Simulations

LEARNING ENVIRONMENTS

DESCRIPTION

Over the past 25 years the use of simulations has been found to be engaging as learning and assessment tools (Behrens, DiCerbo, & Ferrara, 2012; Gegenfurtner, Quesada-Pallarès, & Knogler, 2014; Mitchell & Savell-Smith, 2004; Pai-Hsing Wu et al., 2014; Quellmalz et al., 2012; Shute & Ventura, 2013). A digital simulation can be defined as a technology modeling a system or a process where a user can manipulate parameters in the system (De Jong & Van Joolingen, 1998). In a simulation, processes, systems, and functions of real-life phenomena are simulated in real time in an authentic and complex manner, which in turn helps learners to critically engage with the learning material (Holladay & Quiñones, 2003). Common examples of simulations involve pilot training in flight simulators (Jacobs, Prince, Hays & Salas, 1990; Wong, Meyer, Timson, Perfect, & White, 2012), decision making in business simulations (Lainema & Nurmi, 2006; Siewiorek & Gegenfurtner, 2010), medical diagnosis using simulated patients (Consorti, Mancuso, Nocioni, & Piccolo, 2012; Cook, Erwin, & Triola, 2010; Iseli, Koenig, Lee, & Wainess, 2010), and physics learning in 2D physics simulation environments (Shute & Ventura, 2013). Digital simulations are becoming increasingly popular in professional training for developing complex cognitive skills (Helle et al., 2011; Mayer, Dale, Fraccastoro, & Moss, 2011; Rogers, 2011; Siewiorek, Gegenfurtner, Lainema, Saarinen, & Lehtinen, 2013; Tynjälä, Häkkinen, & Hämäläinen, 2014; Wang & Wu, 2008).

Best practices for designing simulations for learning include:

- Match simulations to learning goals
- Make learning essential to simulation progress
- Build in proven instructional strategies
- Build in guidance and structure
- Manage complexity
- Make relevance salient

LEARNER IMPACTS

- Attitude
- Behavior
- Motivation
- Self-regulation

CAPABILITIES

- Assessment: Software simulation
- Instruction: Active learning experience

SAMPLE DESIGN IMPLEMENTATIONS

- Robust Technology: Flight simulator
- Simple Technology: 2D physics simulations in a digital environment
- Content Support: Using the Evidence-Centered Design (ECD) approach

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SELF-ASSESSMENT INSTRUMENT

Principle Criteria	Integration (4-5 points)	Exploration (2-3 points)	Consideration (1 point)	Not Applicable (0 Points)	Total Points
Definition	Strong application of technology to model a system or process Strong integration of user control to manipulate the simulation Strong use of simulation to engage learners in an authentic context	Some application of technology to model a system or process Some integration of user control to manipulate the simulation Some use of simulation to engage learners in an authentic context	Poor application of technology to model a system or process Poor integration of user control to manipulate the simulation Poor use of simulation to engage learners in an authentic context	Does NOT use effectively or is not a related activity	= _____
Model	Strong use of simulation to foster experimentation, discovery, construction, and collaboration Strong use of simulation to conduct authentic tasks within a situated environment	Some use of simulation to foster experimentation, discovery, construction, and collaboration Some use of simulation to conduct authentic tasks within a situated environment	Poor use of simulation to foster experimentation, discovery, construction, and collaboration Poor use of simulation to conduct authentic tasks within a situated environment	Does NOT use effectively or is not a related activity	= _____
Design	Strong selection of an appropriate simulation type for the context • Virtual world • Virtual modeling • Experimental sandbox • Reactive branching • Adaptive branching Strong evaluation of design risks to optimize the simulation Strong use of evidence-based principles to design the simulation	Some selection of an appropriate simulation type for the context • Virtual world • Virtual modeling • Experimental sandbox • Reactive branching • Adaptive branching Some evaluation of design risks to optimize the simulation Some use of evidence-based principles to design the simulation	Poor selection of an appropriate simulation type for the context • Virtual world • Virtual modeling • Experimental sandbox • Reactive branching • Adaptive branching Poor evaluation of design risks to optimize the simulation Poor use of evidence-based principles to design the simulation	Does NOT use effectively or is not a related activity	= _____
Assessment	Strong application of assessment within the simulation environment Strong evidence of value-added validity beyond traditional assessments Strong use of both product and process data for assessment and feedback	Some application of assessment within the simulation environment Some evidence of value-added validity beyond traditional assessments Some use of both product and process data for assessment and feedback	Poor application of assessment within the simulation environment Poor evidence of value-added validity beyond traditional assessments Poor use of both product and process data for assessment and feedback	Does NOT use effectively or is not a related activity	= _____

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