



# Evaluation for Formal and Informal Nanoscience Curricula and Activities

Frances Lawrenz  
University of Minnesota



Evaluation is the process of delineating, obtaining and providing useful information for judging decision alternatives

Evaluation is determining merit and worth



# Delineation

- Decide on the evaluation questions.
- Define the domain of content, that is, the information that is needed.
- Determine the source for that information.
- Decide on the appropriate method(s) to gather that information.
- Develop the details for the gathering, e.g., cover letters, dates, personnel required, who to questions, etc.



# Models for Evaluation

- Management oriented-Stufflebeam
- Consumer Oriented-Scriven, Quality Control
- Expertise Oriented-Eisner
- Naturalistic, Participant Oriented-Fetterman, Stake, Responsive
- Appreciative inquiry: Preskill; Cooperrider & Srivastva
- Educative Values Engaged-Greene (House, Deliberative Democratic)



# Logic Model/Theory of Action to Prepare for Evaluation

- Why should your project produce your expected outcomes
- Theoretical and actual contingencies
- Inputs
- Processes / Activities
- Outputs / Intermediate Outcomes
- Outcomes



# Obtain and Provide Useful Information

- Working with an evaluator
- Data collection designs
  - RCTs and positivistic evaluation methods
  - Interpretive evaluation methods
  - Mixed evaluation methods
- Evaluation Strategies
- Assessing student outcomes
- Evaluation as a scientific endeavor



# RCT's and Post Positivistic Evaluation

- ACC and PART
- RCTs can determine 'causality' (select from entire population)
- Regression discontinuity designs
- Advanced regression techniques (structural eqn modeling, path analyses, etc.)
- Quasi-experimental, ANCOVA propensity scores
- Threats to internal and external validity—especially selection bias



# Interpretive Methods

- Well grounded rich descriptions and explanations of processes in identifiable local contexts
- Preservation of chronological and natural flow: see which events led to which consequences and derive fruitful explanations
- Flexible data collection and analysis
- More likely to lead to serendipitous findings and new integrations
- Have a quality of “undeniability” a concrete meaningful flavor that can be more convincing



# Analogies for Mixed Methods

- Panzers are strong, push their way through, don't care what's in the way, can overcome any obstacle, have a predefined purpose
- Pansys are soft, have different meanings to different observers, are sensitive to their environment, present themselves for others to make sense of them
- Oil (smooth, take the heat) and Vinegar (spicy, heightens awareness) both needed for salad



# Evaluation Strategies

- Delivery of PD
- Effects on educators
- Effects on learning settings
- Effects on students
- Other effects
- Observations
- Participant observer
- Participant opinion
- Pre-post testing
- Discourse analysis
- Phenomenological studies
- Classroom observations
- Student or teacher opinion
- Ethnographies
- Student achievement
- Case studies
- Policy analysis
- Networking studies



# Assessing Student Outcomes

- **Attitudes/Motivation**
  - attitude scales; beliefs about science or math
  - interviews
  - perceptions of future behavior (take more math, become a scientist)
- **Behaviors**
  - observations
  - behavioral surveys
  - record tracking, e.g., course taking, attendance, viewing time
- **Achievement**
  - different formats: multiple choice, essay, hands-on/performance, complex problem solving/experiments
  - different cognitive levels
  - different situations



# Evaluation as a Scientific Endeavor

- Pose significant questions that can be investigated empirically
- Link research to relevant theory
- Use methods that permit direct investigation of the questions
- Provide a coherent and explicit chain of reasoning
- Yield findings that replicate and generalize across studies, and
- Disclose research data and methods to enable and encourage professional scrutiny and critique (Feuer, Towne and Shavelson, 2002).