Methodological Considerations in Simulation Research: Constructing Rigorous Investigations to Advance Practice

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April 9, 2016
STTI/NLN Nursing Education Research Conference
Disclosures

• Kim Leighton, Greg Gilbert, and Mary Ann Cantrell have no disclosures or conflicts of interest to declare

• Ashley Franklin has active research funding from Texas Higher Education Coordinating Board and National League for Nursing (unrelated)
Learning Objectives

At the completion of this presentation the learner will be able to:

1. describe the foundational elements in developing the conceptual basis of simulation-based study with an emphasis on theoretical frameworks
2. identify strategies to maintain intervention fidelity in simulation-based research studies
3. discuss measurement rigor in simulation-based research studies
4. acknowledge the importance of using published standards of best practices in developing a simulation-based research study
State of the Science in Simulation Research

• Simulation research has moved beyond studies examining learner satisfaction, self-confidence and self-efficacy.

• The current state of the science in simulation-based research calls for intervention studies that examine skill development and skill transfer from simulation to actual patient care settings to support positive health outcomes in patients.
## Developing the Conceptual Basis of a Study

1. **An Idea for a Study is Identified**

2. **The Research Team Brainstorms about the Problem’s Dimensions**

3. **A Literature Review is Conducted**

4. **Concepts are Identified from Research Findings**

5. **A Theoretical Framework that describes the Relationships among These Variables is Chosen**

6. **Research Questions (based on the Theoretical Framework) are developed**
Theoretical Framework:
Definition/Role In The Research Process

A set of interrelated concepts that symbolically represent and convey a mental image of a phenomenon (Alligood, 2013).
Theoretical Framework: Definition/Role In The Research Process

- Guides the conceptual basis for study
- Describes how variables relate to one another
- Provides a rationale for predictions about the relationships among the study variables [predictors and outcome variables]
Theoretical Framework: Definition/Role In The Research Process

• Informs the development of the intervention [simulation exposure]
• Explains how concepts of interest/dependent variables are measured
• Guides the data analysis plan
• Contextualizes the results
Common Theoretical Frameworks: NLN/Jeffries Simulation Theory

- Learner and Facilitator Factors
- Educational Practices
- Design Characteristics and Simulation (Intervention)
- Outcomes
Other Commonly Used Theoretical Frameworks

- Clinical Simulation Practice
- Kolb’s Experiential Learning theory
- Deliberate practice, Mastery Learning Theory
- Benner’s Novice to Expert
- Piaget’s Constructivist Theory
- Cognitive Load Theory
- Social Cognitive Theory
- Debriefing for Meaningful Learning
- Debriefing with Good Judgment
- Tanner’s Clinical Judgment Model
- Lasater’s Clinical Judgement Model
Methodological Challenges in Simulation Research
Sample Size

• Dependent on:
  • $\alpha$ level
  • Effect size
  • Power
  • Variability

• 10—20 observations per variable (Harrell 2001)
• “Just enough”
• Effect size of $>1$ acceptable for educational studies (Cohen 1988)
• $\alpha=.10$ is “good enough” for educational research (Welke et al. 2009)
Statistical Methodology

• Calculate prior to undertaking study; *never* calculate post-hoc

• **Do not use** Microsoft® Excel or other spreadsheet software for statistical calculations (Granville 2012; Microsoft® Corporation 2013; Pottel 2000)

• Make sure to assess and test for normality

• Don’t use the “n>30” rule (Hesterberg 2008)

• Consider using nonparametric statistics

• Use statistical software such as: GENOVA, R, SAS, SPSS, Stata, Systat
Psychometrics

- Validity – an item is valid if it measures what it is intended to measure (Carmines & Zeller 1979)
- Reliability – the extent to which results of an instrument yield consistent results (Elasy & Gaddy 1998)
- Do not create your own instrument
- Instruments (checklists, surveys, etc...) are NOT valid/reliable – they do/do not produce data that are reliable

- “Unidimensional” reliability
- “Multidimensional” reliability (G theory)
Summary
Measurement Instruments: Experience

- The Simulation Effectiveness Tool - Modified (SET-M)
  - Prebriefing, Confidence, Learning, Debriefing

- The Creighton Competency Evaluation Instrument (C-CEI™)
  - Assessment, Communication, Critical Thinking, and Technical Skills

- The Sweeney-Clark Simulation Performance Evaluation Tool
  - Assessment, History Taking, Patient Teaching, Lab/Dx, Nursing Interventions, Clinical Judgment, Communication & Safety

- The Lasater Clinical Judgment Rubric (LCJR®)
  - Noticing, Interpreting, Responding, Reflecting

- The Clinical Simulation Evaluation Tool (CSET)
  - Safety, Assessments & Critical Thinking, Problem Identification & Critical Thinking, Interventions, Evaluations & Critical Thinking, Other Critical Thinking & Processing Components
Other Types of Instruments

- The Clinical Learning Environment Comparison Survey (CLECS)
  - Teaching-Learning Dyad, Holism, Communication, Nursing Process, Self-Efficacy, Critical Thinking

- Indiana University Simulation Integration Rubric (IUSIR) (interprofessional communication); DASH (debriefing)
Intervention Fidelity

- Degree to which an intervention is implemented as originally designed

- In simulation-based research intervention fidelity is maintained by:
  - Have a specific, written, detailed protocol
  - Clear role delineation of research team members
  - Validation of a scenario by content experts; pilot tested with participants similar to the target population
  - Detailed script and cues for each person enacting a scenario
  - Consistent use of props in a scenario
  - Conduct dry run of scenarios
INACSL Standards of Best Practice: Simulation

I. Terminology
II. Professional Integrity of Participants
III. Participant Objectives
IV. Facilitation Methods
V. Simulation Facilitator
VI. The Debriefing Process
VII. Participant Assessment and Evaluation
VIII. Simulation-Enhanced Interprofessional Education (Sim-IPE)
IX. Scenario Design
Summary

- Theoretical foundation is the basis for all decision-making when designing research study.
- Sample size and power analysis are determined BEFORE data collection begins.
- Correct instrument selection is vital.
- Interventional fidelity must be maintained.
- Work toward studies that examine transfer of skills from simulation to practice setting → impact patient outcomes.
Questions?

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