Evaluation of Education Development Projects

Russ Pimmel
National Science Foundation

AASCU
Feb 27, 2010

Caution

The information in these slides represents the opinions of the individual program directors and not an official NSF position.

Framework for the Session

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- Learning situations involve prior knowledge
  - Some knowledge correct
  - Some knowledge incorrect
    - misconceptions
- Learning is
  - Connecting new knowledge to prior knowledge
  - Correcting misconception
- Learning requires
  - Recalling prior knowledge – actively
  - Altering prior knowledge

Active-Cooperative Learning

- Learning activities must encourage learners to:
  - Recall prior knowledge -- actively, explicitly
  - Connect new concepts to existing ones
  - Challenge and alter misconception
- The think-share-report-learn (*TSRL*) process addresses these steps

Session Goals

The session will enable you to collaborate more effectively with evaluation experts in preparing effective project evaluation plans

It will not make you an evaluation expert

Session Outcomes

After the session, participants should be able to:

- Discuss the importance of goals, outcomes, and questions in evaluation process
  - Cognitive, affective, and achievement outcomes
- Describe several types of evaluation tools
  - Advantages, limitations, and appropriateness
- Discuss data interpretation issues
  - Variability, alternate explanations
- Develop an evaluation plan with an evaluator
  - Outline a first draft of an evaluation plan

Evaluation and Assessment

- Evaluation (assessment) has many meanings
  - Individual's performance (grading)
  - Program's effectiveness (ABET accreditation)
  - Project's progress or success (monitoring and validating)
- Session addresses project evaluation
  - May involve evaluating individual and group performance – but in the context of the project
- Project evaluation
  - Formative – monitoring progress
  - Summative – characterizing final accomplishments

Evaluation and Project Goals/Outcomes/Questions

Evaluation and Project Goals/Outcomes

- Evaluation starts with carefully defined project goals/outcomes
- Goals/outcomes related to:
  - Project management
    - Initiating or completing an activity
    - Finishing a "product"
  - Student behavior
    - Modifying a learning outcome
    - Modifying an attitude or a perception

Goals & Outcomes

- Goals provide overarching statements of project intention
  - *What is your overall ambition?*
  - *What do you hope to achieve?*
- Expected outcomes identify specific observable results for each goal
  - *How will achieving your "intention" reflect changes in student behavior?*
  - *How will it change their learning? Their attitudes? Their successes? Their diversity?*

Goals – Objectives – Outcomes -- Questions

- Converting goals to outcomes may involve intermediate steps
  - Intermediate steps frequently called ***objectives***
    - More specific, more measurable than goals
    - Less specific, less measurable than outcomes
- Outcomes (goals) lead to questions
  - These form the basis of the evaluation
  - Evaluation process collects and interprets data to answer evaluation questions

Definition of Goals, Objectives, and Outcomes

Goal **– Broad, overarching statement of intention or ambition**
- A goal typically leads to several objectives

Objective **– Specific statement of intention**
- More focused and specific than goal
- A objective may lead to one or more outcomes

Outcome **– Statement of expected result**
- Measurable with criteria for success

NOTE: No consistent definition of these terms

Exercise #1: Identification of Goals/Outcomes

- **Read the abstract**
  - Note - Goal statement removed
- **Suggest two plausible goals**
  - One focused on a change in learning
  - One focused on a change in some other aspect of student behavior

Abstract

The goal of the project is …… The project is developing computer-based instructional modules for statics and mechanics of materials. The project uses 3D rendering and animation software, in which the user manipulates virtual 3D objects in much the same manner as they would physical objects. Tools being developed enable instructors to realistically include external forces and internal reactions on 3D objects as topics are being explained during lectures. Exercises are being developed for students to be able to communicate with peers and instructors through real-time voice and text interactions. The project is being evaluated by … The project is being disseminated through … The broader impacts of the project are …

Substitute
"organic chemistry" for "statics and mechanics of materials"
"Interactions" for "external forces and internal reactions"

PD's Response -- Goals

- **Goals may focus on**
  - Cognitive behavior
  - Affective behavior
  - Success rates
  - Diversity
    - Cognitive, affective or success in targeted subgroups

PD's Response – Goals on Cognitive Behavior

GOAL**: To improve understanding of**
- Concepts & application in course
  - Solve textbook problems
  - Draw free-body diagrams for textbook problems
  - Describe verbally the effect of external forces on a solid object
- Concepts & application beyond course
  - Solve out-of-context problems
  - Visualize 3-D problems
  - Communicate technical problems orally

PD's Response – Goals on Affective Behavior

GOAL**: To improve**
- Interest in the course
- Attitude about
  - Profession
  - Curriculum
  - Department
- Self- confidence
- Intellectual development

PD's Response – Goals on Success Rates

- **Goals on achievement rate changes**
  - **Improve**
    - **Recruitment rates**
    - **Retention or persistence rates**
    - **Graduation rates**

PD's Response – Goals on Diversity

***GOAL:* To increase a target group's**

- **Understanding of concepts**
- **Achievement rate**
- **Attitude about profession**
- **Self-confidence**

- ***"Broaden the participation of underrepresented groups"***

Exercise #2: Transforming Goals into Outcomes

Exercise #3: Transforming Outcomes into Evaluation Questions

Tools for Evaluating Learning Outcomes

Examples of Tools for Evaluating Learning Outcomes

- **Surveys**
  - **Forced choice or open-ended responses**
- **Interviews**
  - **Structured (fixed questions) or in-depth (free flowing)**
- **Focus groups**
  - **Like interviews but with group interaction**
- **Observations**
  - **Actually monitor and evaluate behavior**

Olds et al, *JEE* 94:13, 2005
NSF's Evaluation Handbook

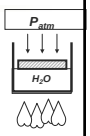
Concept Inventories (CIs)

Introduction to CIs

- **Measures** conceptual understanding
- **Series of multiple choice questions**
  - **Questions involve** single concept
    - **Formulas, calculations, or problem solving not required**
  - **Possible answers include "*detractors*"**
    - **Common errors**
    - **Reflect common "*misconceptions*"**

Sample CI Questions

H_2O is heated in a sealed, frictionless, piston- cylinder arrangement, where the piston mass and the atmospheric pressure above the piston remain constant. Select the best answers.



The density of the H_2O will:

(a) Increase (b) Remain constant (c) Decrease

Exercise #4: Evaluating a CI Tool

- **Suppose you where considering an existing CI for use in your project's evaluation**
- **What questions would you consider in deciding if the tool is appropriate?**

PD's Response -- Evaluating a CI Tool

- **Nature of the tool**
  - **Is the tool relevant to what was taught?**
  - **Is the tool competency based?**
  - **Is the tool conceptual or procedural?**
- **Prior validation of the tool**
  - **Has the tool been tested?**
  - **Is there information or reliability and validity?**
  - **Has it been compared to other tools?**
  - **Is it sensitive? Does it discriminate novice and expert?**
- **Experience of others with the tool**
  - **Has the tool been used by others besides the developer? At other sites? With other populations?**
  - **Is there normative data?**

Tools for Evaluating Affective Factors

Exercise #5: Tools for Affective Outcome

Interpreting Evaluation Data

Exercise #7: Alternate Explanation For Change

- Data suggests that the understanding of Concept #2 increased
- One interpretation is that the intervention caused the change
- List some alternative explanations
  - Confounding factors
  - Other factors that could explain the change

Interpreting Evaluation Data

Quest	No. of Students		Percent with Correct Answer	
	Pre	Post	Pre	Post
1	25	30	29%	23%
2	24	32	34%	65%
3	25	31	74%	85%
-	-	-	-	-

PD's Response -- Alternate Explanation For Change

- Students learned concept out of class (e. g., in another course or in study groups with students not in the course)
- Students answered with what the instructor wanted rather than what they believed or "knew"
- An external event (big test in previous period or a "bad-hair day") distorted pretest data
- Instrument was unreliable
- Other changes in course and not the intervention caused improvement
- Students not representative groups

Exercise #8: Alternate Explanation for Lack of Change

Evaluation Plan

Exercise #9: Evaluation Plan

- Suppose that a project's goals are to improve:
  1. The students' understanding of the concepts in statics
  2. The students' attitude about engineering as a career
- List the topics that you would address in the evaluation plan

Evaluation Plan -- PD's Responses

- Name & qualifications of the evaluation expert
- Goals and outcomes and evaluation questions
- Tools & protocols for evaluating each outcome
- Analysis & interpretation procedures
- Confounding factors & approaches for minimizing their impact
- Formative evaluation techniques for monitoring and improving the project as it evolves
- Summative evaluation techniques for characterizing the accomplishments of the completed project.

Other Sources

- Workshop on Evaluation of Educational Development Projects
  - http://www.nsf.gov/events/event_summ.jsp?cntn_id=108142&org=NSF
- *NSF's User Friendly Handbook for Project Evaluation*
  - http://www.nsf.gov/pubs/2002/nsf02057/start.htm
- Online Evaluation Resource Library (OERL)
  - http://oerl.sri.com/
- Field-Tested Learning Assessment Guide (FLAG)
  - http://www.wcer.wisc.edu/archive/cl1/flag/default.asp
- Science education literature

Question