Handout #1

Goals, Outcomes, and Evaluation Questions

Eileen Lewis & Janis Terpenny
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Janis Terpenny & Keith Sverdrup
April 16, 2013
Lance C. Pérez & Keith Sverdrup
April 18, 2013

Important Notes

- Most of the information presented in this workshop represents the opinion of the IWBW project team and is not an official NSF position.
- Participants may ask questions using the *QUESTION BOX* on the meeting screen.
- Responses will be collected from a few sites at the end of each Group Activity. At the start of the Group Activity, we will identify these sites in the *CHAT BOX* and then call on them one at a time to provide a few of the ideas their group discussed.

Preliminary Comments on Workshop

- More than a set of guidelines on Goals, Expected Outcomes, and Evaluation Questions
- Intended to change the way you think about Goals, Expected Outcomes, and Evaluation Questions.
  - Improve your understanding
  - Help you learn
- Engagement makes learning more effective
  - Good learners are not simply listeners.
- Active, collaborative process to improve learning

Active & Collaborative Learning

- Effective learning activities
  - Recall prior knowledge – actively, explicitly
  - Connect new concepts to existing ones
  - Challenge and alter misconceptions
  - Reflect on new knowledge
- Active & collaborative processes
  - *Think* individually
  - *Share* with partner
  - *Report* to local and virtual groups
  - *Learn* from presenter's response
  - *Learn* from the IWBW team's response

Participant Activities

Two types of activities

- Group Activity ~ 6 min
  - Think individually ~ 2 min
  - Share with a partner ~ 2 min
  - Report in local group ~ 2 min
  - Report to virtual group
    - A few institutions selected
    - Check Chat Box for your Institution's name
- Individual Activity ~ 2 min

IWBW Goals and Expected Outcomes

Goal: Enhance the participants' ability to write goals and the corresponding expected outcomes and evaluation questions for an NSF education project so that they can more effectively address them in preparing proposals or in implementing funded projects.

Expected Outcomes: At the end of the workshop, participants should be able to:

- Critique a set of project goals to determine their strengths and weaknesses and suggest improvements
- Describe the difference between project management goals, cognitive learning goals, and affective learning goals, and write a set of these goals for a given description of a project.
- Write clear specific expected outcomes for given *affective* and *cognitive* goals.
- Write a set of evaluation questions for a given expected outcome and recognize the need to involve an evaluator early in the proposal/project process

Goals and Expected Outcomes

Working Definitions:

- A ***Goal*** is a broad statement about what you hope to achieve or accomplish through the project. What are your intentions or ambitions in conducting the project?
- An ***Expected Outcome*** is a measurable result that is directly related to one or more project goals.

Different Types of Proposal/Project Goals

For TUES, and most educational projects, there are three primary types:

- Management goals
- Cognitive learning goals
- Affective learning goals

What are the differences among these types of goals?

Management Goals

Project personnel successfully complete their assigned responsibilities according to the project timeline

- Creation and testing of materials/activities
- Assessment and evaluation of:
  - Materials/activities developed
  - The overall project

Cognitive Learning Goals

Student/faculty change by acquiring new, or modifying existing:

- Knowledge
- Skills
- Critical thinking
- Synthesis
- Scientific literacy

http://www.nwlink.com/~donclark/hrd/bloom.html

Affective Learning Goals

- Change the student's attitudes
- Skills in the affective domain describe the way people react emotionally. Affective goals typically target awareness and growth attitudes, emotion, and feelings.
- Commonly used terms related to "affect" include:
  - Emotion
  - Motivation
  - Attention
  - Reward
  - Frustration
  - Confidence

http://www.nwlink.com/~donclark/hrd/bloom.html

Group Activity: Project Goals

Read the brief project summary provided on the pre-workshop handout.

- What are the project goals? What type are they?
- List the strengths and weaknesses of one these goals.
  - Think individually ~ 2 min
  - Share with a partner ~ 2 min
  - Report in a local group ~ 2 min

Handout #2

Response: Project Goals

This project will *create* a unique set of virtual reality (VR) experiments that can be used in lower division major's chemistry classes. (Management Goal)

Weakness: The VR experiments will only be used in major's classes. The project would have broader impact if it included non-majors classes as well.

Strength: Innovative and could allow broader range of experiments in courses. Reducing the cost of experiments could increase the likelihood of broad dissemination to other schools.

Response: Project Goals

The proposed collaborative work will *improve* retention and recruitment of science students from diverse populations. (Management Goal – Broader Impact)

Weakness: No comparison group or baseline data for evaluation. Statement lacks detail about how and why this will happen.

Strength: Focus on improved student retention and broadening participation.

Response: Project Goals

The use of VR experiments will improve the students' understanding of chemical reactions (Cognitive Goal)

Weakness: No comparison group or baseline data for evaluation

Strength: Focus on improved student learning

Response: Project Goals

The use of VR experiments will improve student attitudes by increasing their engagement in chemistry. (Affective Goal)

Weakness: Fails to specify the attitudes addressed, statement is too general. What is meant by "engagement?"

Strength: The project recognizes the desirability of improving students' attitudes

Response: How they can be strengthened

- Monitor student performance, progress, and attitudes to guide development of project (formative)
- Verify and document success
- Measure gains in student performance, e.g. pre/post tests
- Include experimental and control group
- Test at diverse institutions

Individual Activity: Rewrite or add a goal

Reread the project summary:

Either rewrite one of the goals or outcomes to include something you find missing or in need of strengthening.

OR

Write a new goal or outcome that contains something you find missing or in need of strengthening.

Think individually ~ 2 min and write your responses

Handout #3

Response: Additions or Rewrites

Building on a pilot study, these three dimensional and fully interactive experiments use methods and technology that promotes their use on laptops and other accessible mobile devices for easy adaptation and dissemination in a large variety of institutions and locations at modest costs.

Student retention will be improved by increasing their engagement and content knowledge.

Components in end-of-course exams will be matched with historical same-course non-lab exams to help understand differences in knowledge attainment. (Outcome)?

Writing Outcomes

- Up to this point we have focused on differentiating between types of goals and between goals and outcomes.
- Focus now on writing outcomes.

Recall: Goals and Expected Outcomes

Working Definitions:

- A ***Goal*** is a broad statement about what you hope to achieve or accomplish through the project. What are your intentions or ambitions in conducting the project?
- An ***Expected Outcome*** is a measurable result that is directly related to one or more project goals.

Recall: Cognitive vs. Affective

- Cognitive goal
  - Addresses change in an individual's knowledge or skills
- Affective goal
  - Addresses change in an individual's attitude, choices, or relationships
    - Internally directed– e. g., self-confidence
    - Externally directed – e. g., attitude about a STEM field

Group Activity: Writing Outcomes

Consider the second reading provided in the pre-workshop handout. One of the project's goals is to improve the students' confidence in their problem solving skills

- Write several expected outcomes that could be derived from this affective goal
- What behavior do good problem solvers exhibit?
  - Think individually ~ 2 min
  - Share with a partner ~ 2 min
  - Report in a local group ~ 2 min

Handout #4

Response: Problem Solving Outcomes

Students will:

- Organize information from the problem statement into an appropriate and useful representation that summarizes essential information symbolically, visually, and/or in writing.
- Specify known and unknown information, assign appropriate symbols for quantities, state a goal or target quantity, a sketch or picture of the physical situation, state qualitative expectations, an abstracted diagram, drawing a graph, defining coordinate axes, and/or choosing a system.
- Select appropriate concepts and principles to use in solving the problem.
- Execute the solution with respect to selecting appropriate mathematical procedures and following mathematical rules to obtain target quantities.
- Stay focused toward a goal, and evaluate the solution for consistency.
- Present a clear, focused, complete, and logically organized solution.
- Provide coherent explanations

Docktor and Heller
http://groups.physics.umn.edu/physed/Talks/Docktor_NARST09_paper.pdf

Response: Self-Confidence Outcomes

Students will:

- Trust their own judgment, move forward and not feel guilty when others don't like their choice.
- Not lose time worrying about what happened in the past, nor about what may happen in the future.
- Trust in their capacity to solve problems and not be discouraged or give up after failures and difficulties
- Make a strong effort to complete a task, and persist longer in that effort
- Ask others to help when they need it
- Be sensitive to the feelings and needs of others; respect generally accepted social rules, and claim no right or desire to prosper at others' expense
- Not exhibit heavy self-criticism and dissatisfaction
- Not be hypersensitive to criticism or feel resentment for critics
- Believe tasks to be harder than they actually are
- Not be erratic or unpredictable

Wikipedia –Self-confidence and Self-Efficacy

Writing Evaluation Questions

What is an evaluation question? Defining evaluation question(s) is an essential in the beginning of developing an evaluation plan.

Types of evaluation questions

- *Descriptive* questions intended to observe, describe and measure changes (what happened?)
- *Causal* questions strive to understand relations of cause and effect (how and to what extent is that which occurred attributable to what was done?)
- *Normative* questions apply evaluation criteria (are the results and impacts satisfactory in relation to targets, goals, etc?)
- *Predictive* questions, which attempt to anticipate what will happen as a result of planned interventions (will the activities result in improving student understanding?)
- *Critical* questions, which are intended to support change often from value-committed stance (how can research on teaching and learning be better accepted by faculty)

Add citation

Individual Activity: Writing Evaluation Questions

Read the goals section of a proposal provided on the pre-workshop handout.

Write three evaluations questions that can be answered by this proposal.

Think individually ~ 2 min and write your responses

Handout #5

Response: Writing Evaluation Questions

As a result of this project:

- Do students link concepts from class with real world instances of thermodynamics and heat transfer?
- Do students see connections within the field of ME?
- Do students increase their laboratory skills?
  - Use of equipment
  - Designing an experiment
- Do students make links to processes in the real world and develop more positive views of jobs/graduate school?
- Are students more excited about engineering in general?

Evaluation Questions from ME Proposal/Project

- What changes occurred in students conceptual understanding of thermodynamics and heat transfer increase as a result of adding the new laboratory components?
- What changes occurred in students' experimental design skills?
- What changes occurred in students' attitudes about a career in engineering?
- What changes occurred in students skills in using the laboratory equipment?
- Were there changes in faculty collaboration? Were there outcomes resulting from faculty collaboration?

Role of an Evaluator

- An evaluator can be facilitator, educator, consultant, collaborator, interpreter, and mediator
- An evaluator:
  - Helps PIs plan a project so that outcomes are measurable
  - Provides professional expertise in evaluation (design, methods, tools) needed to provide a credible evaluation
  - Builds evaluation capacity among project PIs
  - Helps make the entire proposal cohesive

Bring in an evaluator early and have them be an integral part of planning and designing your project.

Thanks for your participation!

- This concludes the virtual session. Thanks for your participation.
- There will be a concluding local session where participants will reflect on their experiences in the virtual session
- All participants will receive an email message with a link to the post-workshop evaluation survey. Please go to the site and complete the survey so that we can identify areas for improvement and have information to report to NSF

Acknowledgement

- This workshop has been offered through a partnership between the American Association for the Advancement of Science (AAAS), Louisiana State University, and Higher Education Services, Inc.
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Pre-Workshop Handout

Project Summary

This project will create a unique set of virtual reality (VR) experiments that can be used in lower division major's chemistry classes. These three-dimensional and fully interactive VR experiments eliminate the need for specialized, expensive, dangerous, and/or fragile equipment. The proposed collaborative work will improve retention and recruitment of science students from diverse populations. The use of VR experiments will improve the students' understanding of chemical reactions and improve student attitudes by increasing their engagement in chemistry.

Pre-workshop Reading for Writing Expected Outcomes Activities

The project will create and assess instructional materials that target one of the central skills required for success in the STEM fields – problem-solving. Instead of focusing solely on the refined end product of problem-solving, written solutions, students will be instructed on how to focus explicitly on the problem solving process, with particular attention paid to how they self-regulate.
To make what is essentially an internal thought process explicit, students and instructors will record think-alouds that will then be included in mathematics, chemistry, physics, and teacher preparation courses to support teaching STEM problem solving. To assist students in actively learning how to problem solve through the analysis and interpretation of these recordings, a rubric will be created and integrated into class activities. Through these activities students will see the role of planning, monitoring and adjusting their work as they solve complex, real-world problems.

Possessing robust problem-solving skills is vital for all STEM students and this project will develop original and creative instructional methods to facilitate student development. By studying their own problem-solving process, as well as that of others via think-alouds, students will learn to self-regulate their thinking. In addition to the materials and methods, which will be publicly available at the conclusion of the project, research findings on student development will be disseminated.

Goals:

- To increase the students problem-solving skills
- To increase the students self-confidence (or self-efficacy) in their problem-solving skills.

Writing Evaluation Questions Activity

The goal of the project is to develop a mechanism that will enhance the education of engineering undergraduates at the University of _____ by adding laboratory components to courses in the Mechanical Engineering curriculum. Specific objectives are (1) to enhance the undergraduate education of Mechanical Engineering students through the development and implementation of a comprehensive thermal laboratory that is linked to the department's curriculum to provide practical extensions to classroom lectures in thermodynamics and heat transfer, (2) to familiarize students with the practice and equipment that are typically used in industry while promoting alliances with the industrial community, (3) to provide students an experience in the design of educational material in order to excite them to pursue graduate studies and possibly a career in academia, and (4) to encourage collaboration between faculty that will enhance student learning.