Professional Development for Assessment of Learning Outcomes in Higher Education

Howard Kimmel, Professor Emeritus of Chemical Engineering

Levelle Burr-Alexander, Associate Director, K-20 Partnerships, Center for Pre-College Programs (CPCP)

John Carpinelli, Executive Director, Center for Pre-College Programs

Ronald Rockland, Professor and Chair, Engineering Technology

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The presentation and all handouts can be downloaded by going to

http://www.njit.edu/precollege/

Click on the **Educators Link**

Click on **Outcomes Assessment and Evaluation**

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Background

- State and national content standards have been established for the K-12 sector, which specify student learning outcomes at different levels of the education ladder.

- As part of a continuing education for faculty at NJIT, we presented workshops that deal with learning outcomes and the assessment and evaluation process

- These efforts can be duplicated at the community college level, especially in trying to identify outcomes for students from a community college who are transitioning to a four year program.

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Speakers

Burr-Alexander

- 8 years of research in pharmaceutical preclinical drug discovery/Biomedical Eng, 16 years at NJIT plus 8 years at science museums in STEM education (curriculum, instruction, assessment, and program/project management)

- Over 20 conference and journal publications in the area of STEM outreach to the K-12 community

- BS in Chemistry, MS in Biomedical Engineering, and PhD Candidate in Education with Specialization in Instructional and Curriculum Leadership

Rockland

- 25 years of industry, 18 years at NJIT- 7 years adjunct at CC

- Over 60 conference and journal publications in the area of engineering outreach to the K-12 community and biomedical research

- Formerly Associate Dean of Engineer

- Holds designation of Master Teacher, Fellow(American Society of Engineering Education)

- PhD in EE/BME, MBA Marketing

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Effective Teaching and Learning at All Levels
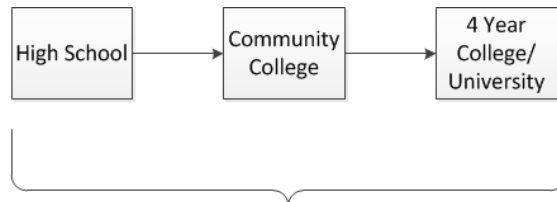
The Commonality

Specification of Expectations (Skills and Knowledge to be acquired by students) and Assessment of Achievement of Expectations

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Rationale for Assessment and Evaluation (A/E) Process

- You think you are a good teacher, but how do you know students are learning?
  - How effective are the courses you are teaching?
- How can we, as a program, assure that needed material is being taught?
- How can we maintain consistency among different people teaching the same course?
- How can we have a system that will support accreditation (such as ABET or Middle States)?

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Four Questions for an Assessment and Evaluation System

- What do I want to measure (learning outcomes)?

- How will I measure them (relating student work to learning outcomes)?

- What criteria do I use for success (i.e. what is called cut scores)?

- What action items are necessary to demonstrate students' level of achievement?

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How do we really know that students are learning what we are trying to teach them

- Define Course Outcomes

- Define items to be assessed (and frequency)

- Define Evaluation Criteria and Evaluate

- Identify any Action Items based on target levels

- Revise course materials (continuous improvement)

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Our goal should not only be that professors think
they teach well

It is also about effective teaching and learning

The goal should be students are learning well

**Quality Education MUST include both teaching and
learning**

**How do we know that students are acquiring skills and
knowledge we think they should have? – Learning
Outcomes**

Lessons planned from the learning expectations of defined
outcomes are essential for student achievement

"How do I know that I know what I need to know to know what I am expected to know in order to know what I am supposed to know from having participated in this learning environment. . . ."

(From Freed, Shirley A. 2003. "Metaphors and Reflective Dialogue Online." *New Horizons in Adult Education, 17:3. pp. 4 – 19).*

Outcomes

Connecting Classroom Practice with Outcomes

- Facilitate an instructional shift in emphasis from teaching to learning (i.e., from teachers "covering material" to students "learning content and skills").

- Outcomes are meant to define what students should know (content) and be able to do (process) in terms of measurable student behavior.

- Assessment must measure the student achievement of the skills and knowledge defined by the outcomes.

- Outcomes do not mandate a particular curriculum, or textbook, and may be achieved in a variety of ways.

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Questions for Developing Learning Outcomes

- What are the <u>skill and/or knowledge</u> the students will acquire as a result of learning?

- What <u>action</u> will students take to acquire the content skills and knowledge?

- What students will use to <u>show</u> what they have learned?

- What are the <u>student work products</u> that will be used to assess their acquired content skills and knowledge?

- What are the criterion for expected level of mastery (proficiency) that students must demonstrate in their work products?

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Three Levels of Outcomes
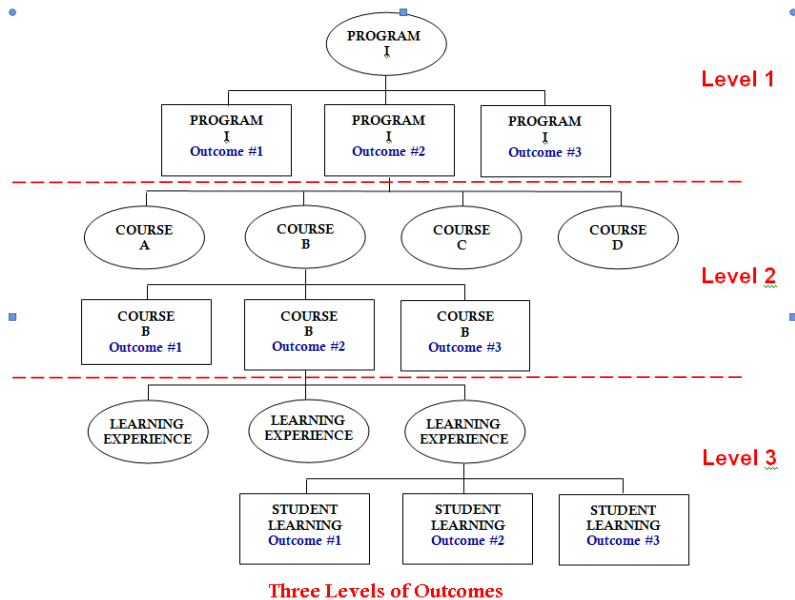
Alignment of Different Levels of Outcomes

- Re-establish learning on the same level as teaching.
    - Require course outcomes for all courses; e.g., specify outcomes in all course syllabi
    - Require common course outcomes for all sections in a course.
    - Require that prerequisites mean more than just earning a grade in a previous course. Completing a prerequisite course should mean that students have acquired requisite skills and knowledge from that course (outcomes).
- Writing learning outcomes as subsets of course outcomes.

Define the learning outcomes

GOAL: Define Outcomes achievable by students and documented through each student work that can be evaluated!

- Learning outcomes use **_behavioral verbs_** to indicate, and communicate to others, specific, observable student behavior (skills and knowledge).

- Behavioral verbs describe an observable student behavior or action that allows inferences about student learning.

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Course Outcomes

– What faculty and department collectively identify as the essential knowledge and skills required for students successfully completing the course
– May relate to topics, but stated from the student perspective, and defined in a way as to be measured
– Example: Identify, in writing, the best circuit theory to apply to various resistive circuits to solve voltage and current measurements

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What is the Connection in All Levels of Education?

- High School
  - **Expectations** expressed as **learning outcomes** aligned with **content standards**
- Two and Four Year Post Secondary Institutions
  - **Expectations** expressed as **learning outcomes** aligned with **criteria of accrediting agency**
- What is the connection?
  - Program outcomes at post secondary relate to content standards
  - How each level feed into each other (courses related via prerequisites (should relate via course outcomes)

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Learning Outcomes stated in terms of anticipated change in student behavior leads to more accurate evaluation of student achievement.
(www.adprima.com/objectives.htm)

Verbs open to many interpretations	Verbs open to few interpretations
• To know	• To state
• To understand	• To identify
• To fully appreciate	• To differentiate
• To grasp the significance of	• To solve
• To enjoy	• To contrast
• To believe	• To list
• To trust	• To compare

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Summary of Key Components:
From Outcomes to Assessment

1. Action or Behavior

   e.g. observable performance

2. Specific Content Skill and Knowledge

   e.g. intended skill and knowledge result

3. Performance Indicators

   e.g. levels of achievement

4. Student Work Product

   e.g. documentation of acquired skills/knowledge

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Preparing Learning Outcome Chart

Behavioral Verb	Content Skills & Knowledge	Performance Indicator	Student Work Products
What action will students take to acquire the content skills and knowledge?	What are the specific content knowledge & skill the students will acquire as a result of learning?	What is the performance indicator the students will use to show acquisition of knowledge?	What are the student work products that will be used to assess their acquired content skills and knowledge?

Learning Outcome: Students are able to
(*behavioral verb*) + (*specific content skills/knowledge*) + (performance indicator) + (*student work product*).

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Fundamentals Of Engineering Design
(How Not to Write Outcomes)

- Students are learning the principles of engineering design and the solution of open-ended problems.

- Students learn the dynamics of team effort. leadership, scheduling, cooperation, responsibility, conflict resolution.

- Modules teach the principles at an early stage of eng. with "hands on", "real life" problems.

- Students are excited and intrigued by the eng. problems and are determined to complete the eng. program.

- Students learn from the modules and give faculty suggestions for curriculum reform.

Better Course Outcomes (ECET 303)

- Upon completing this course, students will be able to:
  - Identify, in writing, the best circuit theory to apply to various resistive circuits to solve for voltage and current measurements.
  - Demonstrate the proper use of simulation software to solve circuit problems.
  - Demonstrate the proper use of measuring equipment for a variety of RLC circuits
  - Theoretically and experimentally generate a Bode plot, using Excel, as well as simulate these results with Multisim.
  - Write an effective laboratory report according to specified guidelines.
  - Present orally technical information in a professional and concise manner, according to specified guidelines. .
  - Describe your role and contribution to your team's analysis of circuits.

Making Assignments/Exams Matter

- Alignment of assignments or exam questions with learning outcomes allows the instructor to:
  - Document the teaching and learning that has occurred.
  - Provides feedback to the student as to how well he/she has acquired specified skills & knowledge.
  - Provides feedback to instructors as to effectiveness of the teaching on the learning.

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Assessment

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Definition of Assessment From ABET

Assessment is one or more processes that identify, collect, and prepare data to evaluate the attainment of student outcomes. Effective assessment uses relevant direct, indirect, quantitative and qualitative measures as appropriate to the outcome being measured. Appropriate sampling methods may be used as part of an assessment process.

Assessment results in a collection of measures that will be evaluated.

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How Do We Assess?

- Direct Measures
  - Reports (oral or written)
  - Laboratory reports
  - Exams (possibly questions within exams) or quizzes
  - Homework
  - Observation (rubric or other measurement)
  - Discussion & Reflection (rubric or other measurement)
  - Student journals or E-portfolio

- Indirect Measures
  - Student Surveys
  - Questionnaires
  - Classroom observations without a rubric

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Student Work as a Measuring Tool

- Assessment must be more than simply providing course grades.

- Assessment must provide evidence of student achievement of skills and knowledge resulting from the learning experiences provided by the instructor during the course.

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Course Grading and Assessing Student Learning

- Is the test only providing grades or is it a measure of student achievement of a learning outcome?

- Are the questions on the tests aligned with specific learning outcomes?

- Do the results of the exams illustrate strengths and weakness of student skills and knowledge, or just provide numbers for grading purposes?

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Evaluation

Definition of Evaluation From ABET

Evaluation is one or more processes for **interpreting** the data and evidence accumulated through assessment processes. Evaluation determines the **extent** to which student outcomes are being **attained**.

Evaluation **results** in decisions and actions regarding program improvement

Classroom evaluation should help teachers answer the following specific questions:

- To what extent are my students achieving the stated outcomes?
- How should I allocate class and out-of-school time for the current topic?
- Can I teach this topic in a more efficient or effective way?
- What parts of this course/unit are my students finding most valuable or challenging?
- How will I change this course/unit the next time I teach it to improve effectiveness?
- What is the performance criterion for mastery that will describe how grades will be assigned to student work?

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Assessment and Evaluation isn't just about Accreditation

It is also about effective teaching

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Process Flowchart

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                    ┌──────────────────────┐
        ┌──────────►│   Program Outcomes    │──────────────┐
        │           └──────────┬───────────┘              │
        │                      ▼                          │
        │           ┌──────────────────────┐              │
        ├──────────►│   Course  Learning    │◄─────────────┤
        │           │      Outcomes         │              │
        │           └──────────┬───────────┘              │
┌───────────────┐             ▲│                          │
│ Documentation │             ││                          │
└───────┬───────┘             ▼│                          │
        ▲           ┌──────────────────────┐              │
┌───────┴───────┐   │   Student Learning    │◄─────────────┤
│  Assessments  │◄─►│      Outcomes         │              │
└───────┬───────┘   └──────────┬───────────┘              │
        │                      ▲│                          │
        │                      ▼│                          │
        │           ┌──────────────────────┐              │
        └──────────►│     Instruction       │◄─────────────┘
                    └──────────────────────┘
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Relating Learning Outcomes to Student Work

- Created 11 learning outcomes for one of our courses, ECET 300 (Circuit Analysis: Transform Methods)
  - Then identified a related student work to provide assessment for each learning outcome
- Example
  - Learning Outcome: Demonstrate the proper use of MATLAB to perform data analysis and graphing to solve technical problems
  - Student Work: MATLAB assignment 2: graphing functions using MATLAB and analysis of data to justify solutions to problems.

Relating Outcomes to Student Work

	Student Work								
Learning Outcomes	Matlab 1 assignment - download primer and upload assignment	Homework Chapter 2 - 2: 53, 61, 71, 75	Matlab 2 - graphing functions using Matlab	Multisim assignment 1 – structure of the report portion of the grade	Multisim virtual lab report 2 – utilizing software and laplace transforms to solve circuit problems	Test 2, question on solving differential equation	Homework from Chapter 6	Multisim virtual lab report 3 - bode plot	Test 5 question on time and frequency response of an RLC circuit
1. Demonstrate the proper use of MATLAB to perform data analysis and graphing to solve technical problems.			X			.			
2. Use Laplace Transforms to solve various RLC circuit problems.							X		
3. Identify the best circuit theory to apply to various RLC circuits to solve for voltage and current measurements, and utilize these theories to solve these circuit problems.							X		
4. Simulate a circuit with the use of Multisim to obtain a prior understanding of a circuit's behavior, and incorporate these results in a laboratory report.					X				
5. List the differences between time and frequency analysis of a circuit.									X
6. Theoretically and experimentally generate a Bode plot, as well as simulate these results with Multisim.								X	
7. Write an effective laboratory report according to acceptable criteria.				X					
8. Demonstrate solutions of differential equations using transform methods						X			
9. Download and upload files with Moodle, as well as utilize other aspects of this learning management application	X								
10. Calculate integration and differentiation of various waveforms using graphical methods.			X						
11. Demonstrate the relationship between various signals and their spectrum.									X

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Evaluation

- Determine what is the minimum level (grade) that still indicates that the students have acquired the skills and knowledge defined by the outcome.
- Determine whether the students, as a group, are below the trigger point (cut score) needed to institute a change in the course
  - i.e. 70% is a minimum level for a rubric that is used for evaluating an individual student's presentation.
  - If less than 70% of the students in that section(s) of a course score below the minimum level, then action is required.
- Continuous improvement process would then assess the change

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Criteria for Evaluation

- Evaluation isn't done, on a program level, for all courses
  - Select a course whose learning outcome relates to a program(student) outcome
  - If you have multiple sections, don't average the response and get a percentage
    - Worse case among all sections
- Evaluation, for a course, means achievement of all course outcomes

Cut Score

- What level for a student is acceptable in terms of the evaluation of an outcome, and how many students
  - Students need to achieve a 70% on a problem, and 70% must achieve this level
    - If they don't achieve it, then should have action plan to correct it
- Need to measure periodically (can be on a multi-year cycle)
  - The next time you are evaluating any changes made the previous time (Continuous Improvement)

Assessment and Evaluation

- Take a learning outcome, and define a student work product that you would use for assessment.
- Identify how you are going to measure the success of that student work product, in terms of an individual student and the class (cut score).
- If the evaluation was below your standards, what action item(s) would you take?
- How often would you go through this process?

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Take Home Assignment

- Look at a course you are teaching:
  - Develop one or more course outcomes
  - Relate the outcome to a student work product
  - Develop a criteria for evaluation

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Available Resources

- NJIT Library
  - http://researchguides.njit.edu/content.php?pid=273992&sid=2358205
- Student Learning Assessment – Middle States Commission on Higher Education
  - http://www.msche.org/publications/SLA_Book_0808080728085320.pdf
- Internet Resources for Higher Education Outcomes Assessment – NC State University
  - http://www2.acs.ncsu.edu/upa/assmt/resource.htm
- Learning Outcomes Assessment Planning Guide –Cal Poly
  - http://www.academicprograms.calpoly.edu/assessment/assessplanguide.html

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How to reach us….

Howard Kimmel
  kimmel@adm.njit.edu

Levelle Burr-Alexander
  levelle.e.burr-alexander@njit.edu

Ronald Rockland
  rockland@njit.edu

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Q & A

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