of simulators (eg, live simulated patient/actor, anatomic trainer, cadaver, and/or computerized or mannequin-based human patient simulator).

To optimize effective and cost-efficient use of simulation, good alignment among the learning objectives, teacher and learner features, simulator(s), and overall purpose of the activity or process is necessary. Underestimating the level of fidelity (realism) can result in not achieving intended learning outcomes and wasting time and expertise. Overestimating fidelity might result in achieving learning outcomes but wasting

Box 1
Common features between simulation-based training and assessment methods

- Learners can be situated in complex scenarios.
- Learners experience cues and consequences that accurately reflect real-life experience.
- Learners respond to simulated situations similarly to how they would in real-life.
- Simulation does not completely replicate real life (ie, fidelity) due to its limitations (eg, cost, technological capacity, time, assessment requirements, ethics, and safety).
- A wide variety of simulation formats facilitate individual or group learning and performance.
- Simulations can involve a variety of simulator technology in single or combined use (eg, a simple inanimate, anatomic model, programmable module, and/or high-fidelity, physiologically responsive, mannequin-based human patient simulator).
- Use of simulation can reflect decisions and consequences that can range from low- to high-stakes impact on the learner.

Adapted from McGaghie WC. Simulation in professional competence assessment: basic considerations. In: Tekian A, McGuire CH and McGaghie WC, editors. Innovative simulations for assessing professional competence. Chicago: Department of Medical Education, University of Illinois at Chicago; 1999.