Types of Educational Research

Corrie M. Yablon, M.D.
Department of Radiology
University of Michigan
Outline

• Background
• Planning your research project
• Types of educational research
• Summary
Why Do Medical Education Research?

- Deepen our knowledge of learning, teaching and education
- Not just to solve local concrete problems
Background

- Educational research not well funded
- JAMA study calculated 75% studies self-funded
- Less than 0.04% of federal spending on graduate medical education is used on education research
- Most common reason for manuscript rejection:
  - Description of curriculum or intervention without outcome or evaluation data

Reed DA, Costs and funding for published medical education research. JAMA. 2005; 294: 1052-1057
Problems with MER

- Many studies performed after the fact
- Retrospectively look for relationship among variables
- Focus has been learner oriented
  - Need to shift to patient-oriented outcomes

Gruppen LD, Improving Medical Education Research. Teaching and Learning in Medicine, 19(4), 331-335
Problems

• Overreliance on pretest
• Single-group pretest–posttest studies
• Multifactorial interventions
• Failure to explicitly define the interventions

Challenge

- Randomized controlled studies (RCT’s) usual gold standard of medical research
  - Most studies are observational cross sectional survey design
- MER deals with knowledge, behavior, skills, attitudes
  - Cross-over into social science
  - Difficult to apply RCT methods
  - Creates a barrier to funding
Planning Ahead

• Not enough to just show that learners learn
  – Will the intervention change a behavior or attitude?
  – Will the intervention change patient care?

• Project must be evidence based

• Show outcome from the intervention

• Outcomes help to get funding
Planning Your Project

- Refine the study question
- Create a conceptual or theoretical framework
- Choose a study design
- Select outcomes
Refine the Study Question

- Ask an important question
- Will this study yield a practice changing result?
- Establish clear goals
- Form the hypothesis first
- Is your expected outcome interesting?
- Is the project really worth doing?
Do a Thorough Literature Review

• Has this topic been written about before?
• Literature review defines the conceptual framework which determines the research method to be used
• Discuss this in the introduction of the manuscript or the grant proposal
Conceptual Framework

- A theoretical roadmap for your project
- Unifies the paper
- Connects your purpose, literature review, methodology, data collection, and analysis
- Places the research question within the appropriate context
- Forms the basis for the hypothesis
Select a Research Study Design

Research

Qualitative – how, what, why
- Field work
  - Case Studies
  - Narratives
  - Surveys

Quantitative – numerical data, generalizable
- Experimental
  - Randomized controlled trials
- Observational
  - Cohort
  - Case control
  - Surveys
  - Reviews
Explorative studies

- **Descriptive studies**
  - Don’t usually qualify as research
  - “Show and tell” description of a curriculum

- **Qualitative studies**
  - Use language based data, surveys
  - Interested in “what, how, and why” of phenomena
  - Focuses on social, individual
  - Can be complementary to quantitative
  - i.e. “What are current resident attitudes to the ABR restructuring of the boards?”
Qualitative Research

• Grounded in social science, humanities, education, history
• Useful for theory building
• Deals with complex social questions and how they relate to health care
  – Social interactions
  – Emotional phenomena
  – How decisions are made
  – Assesses beliefs
  – Reflections on experience
Types of Qualitative Research

• “Field work” –
  – studying and observing local sub-culture
  – i.e. operating room or clinics
  – Analysis of observations, interviews

• “Grounded Theory”
  – Explore social phenomena by developing explanations derived from the practical experience of study participants
  – i.e. Ginsburg’s study in developing a behavioral theory of professionalism
Types of Qualitative Research

• Case Study:
  – Analysis of a particular system, phenomenon, group, or activity to gain understanding of a larger process
  – Use multiple data sources to understand the entity from multiple perspectives
Types of Qualitative Research

- Phenomenology
  - Attempt to understand the nature of an experience or social phenomenon from the perspective of those who have lived it
Qualitative Research

• Narrative research
  – Arises from practice of storytelling as a means of organizing and interpreting human experience
  – Analyzes personal accounts for meaning, context, as way of understanding an experience or situation
Qualitative Research Approaches

- Interviews
- Focus groups/group discussion
- Observation
- Review of documents
Quantitative Research

• Experimental Studies
  – Seek to provide justification
  – Seek evidence of the effects of an intervention
  – Randomized controlled studies

• Observational studies
  – Cohort studies
  – Case-control studies
  – Associational studies
Randomized Controlled Trial

• Usually considered the gold standard in biomedical research

• RCT examines whether an intervention works under circumstances that are controlled and standardized

• Random assignment of one subject or group to an intervention and another group to a non-intervention

• Minimizes the chances that there will be confounding variables between the two groups
RCT

- Only controls for threats to internal validity from selection bias and changes to participants over time
- Does not control for threats by:
  - Location
  - Attitude
  - Implementation
- RCT’s are not appropriate for all types of MER
RCT - Challenges

- In an RCT, comparison between intervention/non-intervention flawed
- Intervention group will outperform a non-intervention group on a posttest
- Baseline measurement can influence the posttest result through test-enhanced learning
- If same posttest is used, learners will remember the test
RCT- Challenges

- Time – if posttest timed too close to intervention, does not test true learning or retention of knowledge or application of knowledge
- True randomization is difficult to accomplish in med ed
- Non-randomized = “quasi-experimental” studies
RCT – Challenges

• May be difficult to administer different treatments for experimental and control group
• Learners may have opinions about benefits of the proposed intervention
• May be difficult to recruit enough subjects
• Homogenous populations may not translate to more general groups in educational practice
Types of Pretest Posttest Designs

- Randomized Pretest Posttest
- Randomized Posttest Only
- Single Group Pretest Posttest
Pretest Posttest Design

• Pretest-posttest, randomized design
  – Participants randomized to 2 or more conditions
  – Take a pretest
  – Undergo an intervention
  – Take a posttest
  – Typically held as a gold standard in MER
Randomized Posttest Only

• Stronger design, preferred
• Pretest not necessary to ensure that randomized groups are equivalent at baseline
Single Group Pretest Posttest

- Participants act as their own control group
- Frequent in MER
- If there is no control group, there are many threats to validity:
  - History, maturation, testing, instrumentation, regression, location, attitude
  - Difficult to draw inferences from research using this design
Problems With Pretest Posttest Design

- Pretest affects performance on an identical posttest
  - Subjects familiar with the questions
  - May influence learning during the intervention, i.e. study for the test
  - A different posttest may have a different level of difficulty
  - Pretests don’t adequately correct for baseline differences between study participants
  - Pretests and posttests introduce measurement error twice
Pretest May Be Useful When:

- The sample size is small <40
- There is a high dropout rate
- Pretest is an integral part of the intervention
- There is a nonrandomized design
Observational Studies

- Cohort
- Case Control
- Associational
- Use naturally existing groups of people rather than randomly selected samples
  - i.e. residency classes
Cohort Study

- Observational study
- Outcomes of subjects with and without an exposure (or intervention) are compared
- Study begins with the predictor variable – i.e. the exposure or intervention
- What effect does the exposure have on the outcome?
Cohort Study

- Subjects not randomized
- Subjects are members of a cohort as a result of processes beyond the experimenter’s control, i.e. 2 residency classes
- Can be prospective or retrospective
- Frequently performed in medical education
- Example:
  - i.e. comparison of problem-based learning vs. lecture based curricula
Case Control Study

• Observational study
• Subjects are selected on the basis of their outcomes
• “Cases” are the ones with the outcome being studied
  – i.e. start with learners who failed an examination or med students who chose radiology as a career and work backwards to assess the factors leading up to the outcome
• “Controls” are selected who did not have the outcome
Case Control Study

- Useful where outcome is binary (yes/no)
- Prevalence of outcome is low
- Time delay until outcome occurs is long
- Usually retrospective
- Efficient way to link educational interventions to patient outcomes
Observational Studies: Challenge

• Can’t control for bias due to confounding variables
• Need to consult a statistician early in the planning stages of the study
• Observed associations can’t be interpreted as causal but can direct future investigations using a RCT or other controlled study
Correlational Studies

• Much medical education derived from survey questionnaires
• Search for relationship among variables
• Crossover between quantitative and qualitative methods
Surveys/ Instruments

• Useful for analyzing knowledge, skills, behavior, attitudes, emotion, intention
• To develop an instrument, you need to define what is to be studied, how it is to be measured
• Define your subject population
• Requires a literature search
• Create a theoretical underpinning
• What other instruments exist?
  – Are they valid and reliable?

Define the Content to be Measured

- There may not be much in the literature about the topic you want to study
- You may have to do a preliminary study first
- Qualitative study
- Needs assessment
- Focus group
- Interviews
Pilot Testing

- Test drive the survey
- Send survey to a test group
- Get feedback
- See if they think the survey is organized
- Is the survey too long?
- Do they understand the questions?
- Are the responses in keeping with the questions?
- Make appropriate modifications

Implement the Instrument

• Answers will be converted to numerical form and analyzed
• What kind of statistical analysis will you use?
• Nominal scale
  – Yes/no questions (yes=1, no=0)
• Interval scale
  – Answers are ranked
  – Distances between scale points are equal
  – Likert scale
Some Survey Writing Tips

• How will you maximize your response rate?
  – Goal >60% for mail and internet

• Simplify

• Organize questions into themes

• Place demographics and controversial items at the end – you want the respondents to complete the survey!

• Ask one question at a time
  – Avoid double barreled questions
Survey Tips

• Try to eliminate leading questions, assumptions and bias in question writing
• Avoid double negatives
• Make survey visually attractive
• Remember, respondents are not that motivated – you need to incentivize them
• Keep it short – less than 5 minutes is best
Survey Introductory Paragraph

- Sponsors of the study
- Purpose of the study, types of questions to be asked
- How was the respondent chosen for this study?
- Is there an “opt out” option?
- How long will this take?
- Are the answers confidential? Will the respondent’s identity be kept confidential?
- How will this data be used? Will it be published?
Reviews

• Scholarly reviews are valuable
• Synthesize available evidence
• Refine understanding of a problem and the implications of literature for application to practice
Systematic Reviews

- Systematic search for all relevant literature pertaining to research topic
- Systematic selection of articles of quality
- Systematic summary with statistical methods to best estimate the effect in question
Meta-Analyses

- Combine effect sizes from each article reviewed
- Weight each article by sample size
- Arrive at average effect size
- Difficult to do due to heterogeneity of study designs, interventions, outcome measures
Critical Reviews

• Present a critical synthesis of the literature
• Identify what is well established
• Identify what is not well understood
• Identify what needs to be better understood
• Present a new perspective
Take Home Points

• Careful attention to study design in the planning stages will ensure success
• Define the intervention, research method and the outcome clearly at the outset
• More success in publications and grants if outcome results in change in behavior or patient care