Outcome-Based Assessment

Ahmet S. Yigit
Office of Academic Assessment
College of Engineering and Petroleum
Kuwait University
Why Assessment?

- "We give grades, don't we? That's assessment. Isn't that enough?"
- "We don't have enough time to start another new project."
- "'Outcomes,' 'Goals,' 'Objectives' - all this is educational jargon!"
- "Isn't this another way of evaluating us, of finding fault with our work?"
- "Find a standardized test or something, and move on to more important things."
- "You want us to lower standards? Have us give more A's and B's?"
- "Our goals can't be quantified like some industrial process."
- "Let's just wait until the (dept chair, dean, president, etc.) leaves, and it'll go away."
Why Assessment?

• Continuous improvement
• Total Quality Management applied in educational setting
• Accreditation/External evaluation
• Competition
• Industry push
• Learning needs
Recent Developments

• Fundamental questions raised (1980’s)
  – How well are students learning?
  – How effectively are teachers teaching?
• Assessment movement (1990’s)
• Lists of basic competencies
  – Best practices
• Paradigm shift from topics to outcomes
• New accreditation criteria (ABET EC2000)
## Focus (Now & Then)

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Focus (Now & Then)

Then

Desired output → Process → Output

Now

Desired output → Comparison → Process → Output

Measurement

Comparison

Process

Output
What is Assessment?

“An ongoing process aimed at understanding and improving student learning. It involves making our expectations explicit and public; setting appropriate criteria and high standards for learning quality; systematically gathering, analyzing, and interpreting evidence to determine how well performance matches those expectations and standards; and using the resulting information to document, explain, and improve performance.”

American Association for Higher Education
A Mechanism for Change

- Outcome-Driven Assessment Process
  - A process that focuses on the measurement of change (outcome) that has taken place based on strategies and actions implemented in the pursuit of achieving a pre-determined objective.
  - Results are used in the support of future change and improvement.
Assessment is…

- Active
- Collaborative
- Dynamic
- Integrative
- Learner-Centered
- Objective-Driven
- Systemic
Assessment

• is more than just a grade
  – is a mechanism for providing all parties with data for improving teaching and learning
  – helps students to become “more effective”, “self-assessing”, “self-directing” learners

• drives student learning
  – may detect superficial learning
  – guide the students to attain the desired outcomes
Levels of Assessment

- Institution
- Department
- Program
- Course/Module/Lesson
- Individual/Group
Defining Objectives & Outcomes

- Determine level of analysis
- Gather input from many sources:
  - institutional mission
  - departmental/program objectives
  - accreditation bodies (e.g., ABET)
  - professional societies
  - constituents (students, faculty, alumni, employers, etc.)
  - continuous feedback
- Assure a common language
- Use a structured process
Assessment Design Steps

Step #1
Define results
to be measured
Assessment Design Steps

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Define results to be measured

Step #2
Identify data required & sources
Assessment Design Steps

Step #1
Define results to be measured

Step #2
Identify data required & sources

Step #3
Review existing assessment methods
Assessment Design Steps

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Define results to be measured

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Step #3
Review existing assessment methods

Step #4
Define additional methods and measures
Assessment Design Steps

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Define results to be measured

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Step #3
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Step #4
Define additional methods and measures

Step #5
Implement and evaluate
Assessment Design Steps

Step #1 Define results to be measured

Step #2 Identify data required & sources

Step #3 Review existing assessment methods

Step #4 Define additional methods and measures

Step #5 Implement and evaluate

Continuous Improvement

Fall 2003
Development Process

- Identify broad goals desired for your specific course/program
- State objectives for each goal
- Define measurable outcomes for each objective.
- Review tools & their use for continuous improvement
Identify Broad Goals

Question: Describe what broad objectives you want to achieve through your course or program.

Example: The program will provide a quality undergraduate education.
State Objectives

Identify what you need to do to achieve your goals.

Examples:
To provide an integrated experience to develop skills for responsible teamwork, effective communication and life-long learning needed to prepare the graduates for successful careers.

To improve students’ communication skills through term project.
Define Outcomes

Question: Identify what expected changes you expect to occur if a specific outcome is achieved.

Examples: The students will communicate effectively in oral and written form.

Students will prepare and present a final report for the term project.
Objectives Summary

- Each addresses one or more needs of one or more constituencies
- Understandable by constituency addressed
- Number of statements should be limited
- Should not be simply restatement of outcomes
Outcomes Summary

- Each describes an area of knowledge and/or skill that a person can possess
- Should be stated such that a student can demonstrate before graduation/end of term
- Should be supportive of one or more Educational Objectives
- Do not have to include measures or performance expectations
In considering the goals, objectives, and outcomes previously discussed, what assessment tools exist to support measurement needs?

Questions:

Are there any other tools that you would like to see implemented in order to effectively assess the learning outcomes previously defined?
Strategies/Practices

Practice

Curriculum
  – Courses
  – Instruction (Teaching methods)
  – Assessment

Policies
  – Admission and transfer policies
  – Reward systems

Extra-curricular activities
“Assessment *per se* guarantees nothing by way of improvement, no more than a thermometer cures a fever. Only when used in combination with good instruction (that evokes involvement in coherent curricula, etc) in a program of improvement can the device strengthen education.”

Theodore Marchese (1987)
A Manufacturing Analogy

Mission: To produce passenger cars

- Establish specifications based on market survey, current regulations or codes, and the resources available (capital, space etc.) e.g., good road handling, fuel economy, ride comfort
- Establish a process to manufacture the product; e.g., produce engine, transmission, body
Manufacturing Analogy (cont.)

- Translate specifications into measurable performance indicators, e.g., mileage, rms acceleration
- Make measurements to assure quality
  - measurements at the end of the assembly line
  - measurements at individual modules
- Need to evaluate specifications periodically
  - to maintain customer satisfaction
  - to adopt to changing regulations
  - to utilize new technology or resources
Manufacturing analogy (cont.)

- Specifications = educational objectives
- Process = curriculum
- Production modules = courses
- Performance indicators = outcomes
- Measurements = outcomes assessment
  - Program level assessment
  - Course level assessment
Manufacturing Analogy (cont.)

- Customers, regulatory institutions, personnel = = constituents (employers, students, government, ABET, faculty)

- Need to evaluate objectives periodically
  - to address changing needs
  - to adopt to changing regulations (e.g., new criteria)
  - to utilize new educational resources or philosophies
Evaluation & Assessment Cycles
“A 2-loop Process”

- Determine educational objectives
- Input from Constituencies (e.g., Students, Alumni, Employers)
- Formal Instruction
- Student Activities

Assess Outcomes/Evaluate Objectives

- Determine Outcomes Required to Achieve Objectives
- Determine How Outcomes will be Achieved

Establish Indicators for Outcomes to Lead to Achievement of Objectives

- Determine How Outcomes will be Assessed
- Assess Outcomes/Evaluate Objectives
Exercise

• Given your University and your Program missions develop two educational objectives which address the needs of one or two of your constituencies

• Given the program objectives you developed, select ONE objective and develop a set of measurable outcomes for it.

• Be prepared to report to the full group
Course Level Assessment

Assessment Design
Objectives and Outcomes

• Setting objectives is the first and most important step in course development, it affects content, instruction and assessment.
• Effective way of communicating expectations to students
• Objectives developed to measurable outcomes form the basis for creating assignments, exams and projects
Example Objectives

- “To teach students various analysis methods of control systems”
- “To teach students the basic principles of classical thermodynamics”
- “To motivate students to learn a new software package on their own”
- “To provide opportunities to practice team building skills”
Example Outcomes

- “Obtain linear models (state space and transfer functions) of electro-mechanical systems for control design” (measurable)
- “Select the optimum heat exchanger configuration from several alternatives based on economic considerations” (measurable)
- “Understand the concept of conservation of mass and energy” (not measurable)
- “know how to use the first law of thermodynamics” (not measurable)
Writing Outcomes

Write outcomes using quantifiable action verbs and avoid terms which are open to many interpretations

• Words open to many interpretations
  – know, understand, appreciate, enjoy, believe, grasp

• Words open to fewer interpretations
  – write, identify, solve, build, compare, contrast, construct, sort, recite

• Use Bloom’s taxonomy
Bloom’s Taxonomy

- Cognitive domain of required thinking levels
  - “Lower order” thinking
    • knowledge, comprehension, application
  - “Higher order” thinking
    • analysis, synthesis, evaluation

- Affective domain of required attitude changes
  - “Lower order” changes
    • Receiving, responding
  - “Higher order” changes
    • Valuing, organization, characterization
Example Outcomes (cognitive)

- “Lower order” thinking
  - Knowledge
    - Define “particle”
  - Comprehension
    - Distinguish a “particle” from a “rigid body”
  - Application
    - Given the initial velocity, find the trajectory of a projectile
Example Outcomes (cognitive)

- “Higher order” thinking
  - Analysis
    - Sketch the necessary free body diagrams
  - Synthesis
    - Determine the required friction coefficient for a given motion
  - Evaluation
    - Choose the best solution method for a given kinetics problem
Assessment Design (continued)

- Identify course contents based on outcomes
  - Topics that can/should be covered in a semester
  - Activities (e.g., teamwork, life-long learning etc)
- Rate the level of service to program outcomes
- Identify the mode of teaching
  - Lectures, projects, self learning, field trips
- Identify assessment methods and tools
- Plan for course delivery
  - Outline of the course, time table of activities
Service to Program Outcomes

• Rate the level of importance of each program outcome as it relates to the course
• H (high)
  – Demonstrating this knowledge or skill is critical for the student to perform successfully
• M (medium)
  – Demonstrating this knowledge or skill has considerable impact on the overall performance of the student
• L (low)
  – Demonstrating this knowledge or skill has only minor impact on the overall performance of the student
Assessment Practices

• Identify resources
  – Support personnel and facilities
  – Available instruments
  – Develop necessary tools (e.g., scoring rubrics)

• Implement assessment

• Analyze and interpret results

• Feedback for improvement
Exercise

- Choose a course you currently teach or would like to teach
- Complete the teaching goals inventory (TGI)
- Write 2-3 general objectives for the course
- Be prepared to report to the full group
Exercise

• Consider the course you chose earlier
• Develop one of the objectives into measurable outcomes based on Bloom’s taxonomy
• Discuss with the whole group
Assessment Design

Tools and Methods
Need for Tools and Methods

• Traditional grading is not sufficient for outcomes assessment
• Need detailed and specific information on achievement of outcomes
• Some outcomes are difficult to measure without specific tools (e.g., teamwork, communication skills)
• A properly designed tool may also help improve performance
Assessment Methods

• Program Assessment
  – Tests (standard exams, locally developed tests)
  – Competency-based methods (stone courses)
  – Attitudes and perceptions (surveys, interviews, focus groups)

• Course/Classroom Assessment
  – Performance evaluations (oral presentations, written reports, projects, laboratory, teamwork)
  – Classroom Assessment Techniques (minute paper, background probe, concept maps)
Assessment Tools (Program)

- Employer survey
- Alumni survey
- Faculty survey
- Exit survey
- Drop-out survey
Assessment Tools (Course)

- Instructor class evaluation
- Oral presentation
- Project reports
- Lab reports
- Teamwork
- Use of scoring rubrics
Important Points

- All assessment methods have advantages and disadvantages
- The “ideal” methods are those that are the best compromise between program needs, satisfactory validity, and affordability (resources)
- Need to use multi-method/multi-source approach to improve validity
- Need to pilot test to see if a method is appropriate for your program/course
Validity

- **Relevance**: the option measures the educational outcome as directly as possible
- **Accuracy**: the option measures the educational outcome as precisely as possible
- **Utility**: the option provides formative and summative results with clear implications for program/course evaluation and improvement
Exercise

• Consider the outcomes you developed earlier
• Specify relevant activities/strategies to achieve these outcomes
• Determine the assessment methods/tools to measure each outcome
Assessment Practice

Assessment at Kuwait Univ.
Strategies

- Refine and maintain a structured process
  - Involve all constituents
  - Establish a viable framework
- Provide assessment awareness/training for faculty and students
  - Instill culture of assessment
- Create an assessment toolbox
- Align key institutional practices
Case Study: ME Program at KU

• Program Educational Objectives (PEO)
  – To provide the necessary foundation for entry level engineering positions in the public and private sectors or for advanced studies, by a thorough instruction in the engineering sciences and design.
  – To provide an integrated experience to develop skills for responsible teamwork, effective communication and life-long learning needed to prepare the graduates for successful careers.
  – To provide a broad education necessary for responsible citizenship, including an understanding of ethical and professional responsibility, and the impact of engineering solutions to society and the environment.
ME Program at KU (continued)

- **Program Outcomes (sample)**
  - An ability to apply knowledge of mathematics, science, and engineering.
  - An ability to design and conduct experiments, as well as to analyze and interpret data.
  - An ability to design and realize both thermal and mechanical systems, components, or processes to meet desired needs.
  - An ability to function as effective members or leaders in teams.
  - An ability to identify, formulate, and solve engineering problems.
  - An understanding of professional and ethical responsibility.
  - An ability to communicate effectively in oral and written form.
  - A recognition of the need for, and an ability to engage in life-long learning.
**Outcome Attributes (life-long learning)**

Graduates are able to:

- seek intellectual experiences for personal and professional development,
- appreciate the relationship between basic knowledge, technological advances, and human needs,
- life-long learning as a necessity for professional development and survival.
- read and comprehend technical and other materials, and acquire new knowledge independently,
- conduct a literature survey on a given topic, and
- use the library facilities, the World Wide Web, and educational software (encyclopedias, handbooks, and technical journals on CDs).
Practices

- Encourage involvement in professional societies (ASME, ASHREA, Kuwait Society of Engineers)
- Emphasize self-learning in certain courses (e.g., project based learning, reading or research assignments)
- Encourage attendance in seminars, lectures and professional development courses
- Implement active learning strategies in cornerstone and capstone design courses
- Re-design senior lab courses to encourage more creativity and independent work
Assessment

- Instructor course evaluation at selected courses (every term) - Faculty
- Exit survey (every term) - OAA
- Alumni survey (every three years) - OAA
- Employer survey (every four years) - OAA
- Faculty survey (every two years) - OAA
Analysis and evaluation of assessment

- Faculty
- Teaching Area Groups (TAG)
- Departmental assessment coordinator
- Undergraduate Program Committee (UPC)
- Office of Academic Assessment/College Assessment Committee
- College Undergraduate Program Committee
- Chairmen Council (College Executive Committee)
Feedback

- Faculty
- Undergraduate Program Committee
- Department council
- Student advisory council
- External advisory board
Course Assessment Example: ME-455 CAD

- Course Objectives
  - To develop students’ competence in the use of computational tools for problem solving and design (PEO #1)
  - To introduce a basic theoretical framework for numerical methods used in CAD, such as FEM, Optimization, and Simulation (PEO #1)
  - To provide opportunities for the students to practice communication and team-building skills, to acquire a sense of professional responsibility, to motivate the students to follow new trends in CAD and to train them to learn a new software on their own (PEO #2, and #3)
ME-455 (continued)

- Course design
  - Make sure all course objectives are addressed
    - theoretical framework, hands on experience with packages, soft skills
  - Make sure to include activities to address each outcome
    - team project, ethics quiz, written oral presentations
  - Obtain and adopt material related to team building skills, and engineering ethics
  - Devote first lecture to introduce course objectives and outcomes and their relation to Program Educational Objectives
Me-455 (continued)

- Course assessment
  - Make sure all course outcomes are measured
  - Use standard assessment tools (written report, oral presentation, teamwork)
  - Develop and use self evaluation report (survey and essay)
  - Design appropriate quizzes to test specific outcomes
    - Ethics quiz
    - Team building skills quiz
  - Design appropriate in-class and take home exams
  - Use portfolio evaluation in final grading and assessment
ME-455 (continued)

• **Assessment results**
  - Students were able to learn and use the software packages for analysis and design
  - Students recognized the need for life long learning
  - Students were able to acquire information not covered in class
  - Students are not prepared well with respect to communication and teamwork skills
  - Students lack a clear understanding of ethical and professional responsibilities of an engineer
  - Students are deficient in their ability to integrate and apply previously learned material
ME-455 (continued)

- **Corrective measures**
  - Communicate and discuss the deficiencies to students
  - Discuss the results within the area group and formulate common strategies for corrective actions.
    - Increase opportunities to practice communication and teamwork skills with curricular and extra-curricular activities
    - Communicate results to concerned parties
    - Introduce and explain engineers’ code of ethics at the beginning of the course. Introduce more case studies.
  - Keep in mind that not all deficiencies can be addressed in one course
Assessment Practice

Kuwait University Experience
Some Do’s and Don’ts

• Don’t start collecting data before developing clear objectives, outcomes, and a process, but don’t wait until you have a “perfect” plan.

• Do promote stakeholder buy-in by involving as many constituencies in the process as possible.
Some Do’s and Don’ts

• Don’t forget that quality of results is more important than quantity. Not every outcome needs to be measured for every student every semester.

• Do collect and interpret data that will be of most value in improving learning and teaching.
Some Do’s and Don’ts

• Do involve as many faculty members as possible; balance day-to-day assessment tasks (one person?) with periodic input from program faculty.

• Don’t forget to look for campus resources to help supplement program assessment efforts.
Some Do’s and Don’ts

- Do minimize faculty time reporting classroom assessment results. Faculty should use results to improve learning.
- Don’t use assessment results to measure teaching effectiveness. Assessment of students and assessment of instructors are separate activities.
10th Principle of Good Assessment

"Assessment is most effective when undertaken in an atmosphere that is receptive, supportive, and enabling... [with] effective leadership, administrative commitment, adequate resources, faculty and staff development opportunities, and time."

For Further Information

- Check out the references given in the fold
- Check out OAA web page and the links provided
  www.eng.kuniv.edu.kw/~oaa
- Contact us
  - E-mail:oaa@eng.kuniv.edu.kw