Project Evaluation

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Workshop Goals and Outcomes

Goal: **The workshop will enable you to collaborate with evaluation experts in preparing effective project evaluation plans**

Workshop Goals and Outcomes

- ***Outcomes :*** **Participants should be able to:**
  - **Describe several types of evaluation tools**
  - **Discuss some advantages and limitations of them**
  - **Define questions about the appropriateness of a tool in given situation**
  - **Outline a first draft of an evaluation plan**
  - **Work with an evaluator to develop a complete evaluation plan**

Framework for the Workshop

- **Learning situations involve prior knowledge**
  - **Some knowledge correct**
  - **Some knowledge incorrect (i. e., 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

Workshop Format

- "Working" Workshop
  - Short presentations (mini-lectures)
  - Group exercise
- Exercise Format
  - *Think → Share → Report → Learn*
    - *(TSRL)*
- Limited Time -- Feel rushed
  - Intend to identify issues & suggest ideas
    - Get you started
    - No closure -- No "answers" – No "formulas"

Workshop Outline

- The workshop will address the following topics:
  - Project goals, objectives, and outcomes
  - Tools for evaluating learning outcomes
  - Tools for evaluating non learning behavioral outcomes
  - Project evaluation plans
  - Working with an evaluator

Evaluation and Assessment

- Evaluation and assessment have many meaning
  - Evaluating an individual's performance (i. e., grading)
  - Evaluating a program's effectiveness (i. e., ABET assessment)
  - Evaluating project's progress and implementation (i e., formative evaluation as part of project management)
  - Evaluating a project's success (i e., summative evaluation)
- Workshop concerned with project evaluation
  - May involve evaluating individual and group performance – but in the context of the project

Project Goals, Objectives, and Outcomes

Goals, Objectives, and Outcomes

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

Project Goals, Objectives, and Outcomes

- Evaluation starts with carefully defined project goals, objectives, and outcomes
- Goals objectives, and outcomes take many forms
  - Some related to project management
    - Completing
      - Products (e.g., laboratory write-ups)
      - Milestones in a process (e.g., presenting a paper at a conference
    - Implementing activities
  - Some related to student behavior
    - Achieving a learning outcome
    - Modifying an attitude or a perception

Identification of Goals and Objectives: Exercise (1)

Read the abstract and come up with several goals for the project. Include both learning and non-learning goals.

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. Educational research includes detailed exploration of learning and instructional design variables to provide insights into basic cognitive and educational issues that underlie learning using innovative software for a diverse population of students. The material is being beta tested at multiple institutions including community colleges. The project is being evaluated by …….. The project is being disseminated through …….

PD's Response

- Increase student understanding of statics and strength of materials through animated, web-based 3D objects
- Increase student ability to visualize external forces and internal reactions in web-based 3D objects
- Improve student communication through real time voice and text interactions
- Broaden participation of underrepresented groups
- Understand how the use of learner-centered instruction affects students with different learning styles

Identification of Goals and Objectives: Exercise (2)

Write several objectives for this goal:

"Broaden participation of underrepresented groups"

PD's Response

- Create lab exercises with clear social context to possibly increase female students' interest
- Provide better retention of minority students
  - Tutoring, mentoring, etc.
- Increase African American students' participation in laboratory groups

Tools for Evaluating Learning Outcomes

Tools for Evaluating Learning Outcomes

- Surveys (forced choice or open-ended responses)
- Interviews and focus groups
- Conversational analysis
- Observations
- Ethnographies
- Meta-analysis

Olds et al, *JEE* 94:13, 2005

Comparison of Two Tools

- Survey
  - Efficient
  - Accuracy depends on subjects honesty
  - Difficult to develop reliable and valid survey
  - Low response rate threatens reliability and validity
- Observations
  - Useful for observable behavior
  - Useful for capturing behavior that subjects unlikely to report
  - Interrater reliability must be established
  - Time and labor intensive

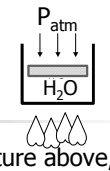
Olds et al, *JEE* 94:13, 2005

Concept inventories (CIs)

Introduction to CIs

- **Force Concept Inventory (FCI)**
  (*The Physics Teacher* 30:141, 1992)
- **Diagnostic test**
- **Measures students' conceptual understanding**
  - **Strongly influenced by their beliefs, intuition, and "common sense"**
  - **Many misconception from prior knowledge**
    - **Difficult to change**

Sample Questions



- The questions pertain to the picture above, which depicts H_2O being heated in a sealed, frictionless, piston-and cylinder arrangement, where the piston mass and the atmospheric pressure above the piston remain constant.
- The *density* of the H_2O will: (a) Increase (b) Remain constant (c) Decrease.
- The *pressure* of the H_2O will: (a) Increase (b) Remain constant (c) Decrease.
- The *energy* of the H_2O will: (a) Increase (b) Remain constant (c) Decrease.

From Thermodynamics Concept Inventory: Midkiff, Litzinger, and Evans, http://www.foundationcoalition.org/

Introduction to CIs

- Series of multiple choice questions
  - Items involving single concept
    - Do not require use of formulas, calculations, or solving problems
  - Answers include "detractors" reflecting common misconceptions
- Use of FCI has changed how physics is taught

  (Mazur, *Optics and Photonics News* 3:38, 1992)

Other Concept Inventories

- Concept inventories developed for:
  - Chemistry
  - Statistics
  - Strength of materials
  - Thermodynamics
  - Heat transfer
  - Fluid mechanics
  - Circuits
  - Signal and systems
  - Electromagnetic waves

Richardson, in *Invention and Impact*, AAAS, 2004

Tools for Evaluating CI: Exercise (3)

- What questions would you use decide if a specific CI was appropriate for your evaluation?

PD's Response

- Is it competency based?
- Is the tool relevant to what was taught?
- Is it conceptual or procedural?
- What is the tool's development stage?
- Is the tool tested? Reliable? Validated?
- Has it been compared to other measures? Other tools?
- Is it sensitive? Does it discriminate novice and expert or pre and post?
- Has it been used by others beside the developer? At other sites? With other populations?
- Is there normative data?

Concept Inventories: Exercise (4)

- Consider the hypothetical CI data.
  - What observations can you make from this data?
  - What inferences would you draw from those observations?

Hypothetical CI Data

Q \ S	PRE						POST					
	1	2	3	--	50	T	1	2	3	--	50	T
1		c		--		4	c			--	c	8
2	c	c		--	c	23	c	c		--	c	30
3		c	c	--		15	c			--	c	11
:	:	:	:	:	:	:	:	:	:	:	:	:
20	c			--		8	c	c	c	--	c	42
T	9	18	6	--	12		14	12	17	--	12	

- Pre and Post scores for 50 students (S1 to S50) on 20 questions (Q1 to Q20). All 50 students answered every question.
- A blank indicate incorrect answer and a "c" indicates correct answer.
- "T" indicates the total correct answers.

Hypothetical CI Data

S / Q	PRE						POST					
	1	2	3	--	50	T	1	2	3	--	50	T
1		c		--		4	c			--	c	8
2	c	c		--	c	23	c	c		--	c	30
3		c	c	--		15	c			--	c	11
:	:	:	:	:	:	:	:	:	:	:	:	:
20	c			--		8	c	c	c	--	c	42
T	9	18	6	--	12		14	12	17	--	12	

Use the concept inventory method to interpret question 3. The data suggests:

a. This was an easy concept
b. This was a difficult concept
c. The intervention had an effect
d. The intervention did not have an effect

Tools for Evaluating Learning: Exercise (5)

- **These observations could be attributed to changes in learning or some other factor.**
- **What are some alternative explanations?**

PD's response

- Students learned concept out of class such as in the dorm study sessions.
- The students answered what the instructor wanted rather than what they knew.
- This may not be a representative group of students.
- The students had a bad hair day or didn't care about performance.
- The instrument was not sensitive.
- Implementation of the intervention was poor.

Tools for Evaluating Non-learning Outcomes

Improved Non-Learning Outcomes

- Attitudes toward learning
- Perceptions about the profession, the department, working in teams
- Motivation for learning
- Self-efficacy, confidence
- Learning styles
- Intellectual development
- Ethical behavior

Tools for Evaluating Non-Learning Outcomes

- Perception of engineering
- Beliefs about own abilities
- Communication capabilities
- Ability to engage in design activities
- Adaptive expertise
- Intellectual development

Turns et al, *JEE* 94:27, 2005

Evaluating Student Characteristics

- Learning styles
  - Student
    - Preferentially focus on different types of information
    - Tend to operate on perceived information in different ways
  - Tools
    - Meyers-Briggs Type Indicator (MBTI)
    - Learning Style Indicator (LSI)
    - Index of Learning Styles (ILS)

Felder et al, 94:57, 2005

Tools for Evaluating Student Characteristics

- Approaches to learning:
  - Students use a
    - Surface (memorize)
    - Deep (focus on understanding)
    - Strategic (multiple) approaches
  - Tool
    - Lancaster Approach to Studying Questionnaire (LASQ)

Felder et al, 94:57, 2005

Tools for Evaluating Student Characteristics

- Levels of Intellectual Development
  - Students see knowledge, beliefs, and authorities in different ways (e. g., certain or contextual)
  - Tools
    - Measure of Intellectual Development (MID)
    - Measure of Epistemological Reflection (MER)
    - Learning Environment Preferences (LEP)

Felder et al, 94:57, 2005

Assessment of Attitude - Example

- Besterfield-Sacre et al evaluated students attitudes Developed a survey – select one of five predefined answers
  - Questions about their perception of their abilities
    - Confidence in their skills in chemistry, communications, engineering, etc.
  - Questions about their perception of engineering as a profession
    - Impressions about engineering as a precise science, as a lucrative profession, etc.

JEE 86:37, 1997

Assessment of Attitude - Example

- Survey validated in pilot studies using alternate approaches:
  - Item analysis
  - Verbal protocol elicitation
  - Factor analysis
- Used survey tool to compare students who stayed in engineering to those who left

Evaluation Plan

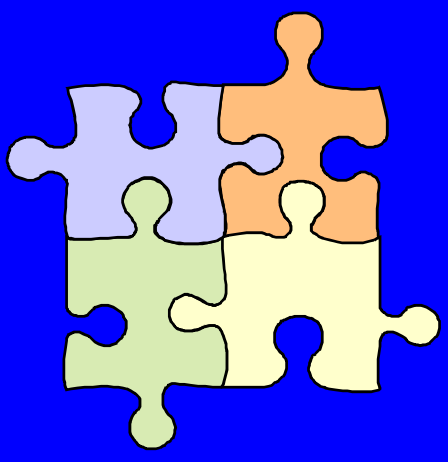
Evaluation Plan: Exercise (6)

- **Every project (proposal) needs an evaluation plan**

How would you go about developing an evaluation plan?

Getting a Start on Project Evaluation:

- What is working?
- For whom is it working?
- Why is it working?
- Under what conditions is it working?



Getting a Start on Project Evaluation

Goals	Objectives	Activities	Outputs/ Outcomes	Measures

The Project

- Goals
- Objectives
- Activities
- Expectations
- Measures/Methods

What do I want to know about my project?

(a)

(b)

(c)

Finding an Evaluator

- Departments of education, educational psychology, psychology, administration, sociology, science education, engineering education
- Campus teaching and learning center
- Colleagues and researchers
- Professional organizations
- Independent consultants
- NSF workshops/outreach
- NSF project and project PIs

Consult other sources

- *User Friendly Handbook for Project Evaluation*
  - http://www.nsf.gov/pubs/2002/nsf02057/start.htm
- **Existing tools**
- **Science education literature**

- What are our purposes for the evaluation?
- What are the benefits for each party?
- Who is responsible for what?
- What are the resources?
- What is known about the project and evaluation?
- What can we add to the knowledge base?
- How can we work together?
- How do we end the relationship?

Summary

- Become knowledgeable.
- Draw on your experience/talk to colleagues.
- Stress usefulness.
- State the purpose.
- Develop a map of the project.
- Find an evaluator.
- Develop questions.
- Document activities.
- Focus on implementation and outcomes.
- List expected benefits.
- Consider possible unanticipated benefits.
- Consider possible unintended negative consequences.
- Develop a team-orientation.
- Assess the relationship.

...What evaluation can do is provide reasonably reliable, reasonably valid information about the merits and results of a particular program or project operating in particular circumstances …

Presentation available at:

http://www.nsf.gov/events/