Developing an Assessment and Evaluation Plan for EC2000

University of Bridgeport

August 27 and 28, 2001

Workshop Presenters

- ***Susan Haag***, Director of Assessment, College of Engineering & Applied Sciences, Arizona State University
- ***Rita Caso***, Director of Assessment & Evaluation, Educational Achievement Division, College of Engineering, Texas A&M University
- ***Ann Kenimer***, Associate Professor, Department of Agricultural Engineering, Texas A&M University

Dr. Susan Haag

- Specialist in Instructional Technology and Educational Psychology
- Ph.D. from Arizona State University
- Associate faculty in Educational Psychology
- Working with ABET committee on web-based assessment
- Develops and instructs courses for online delivery—full virtual delivery and web enhanced

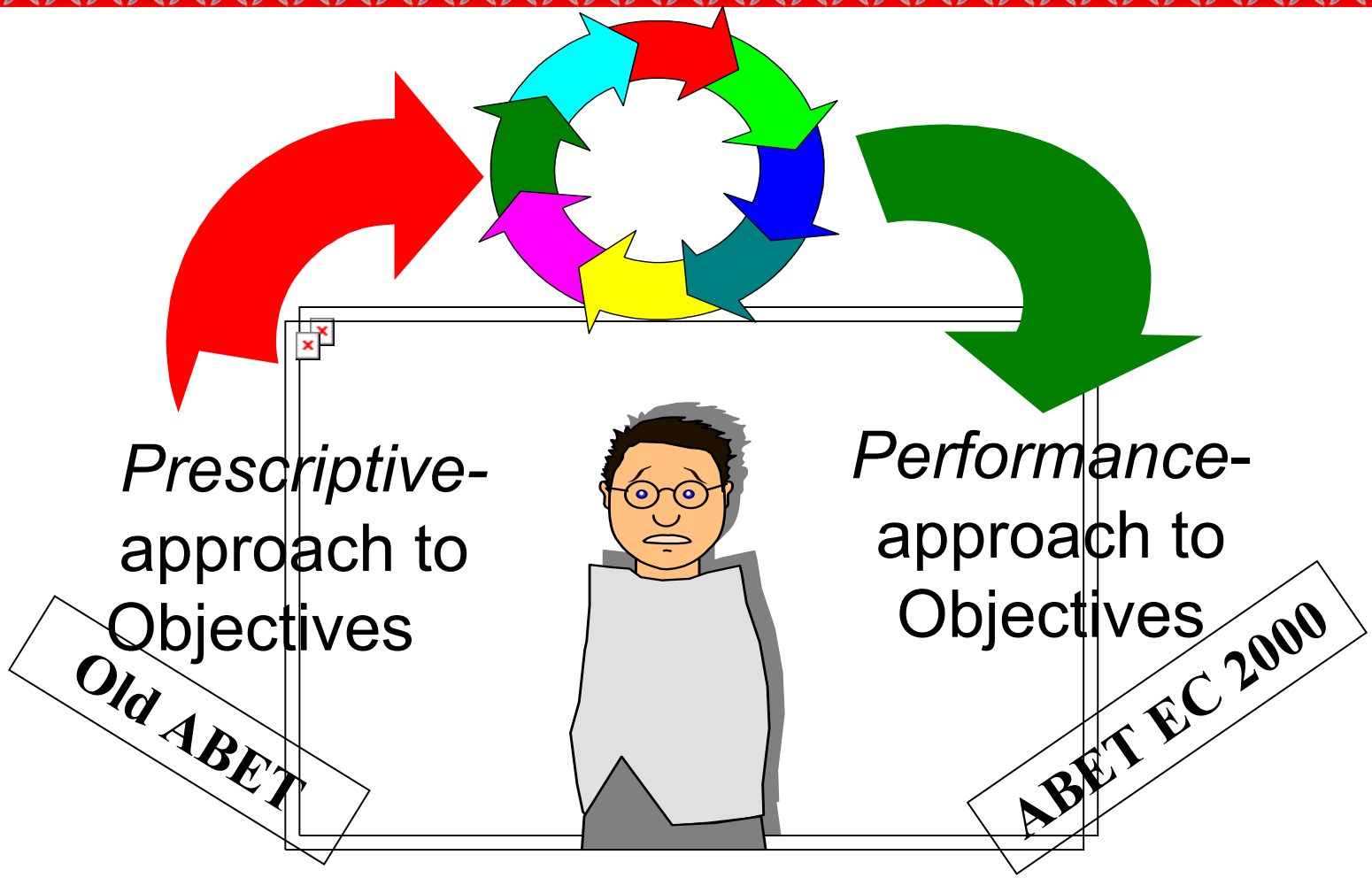
Dr. Rita Caso

- Ph.D. Applied Research and Evaluation in Education, Counseling and Psychology
- 20 + years experience in teaching, administration, research, assessment, evaluation, and accreditation-review preparation in K-12, Adult, and Higher Education, in Human Services, and National Market Research.
- 7 years specific experience assessing and evaluating University Level Engineering programs, and Science, Math, Engineering, and Technology (SMET) programs

Dr. Ann Kenimer

- B.S., M.S., Agricultural Engineering, Virginia Tech
- Ph.D., Agricultural Engineering, University of Illinois
- Teaches engineering design processes, fundamental problem solving, environmental engineering
- FC Project Manager for Assessment and Evaluation

The Trek to Accreditation
EC 2000



II. 2. Program: Education Objectives

Each engineering program must have in place:

(a) detailed published educational objectives that are consistent with the mission of the institution and these criteria

(b) a process based on the needs of the *program's various constituencies* in which the objectives are determined and periodically evaluated

(c) a curriculum and process that ensure the achievement of these objectives

(d) a system of ongoing evaluation that demonstrates achievement of these objectives and uses the results to improve effectiveness of the program

Workshop Objectives
What you will learn:

- What ABET reviewers are looking for
- The meaning of key ABET assessment terminology
- How student outcomes and program, course and class objectives fit together in the BIG PICTURE of your Educational System, and ABET evaluation
- How to discover, organize, use, and add to existing information, and processes to satisfy the BIG PICTURE and ABET evaluation

Workshop Objectives
What you will learn [cont.] :

More specifically…..

- Why program goals matter at the course and class outcome level (Inter-dependence in the BIG PICTURE)
- How to recognize and express your goals and objectives in relation to measurable student outcomes
- What your BIG PICTURE looks like.
- How to identify, organize, modify and use existing mechanisms of classroom assessment and routine institutional data collection for program assessment.
- How to construct new assessment instruments

Workshop Agenda

Monday, August 27

- Workshop background
- A&E terms
- How the pieces fit together to form the big picture
- Program goals and objectives
- Classroom goals and objectives

Workshop Agenda

Tuesday, August 28

- Your “Big Picture”
- Appropriate assessment
- Using institutional data
- Closing the loop
- Summary from ABET Reviewer’s Perspective
- Question and answer session

The Foundation Coalition

- Six cooperating universities:
  - Arizona State University
  - Rose-Hulman Institute of Technology
  - Texas A&M University
  - University of Alabama
  - University of Massachusetts—Dartmouth
  - University of Wisconsin—Madison
- Funded by NSF

The Foundation Coalition

Mission

- Establish improved curricula and learning environments
- Attract and retain a more demographically diverse student body
- Graduate engineers who posses those transforming attributes that fully reflect the FC outcomes

The Foundation Coalition

FC Outcomes

- Appreciation and motivation for life-long learning
- Ability to participate in effective teams
- Oral, written, graphical, and visual communication skills
- Ability to appropriately apply the fundamentals of mathematics and the sciences

The Foundation Coalition

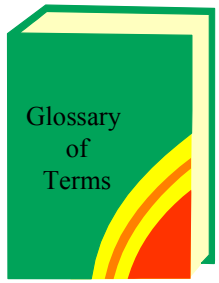
FC Outcomes

- Capability to integrate knowledge from different disciplines to define problems, develop and evaluate alternative solutions, and specify appropriate solutions
- Flexibility and competence in using modern technology effectively for analysis, design, and communication
- Ability to design a system, component, or process to meet desired needs

A&E Glossary

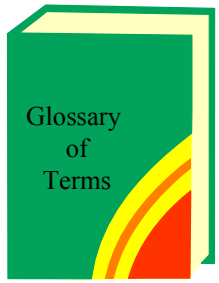
Common terms used in educational planning, assessment, and evaluation

Glossary of Terms



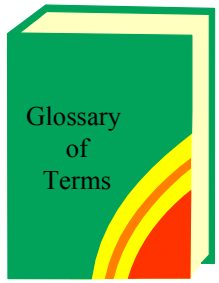
- **Objective**-statement describing desired results which is:
  - Broad
  - Likely to address multiple ABET criteria
  - Highest level for discussion
- *Example- Students will be able to communicate effectively*

Glossary of Terms



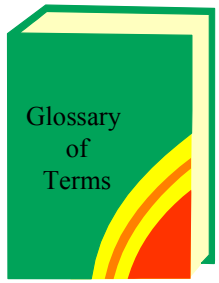
- **Outcome**-statement(s) derived from an objective
- More specific than objective
- Likely to address more than one ABET criteria
- *Example- Students will be able to plan, prepare, deliver, and assess formal and informal oral presentations*

Glossary of Terms



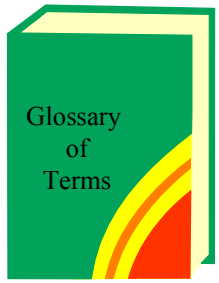
- **Performance indicators**-specific, measurable statement(s) of performance required to meet the outcome
- *Example- Students demonstrate audience awareness when they make oral presentations*

Glossary of Terms



- **Strategies and Actions**-program and institutional practices designed to achieve specific outcomes.
- *Example- Inform students and faculty of presence of the Engineering Writing Center, and require its use*.

Glossary of Terms



- **Assessment Methods and Metrics**- Processes, tools, and measurement scales used to collect evidence of outcome performance.
- *Example- Individual classroom assessment using checklists and rubrics*.

A Working Definition of Assessment [for this discussion]

Assessment involves
... *Consistently,Systematically, and Meaningfully..*

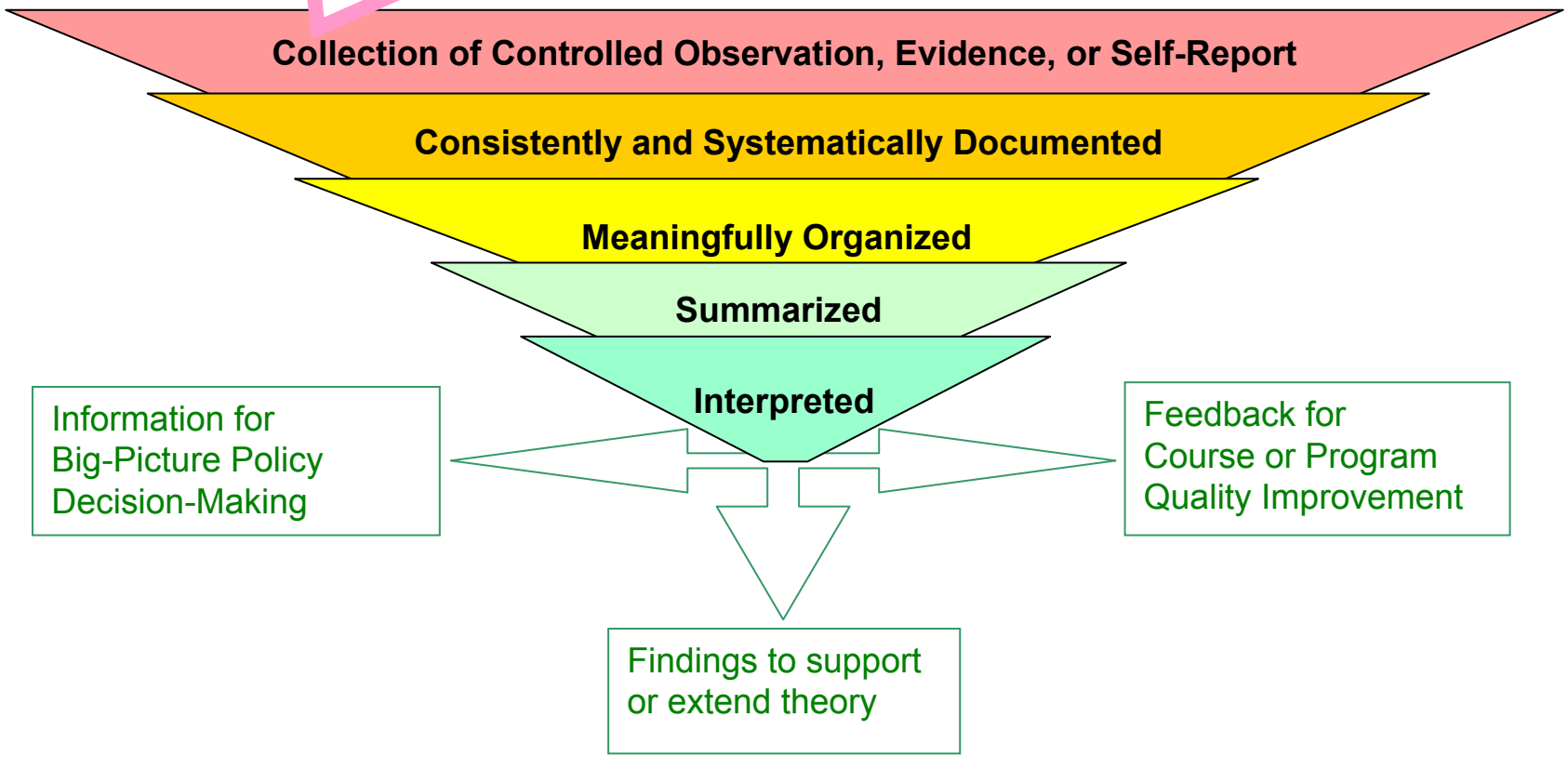
- Capturing and Documenting
- Organizing
- Summarizing
- Interpreting
- Reporting

…Controlled Observation, Self-Report, or Other Evidence of Performance,Behavior, Perception or Attitude.

A Working Definition of Assessment

OUTCOMES

Performance, Behavior, Perception, or Attitude



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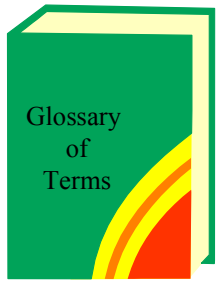
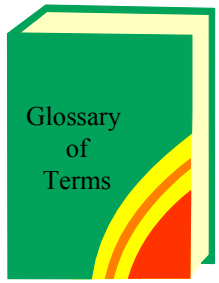


- **Evaluation**-The system of critically examining the assessment data and performance indicators to measure progress toward and improvement of program objectives.
- *Example- Committee for random sampling of graduates*.

Glossary of Terms



- **Feedback**-The application of evaluation results to the further development and continuous improvement of program objectives.
- *Example- Feedback to college or program curriculum committee to improve course outlines, topical structures within courses, and resource allocations*.

The Big Picture

How the various pieces of assessment and evaluation work together

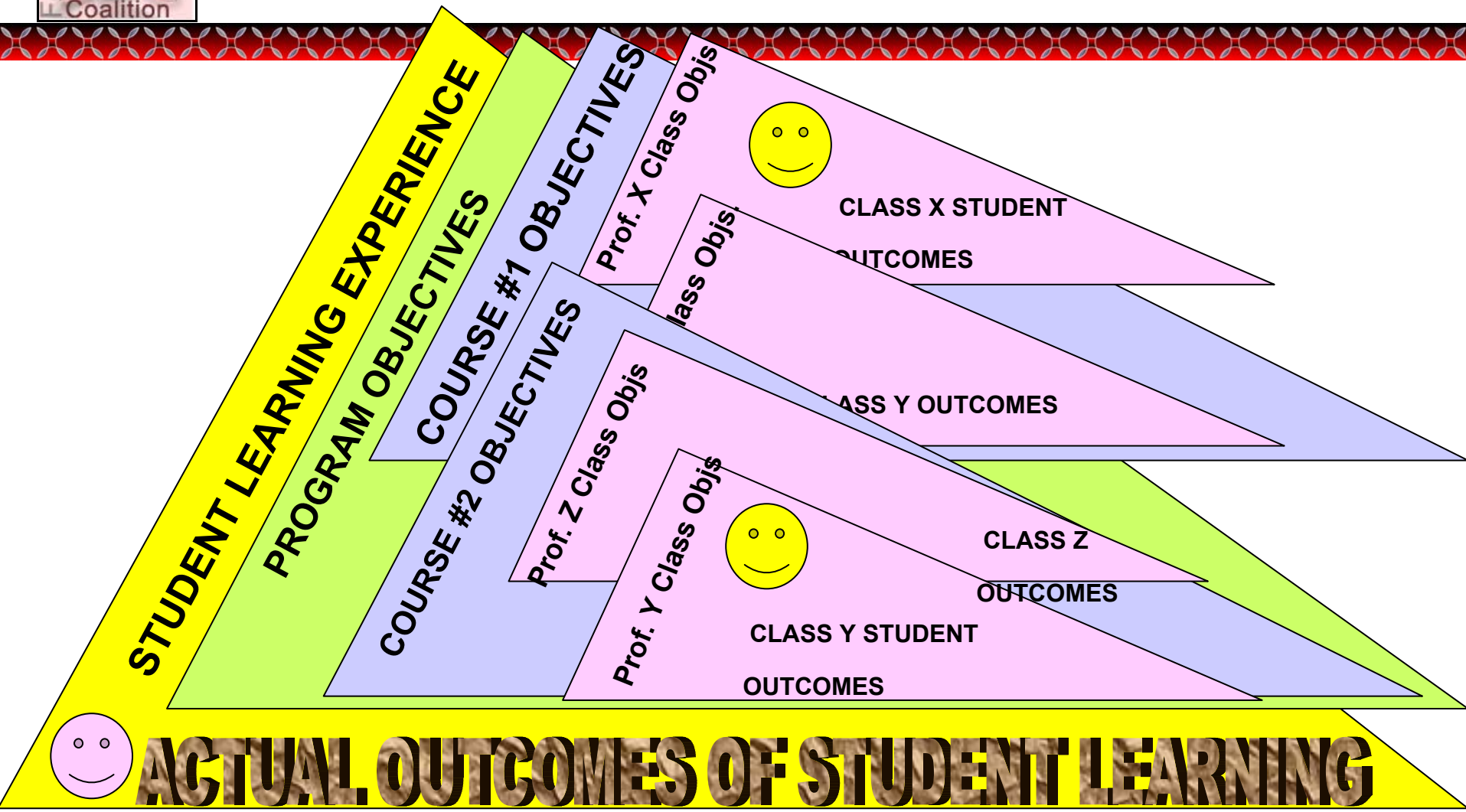
The BIG PICTURE

- **The Education System: Program, Course, and Class Inter-Dependence**
  - **Objectives, Delivery and Outcomes**
  - **Where's the student?**
- **The Ongoing Evaluation System**
  - **Where the Education System and the Student fit in**

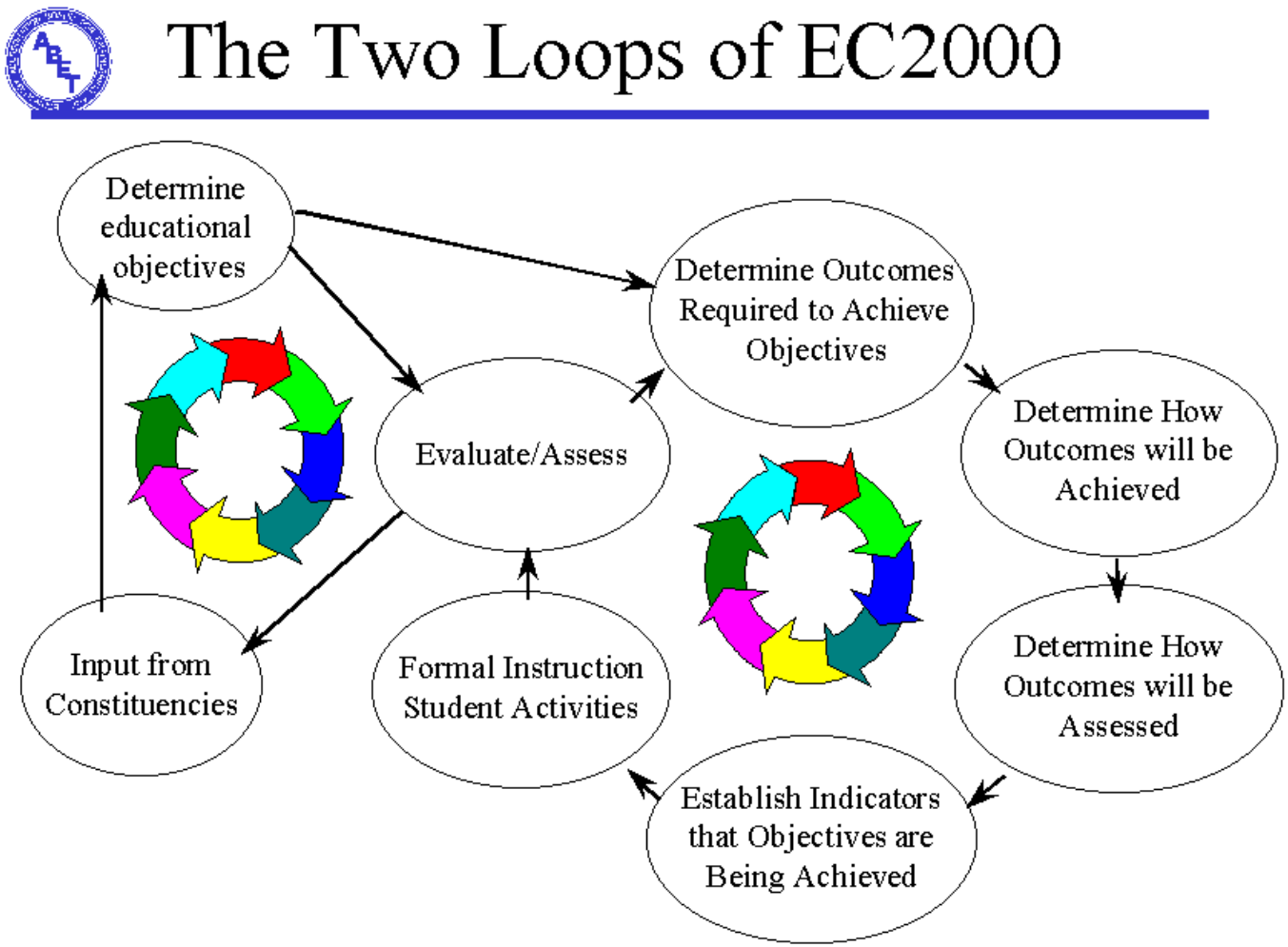
The BIG PICTURE CONT.

- **PRE-VIEW: Considering What, When, How to Implement Assessment**
  - **WHAT-- Levels of Student Learning**
  - **WHEN-- Terminal and Interim Assessment**
  - **HOW -- Using what you already have**

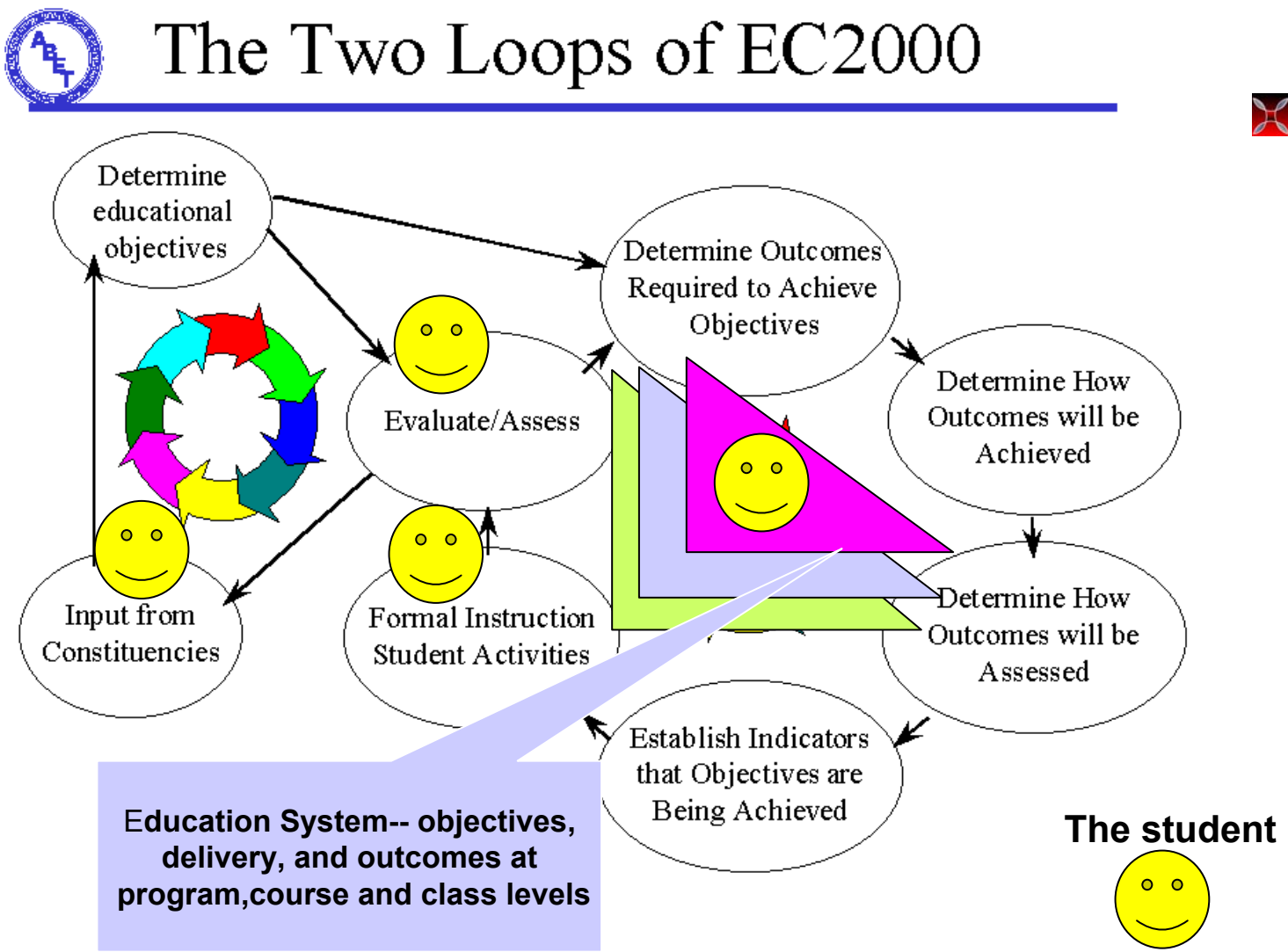
THE EDUCATION SYSTEM
Student Outcomes and Program, Course and Class Inter- Dependence



ONGOING EVALUATION SYSTEM

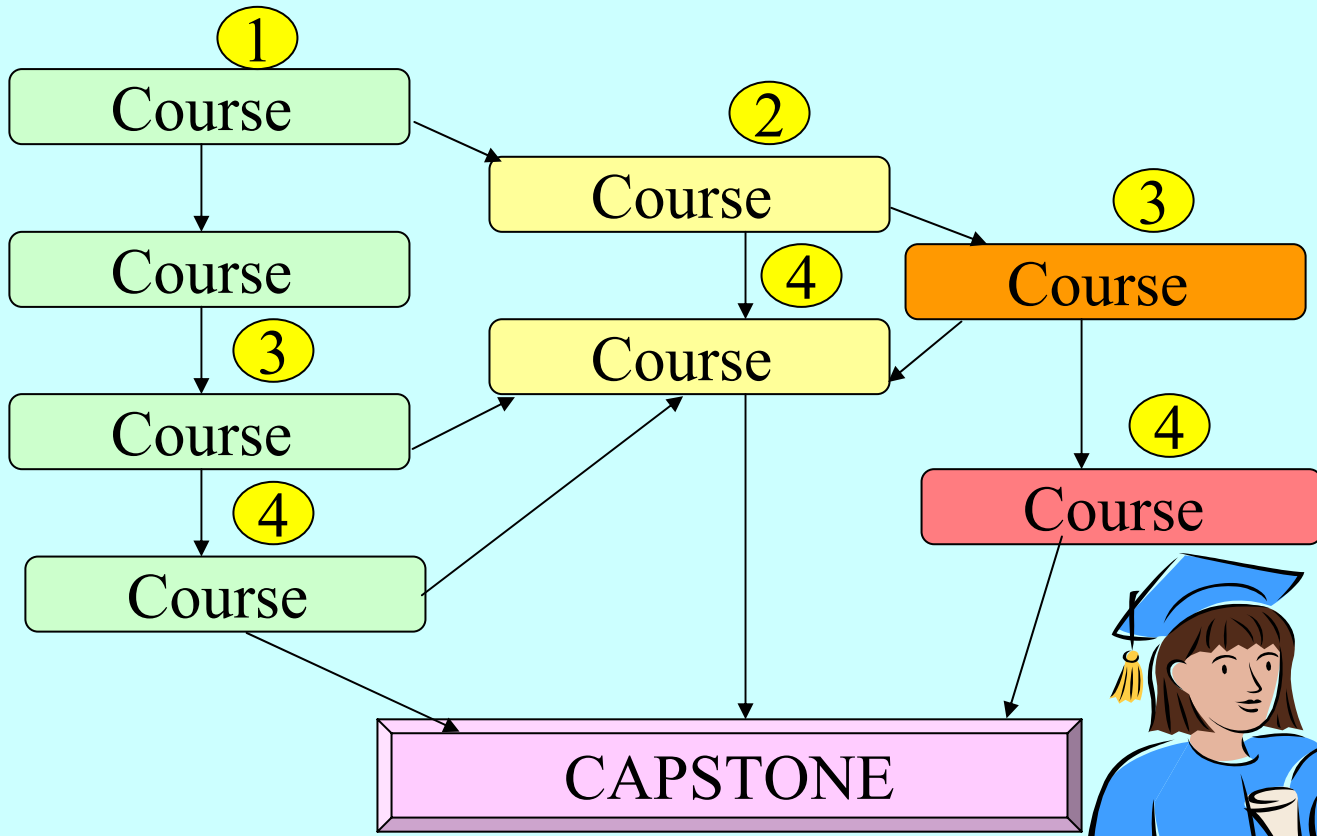


The Ongoing Evaluation System: Relationship to Education System and Student



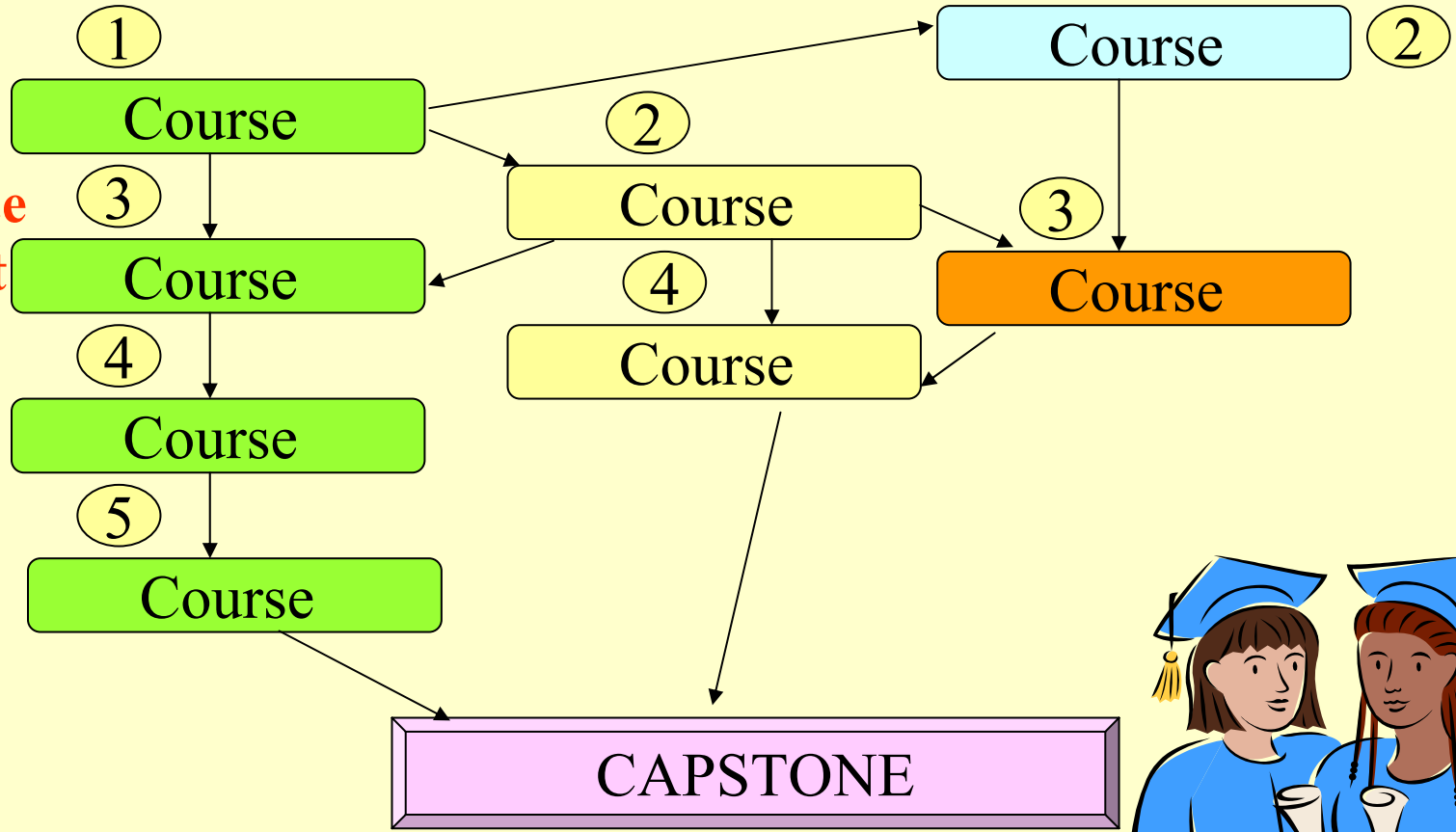
Why be concerned about Program Objectives & Program Outcomes at Course Level ??

Program Experience of Student #1:



Why be concerned about Program Objectives & Program Outcomes at Course Level ??

Program Experience of Student #2:



Sequence

Terminal Outcomes

Final outcomes observed at the end of the process of education

Examples:

- **Senior Design Project Assessment-Faculty, Panel of Faculty, Professionals and/or Students**
- **Assessment of Oral and Written Communication in Senior Project Presentation or Report**
- **Assessment of Senior Project Teamwork (i.e., Faculty Assessment; Self Assessment; Group Self Assessment)**

Terminal Outcomes

Concerns

- **Collection…Great burden upon the final year or greater difficulty in observing outcomes following outcomes**
- **Loss of "quasi experimental controls", threats to validity, reliability, increased expense, effort, intrusiveness**
- **Most terminal outcomes assumed to be cumulatively or progressively produced throughout the educational process**

Interim Outcomes

Interim Student Assessment:

Meaningful student outcomes observed at various points in time during the course of the education process to demonstrate student growth in competency through the educational process

Interim Outcomes

Examples:

- **Assessment of student group projects for knowledge, skills and processing competencies recognized as salient elements of good engineering designing , at various points in the educational continuum,**
- **Assessment of Oral and Written Communication in Project Presentations or Reports, at various points in the educational continuum**
- **Assessment of Class and Project Teamwork , at various points in the educational continuum (i.e., Faculty Assessment; Self Assessment; Group Self Assessment)**

Interim Process Reporting

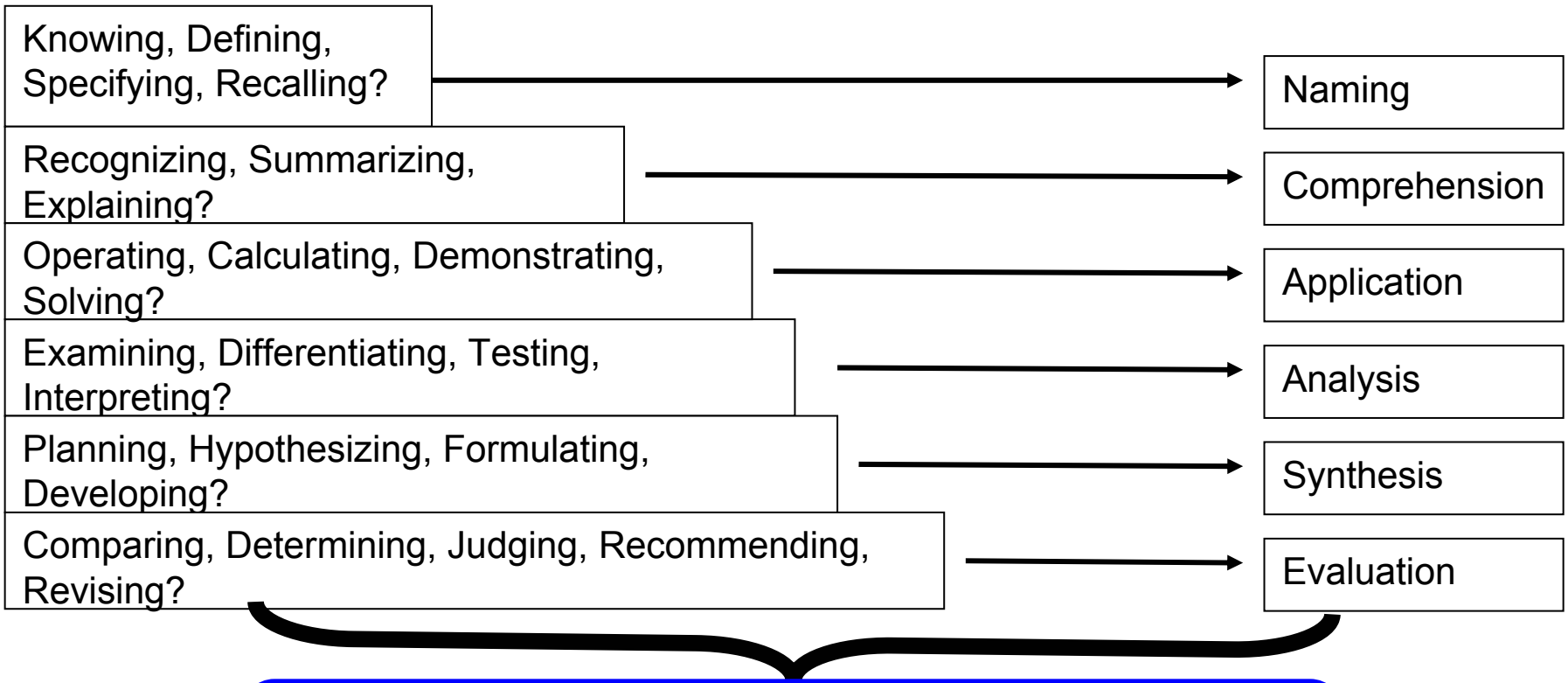
Instructional Processes Related to Terminal Outcomes Observed and Reported at intervals, in conjunction with the Assessment of that Terminal Outcome

Examples:

- **Regularly repeated Surveys (in each course, or in specifically selected courses) of Student and Faculty perceptions about instructional activities pointedly intended to facilitate learning for the Terminal Outcome**

Developing Program Objectives and Outcomes

Keep in Mind: LEVELS OF LEARNING
[Bloom's Taxonomy of Cognitive Learning]



Q: What specific learning / instruction activities will facilitate learning this content, operation, or processes at the desired level?
A:

II. 2. Program: Education Objectives

Each engineering program must have in place:

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II. 3. Program Outcomes and Assessment

Need to "Demonstrate" Abilities of Graduates to:

a Apply math, science and engineering principles	b Design and conduct experiments	c Design a system, comp., or process
d Function in teams	e Solve engr'g problems	f Be profess'nal and ethical
g Communicate effectively	h Understand global and societal impact	i Learn life-long
j Understand contemporary issues	k Use modern engineering tools	

Objective Template

Objective:

Outcomes	Performance Indicators	Strategies & Actions	Assessment Methods & Metrics	Evaluation	Feedback	ABET 2000 criteria & links to University, College & Depts

Professionalism & Ethics Objective

Professionalism & Ethics Objective: Students will understand and practice professional and ethical responsibility

Outcomes	**Performance Indicators**	**Strategies & Actions**	**Assessment Methods & Metrics**	**Evaluation**	**Feedback**	**ABET 2000 criteria & links to University, College, Depts**
Students are aware of engineering as a profession, identify as a member, and demonstrate collegiality in the profession	Participation in local and or national student societies. Participation in field trips (plant tours) Participate in multi-disciplinary experiences. Share professional experiences	Provide resources for local/national professional societies Provide resources and planning assistance for tours Encourage use of multi-disciplinary experiences	Collect data regarding memberships and participation. Number of students participating Performance evaluation using established standards and rubrics	Set goals for membership and participation Panel of evaluators go over the evaluations	Data and evaluations go to departments & associate dean for action . Evaluations also go to instructors who teach courses to enable course modifications	ABET: f, I, j College: Professionalism, Technical Competence, Life-Long Learning

Group Activity

- As a large group:
  - develop 1 program objective
  - refine language

- Break into teams to:
  - develop that program objective using the matrix/template handout
  - fill in the matrix/template cells

Discussion

- Select one representative from your group to share your activity results

Developing Classroom Objectives and Outcomes

Criteria for Developing Classroom Objectives

- Align classroom objectives with College objectives
- Include faculty in the development of objectives to enable faculty ownership
- Gain support from division chair and College administration
- **Question**- What do you want students to accomplish in this course? (Physics)
  - *Example- Students will be able to use and understand Newton's Third Law (for every interaction there are two equal and opposite forces, one on each object).*

Criteria for Developing Classroom Outcomes

- **Question**- More specifically, what do you want to accomplish in this course?
- *Example-*
  - *Students will be able to identify Newton's 3rd Law pairs*
  - Students can articulate Newton's 3rd Law in their own words
  - Students can use 3rd Law in static and dynamic systems

Criteria for Developing Classroom Performance Indicators

- **Question**- What can you measure to assess student performance?
- *Example-*
  - *Students will show coordination of pre-existing tools in terms of new experiment activity*
  - *Students will be able to apply Newton's 3rd Law to new situations and approaches not presented in class*

Criteria for Developing Classroom Strategies, Actions

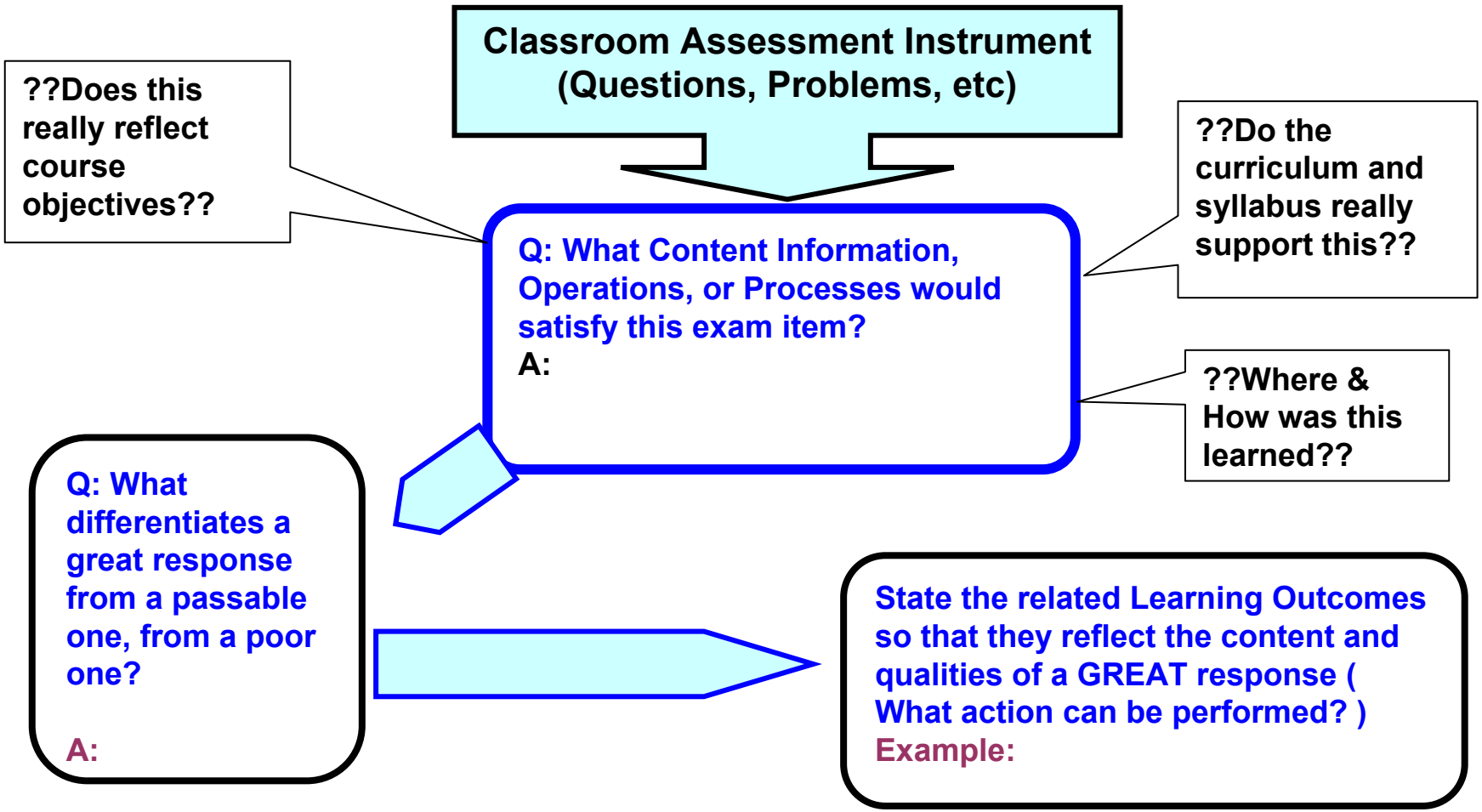
- **Question**- What specific practices and processes are necessary to achieve outcomes?
- *Example-*
  - *Provide time for group discussions of perceptions associated with Newton's 3rd Law before instruction (preconceptions)*
  - *Interactive demos of collisions with force probes*
  - *In class group work aimed at concepts of 3rd law and tools for using it*
  - *Student led post discussions of results of experience, demo and group work*

Group Activity

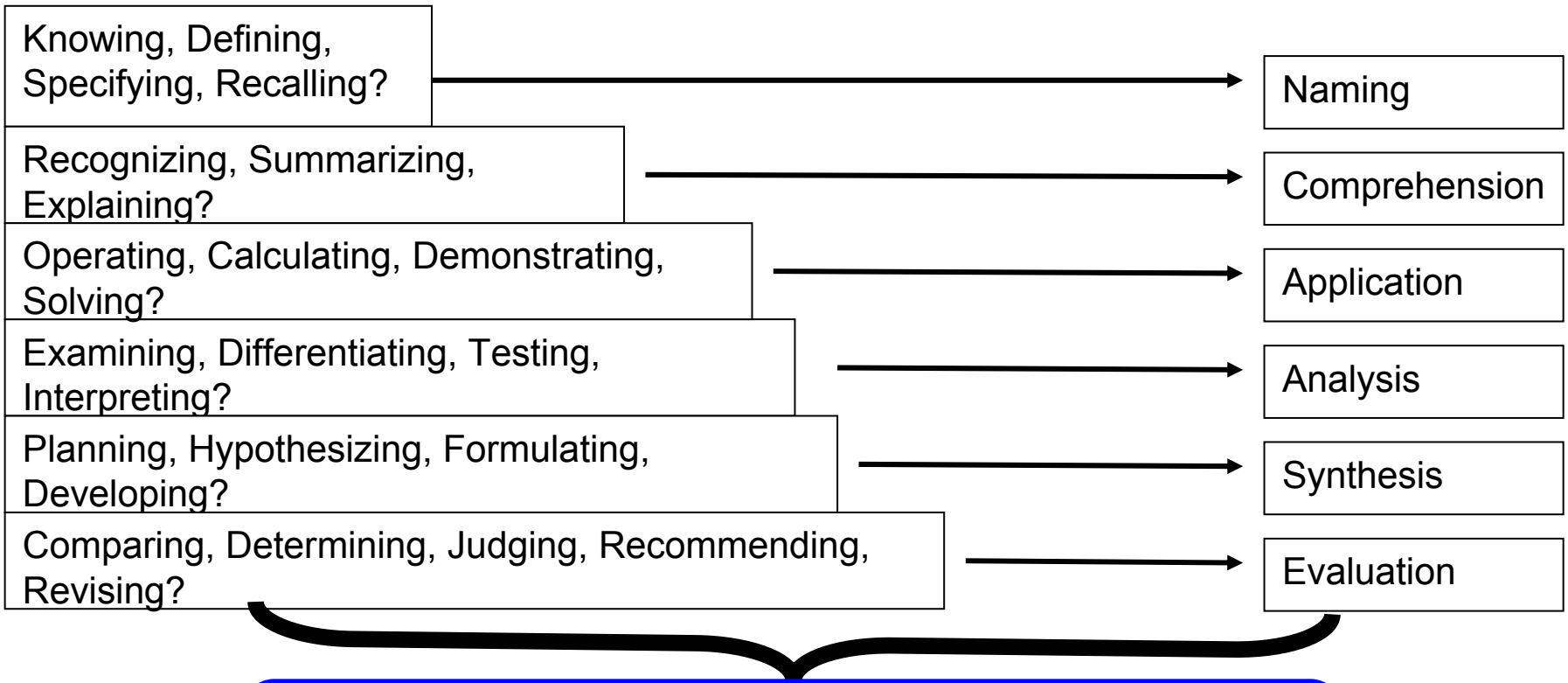
Reverse Engineering YOUR Course Objectives

- Use exams you have brought to the workshop to develop objectives and outcomes for your course

Q & A Guide for Generating Learning Objectives-to-Learning Outcomes: Flow Chart for De-constructive Approach



Q & A Guide for Generating Learning Objectives-to-Learning Outcomes: Flow Chart for De-constructive Approach (Cont'd….)



Q: What specific learning / instruction activities will facilitate learning this content, operation, or processes at the desired level?
A:

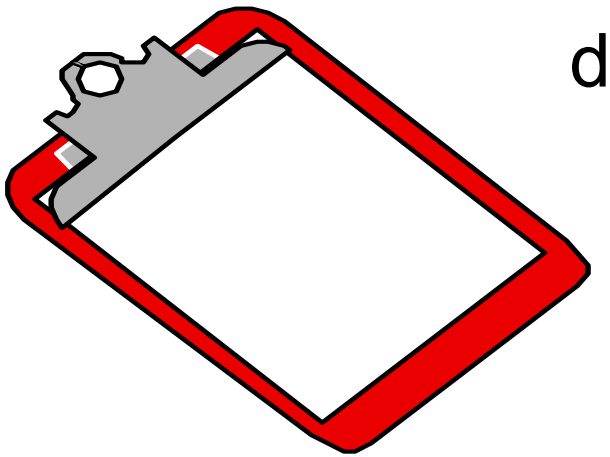
Discussion

Aligning YOUR Course Objectives with Those of Your Colleagues: Sharing and Discussing

- Select one representative from your group to share your activity results

Appropriate Assessment

Selecting and implementing data collection methods



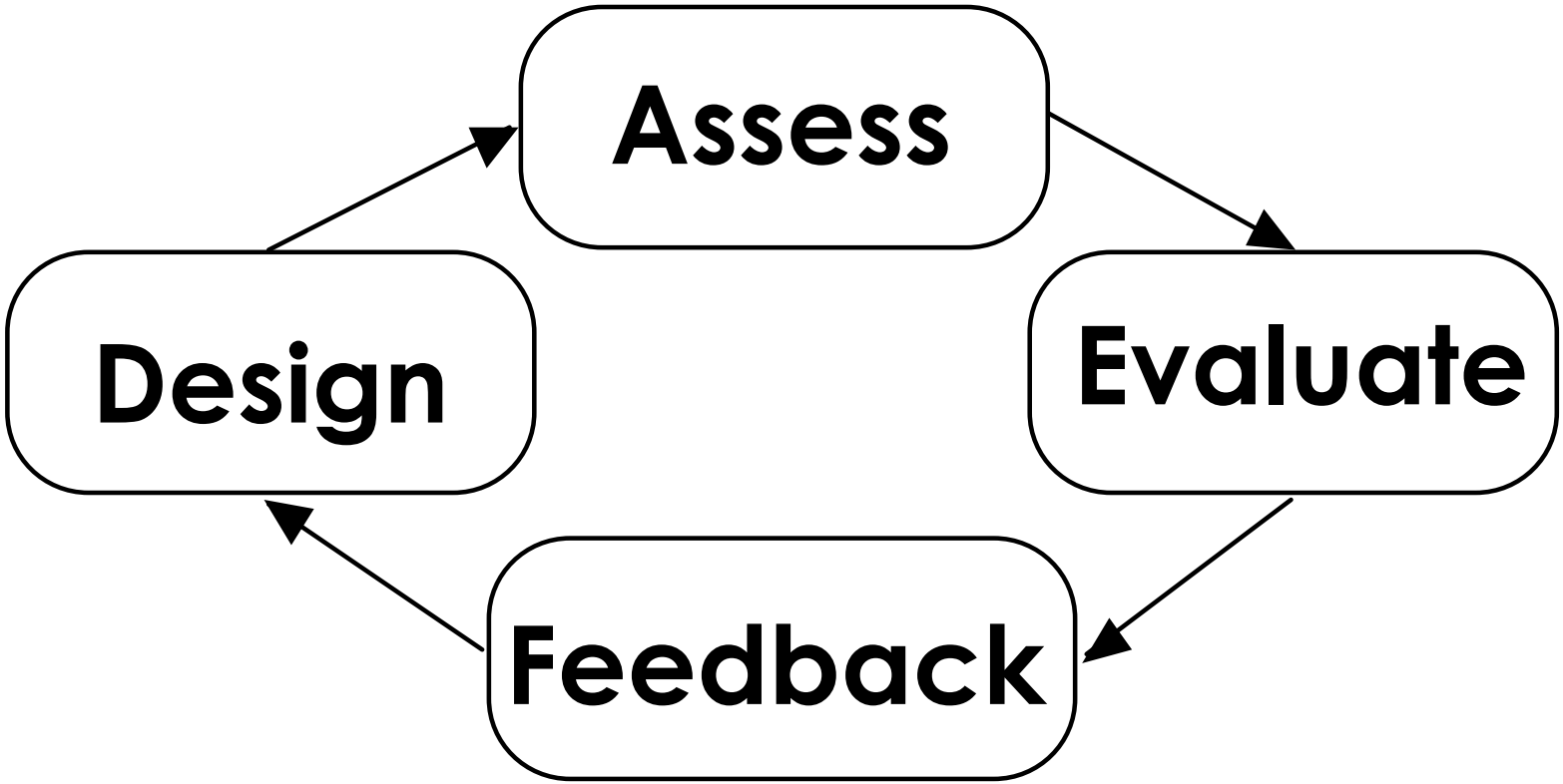
You Are in Control

- You choose what to measure
- You choose how to measure it
- You evaluate the results
- You change the course
- No external agendas

Develop an Assessment Tool

- **It should be:**
  - Informal but systematic--all students
  - Identify strengths & weakness
  - It should inform improvement
- **Types of assessment tools**
  - Products--reports, papers, tests
  - Product substitutes (self-assessments, attitudes)
  - Process--how students work

Continuous Improvement Loop



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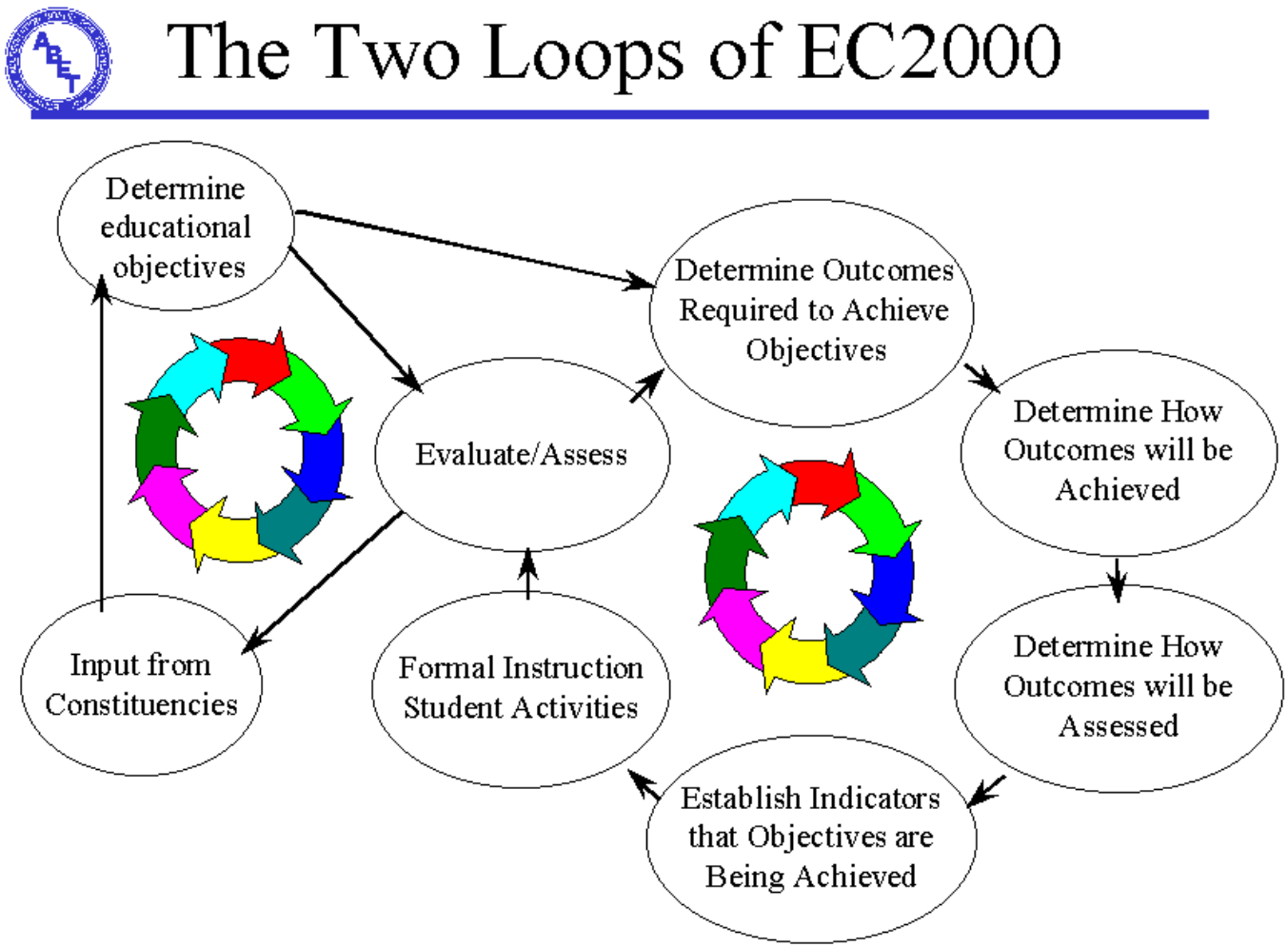


Closing the Loop

- Evaluate the assessment results
- Reflect on how to improve course
- Write an implementation plan
- Repeat closing the loop for the assessment itself

Comments on Course-based Continuous Improvement

- Goal is not rigorous, scientific evaluation
- Goal is to find something useful that will help you improve your course
- Best assessment is one that tells you about the "why"
- This is you & the students building a better course

Assessment Example

- Web-based assessment at Arizona State University
- Results from several questions shown on the following slides

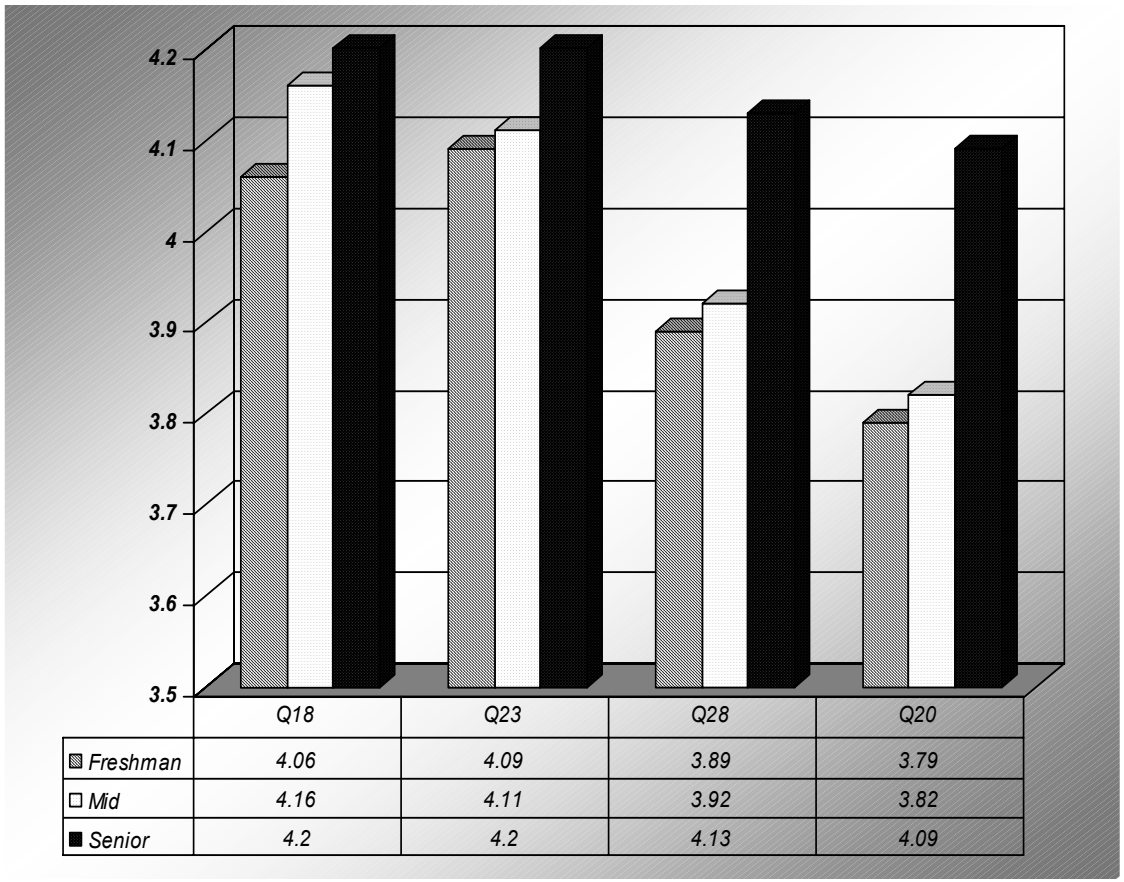
Communication Skills: 2000/2001

Q18. I can write effectively

Q23. I can effectively communicate my ideas to another person

Q28. I am confident in my speaking skills

Q20. I can make effective presentations in front of others



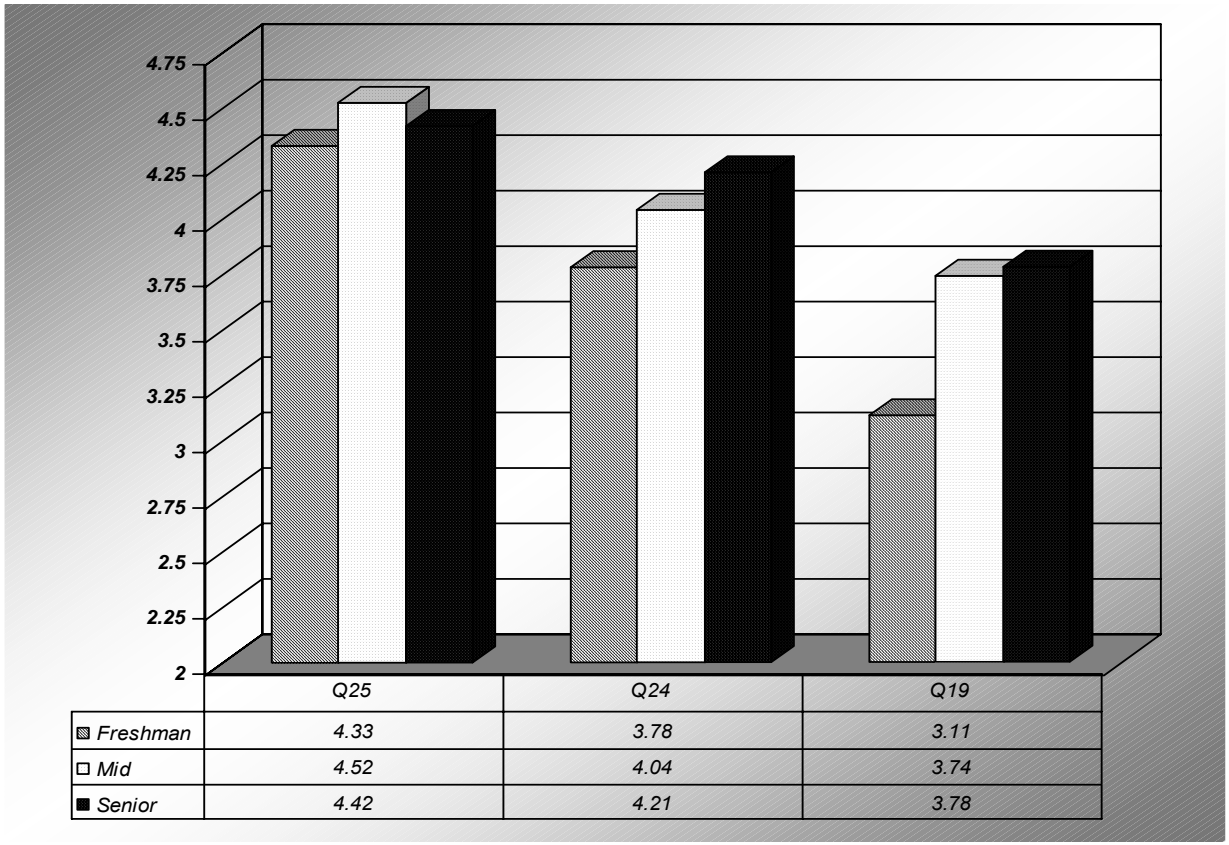
	Q18	Q23	Q28	Q20
Freshman	4.06	4.09	3.89	3.79
Mid	4.16	4.11	3.92	3.82
Senior	4.2	4.2	4.13	4.09

Technology: 2000/2001

Q25. I enjoy using computers

Q24. I have an ability to use commercial software to solve problems

Q19. I have computer programming skills



	Q25	Q24	Q19
Freshman	4.33	3.78	3.11
Mid	4.52	4.04	3.74
Senior	4.42	4.21	3.78

Metropolitanism: 2000/2001

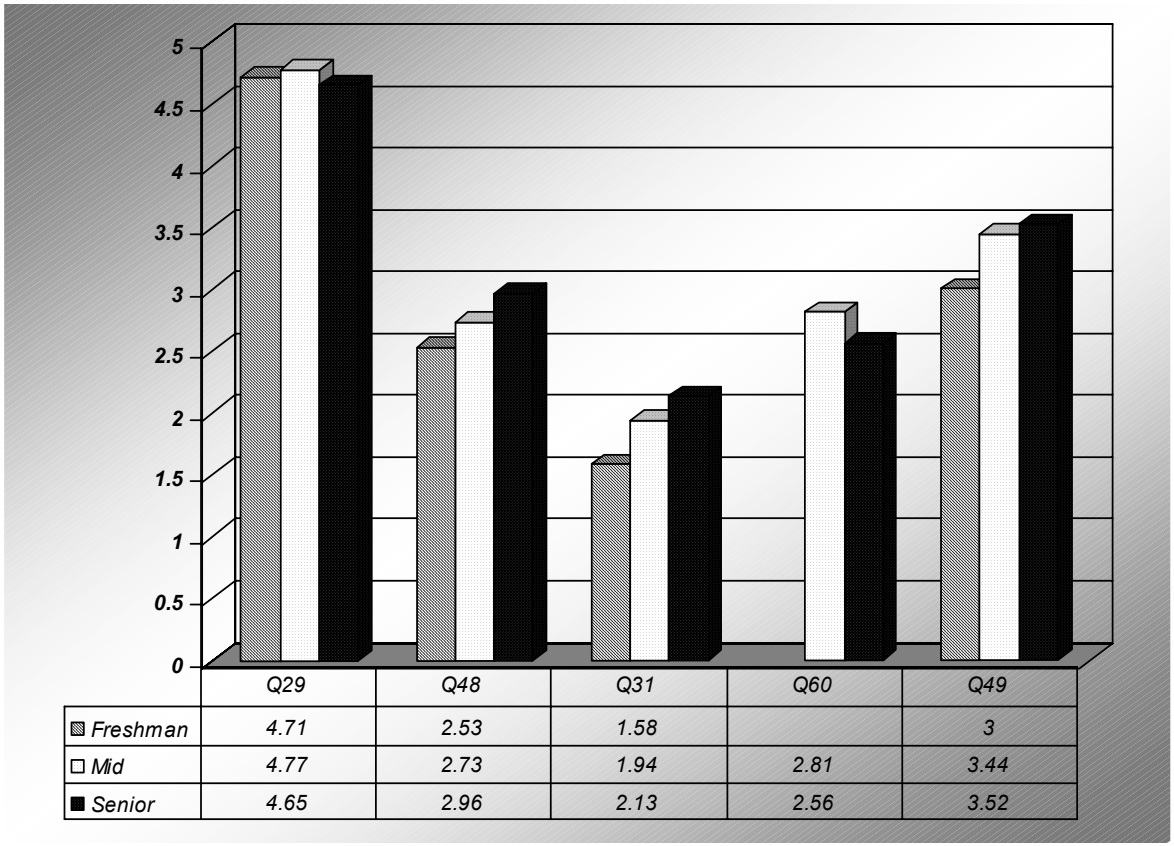
Q29. Engineers have contributed to solving problems in the world

Q48. I am aware that engineers develop solutions to issues surrounding metro Phoenix

Q31. I am aware of opportunities for outreach activities in the Phoenix metropolitan area

Q60. I have participated in Community service

Q49. I value diversity among classmates and colleagues



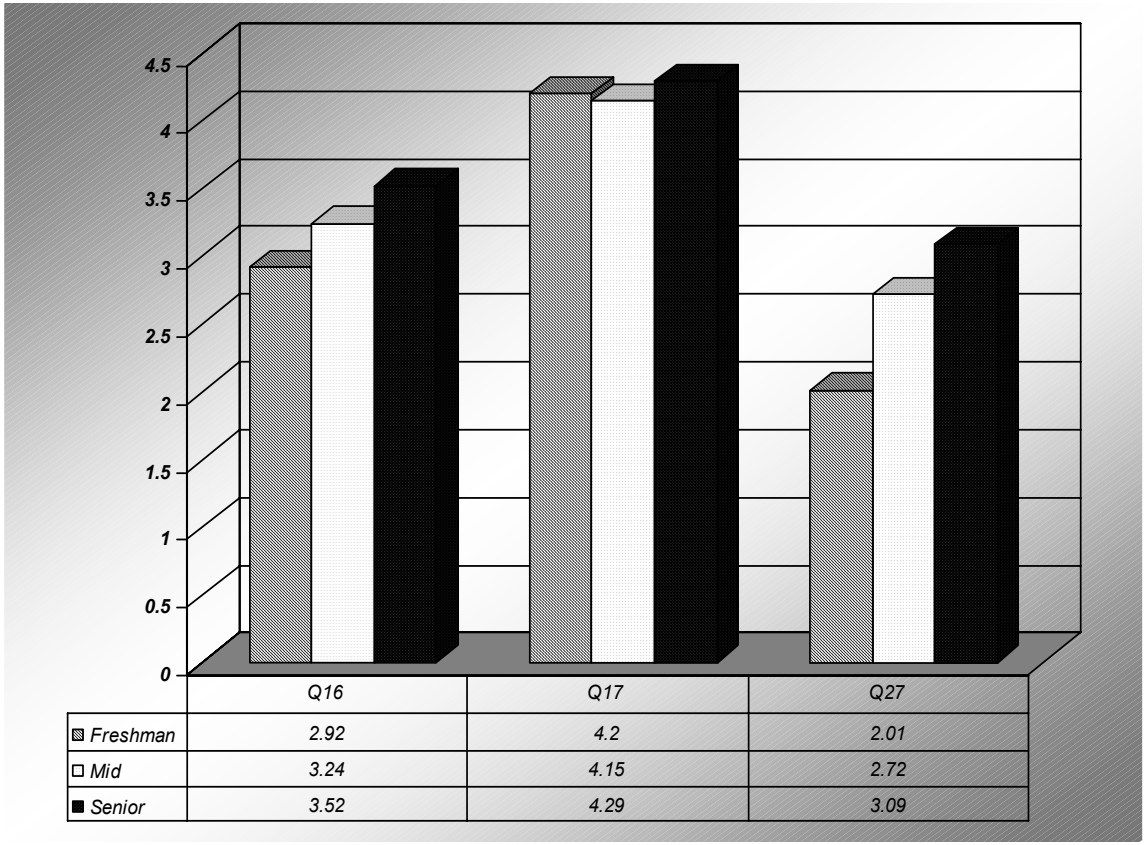
	Q29	Q48	Q31	Q60	Q49
Freshman	4.71	2.53	1.58		3
Mid	4.77	2.73	1.94	2.81	3.44
Senior	4.65	2.96	2.13	2.56	3.52

Professionalism: 2000/2001

Q16. I understand principles of ethics for engineering

Q17. I understand the professionalism that goes with being an engineer

**Q27. (2.0 I know the name of a professional society for my discipline;
3.0 I have attended meeting of the student section of my discipline's society)**



	Q16	Q17	Q27
Freshman	2.92	4.2	2.01
Mid	3.24	4.15	2.72
Senior	3.52	4.29	3.09

Life Long Learning: 2000/2001

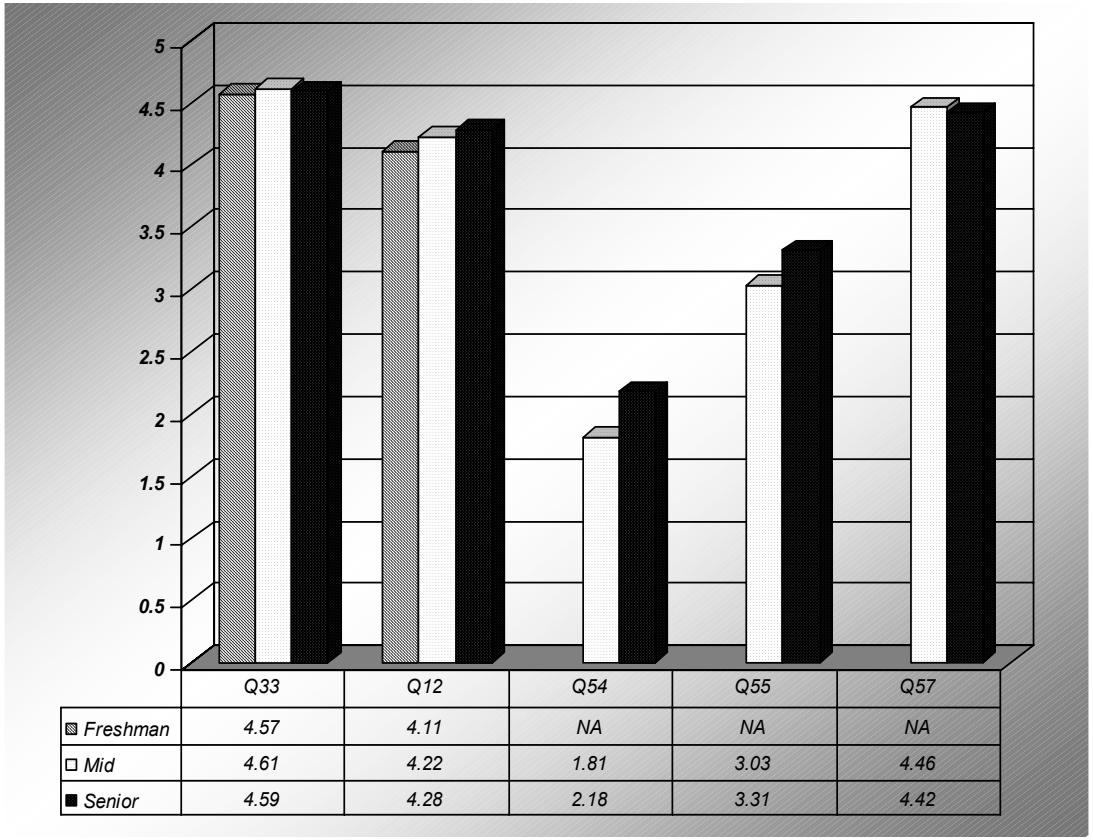
Q33. I enjoy learning about new technology

Q12. I enjoy problems that can be solved in different ways

Q54. I have participated in workshops and conferences beyond required coursework

Q55. I have read technical magazines and journals beyond coursework

Q57. I have used the Internet as a learning resource beyond required coursework



	Q33	Q12	Q54	Q55	Q57
Freshman	4.57	4.11	NA	NA	NA
Mid	4.61	4.22	1.81	3.03	4.46
Senior	4.59	4.28	2.18	3.31	4.42

Group Activity

Form Work Groups

- Using Computers
- Communication
- Life Long Learning
- Teaming

Group Activity

- Examine sample tools
- Adopt, adapt, or replace
- Imagine varying results with tool
- How would results provide basis for improvement of curriculum?
- Reflect on work
- Present work to whole group

Discussion

- Select one representative from your group to share your activity results

Using What You Have to Assess Your BIG PICTURE

Institutional Data Resources

- Institutional data is an invaluable source of historical and longitudinally stored student and program information, such as..
  - **DEMOGRAPHICS**
  - **SAT SCORES**
  - **H.S. STANDING**
  - **COURSES TAKEN IN YOUR PROGRAM**
  - **GPA AND COURSE GRADES**
  - **ENROLLMENT AND MAJOR INFORMATION**

Using What You Have to Assess Your BIG PICTURE

Institutional Data Resources: Student Outcomes

- **Institutional data can be used to compute outcome indicators such as**
  - **RETENTION -- IN COLLEGE, IN MAJOR, ETC**
  - **PROGRESSION AND GRADUATION RATES**
  - **GPA IN CORE MAJOR COURSES**
  - **UP-LINE IMPACT OF SPECIFIC PRECURSOR COURSES UPON SUCCESSOR COURSES**
  - **SPEED OF PROGRESSION THROUGH CORE MAJOR COURSES AND SPEED OF PROGRESSION TO GRADUATION**
- **In addition, IR may also administer course evaluation, student satisfaction and alumni follow-up surveys**

Using What You Have to Assess Your BIG PICTURE

Institutional Data Resources

- Identify and learn about your Institutional Research personnel
- Identify what raw data your institution routinely collects
- Identify what reports the IR group routinely generates and for whom and when
- Discuss your evaluation needs with them

What Does Your BIG PICTURE Look Like ?

GROUP ACTIVITY

- List your major program objectives and program competency ‘threads’
- List the courses which deliver those competencies
- Chart the progression of your program through successions of courses

What Does Your BIG PICTURE Look Like ? Cont.

GROUP ACTIVITY

- Identify which courses can provide baseline indicators of major student competencies targeted by program objectives
- Identify which courses can produce student outcomes demonstrating progress towards objectives
- Identify which courses can produce student outcomes demonstrating most complete satisfaction of particular program objectives

Using What You Have to Assess Your BIG PICTURE

SUGGESTION FOR FUTURE GROUP ACTIVITIES

- Gather and generate classroom assessment questions, problems and performance assignments from courses identified for producing competency outcomes for
  - baseline
  - interim progress
  - terminal satisfaction

Using What You Have to Assess Your BIG PICTURE

SUGGESTION FOR FUTURE GROUP ACTIVITIES

- Develop consensus about consistently adopting some common classroom assessment questions, problems, or project assignments with fixed scoring instructions
- Develop and maintain a pool of assessment items, scoring instructions and examples of A,C and Unsatisfactory student performance and categorize items by program objective, course objective and level of learning

Institutional Data

Round table discussion on using institutional data as part of the assessment and evaluation loop

ABET Reviewer's Perspective

Information ABET provides to reviewers in training

Engineering Accreditation Criteria

1. Students
2. Program Educational Objectives
3. Program Outcomes and Assessment
4. Professional Component
5. Faculty
6. Facilities
7. Institutional Support and Financial Resources
8. Program Criteria

Criterion 1—Students

Quality and performance of students

- Institution must advise, evaluate, monitor
- How are students advised?
- Policy in place and enforced:
  - All students meet graduation requirements
  - Transfer students and transfer credits
- Transcript analysis
  - Right courses, transfer credits, course sequencing

Criterion 2—Program Educational Objectives

Educational Objectives consistent with mission and criteria

- Addresses needs of constituents, allows for periodic input
- A sustainable, ongoing improvement process that checks achievement of the objectives and uses results to improve program effectiveness
- Curriculum and improvement process ensures achievement of objectives

Criterion 3—Outcomes and Assessment

Demonstrate that graduates have achieved desired outcomes

- Define an acceptable level of achievement
- Outcomes linked to mission and objectives
- Use results in the improvement process

Criterion 3—Outcomes and Assessment

Program Outcomes (a-k)

a) Apply knowledge of mathematics, science, and engineering appropriate to the discipline

b) Design and conduct experiments, analyze and interpret data

c) Design a system, component, or process to meet desired needs

Criterion 3—Outcomes and Assessment

Program Outcomes (a-k)

d) Function on multidisciplinary teams (define multidisciplinary)

e) Identify, formulate, and solve engineering problems

f) Understand professional and ethical responsibility

g) Communicate effectively

Criterion 3—Outcomes and Assessment

Program Outcomes (a-k)

h) Understand the impact of engineering solutions in a societal context

i) Recognition of the need for and ability to engage in life-long learning

j) Knowledge of contemporary issues

k) Use techniques, skills, and modern engineering tools necessary for engineering practice

Criterion 3—Outcomes and Assessment

- Outcomes must be clearly documented and prioritized
- Outcomes must be linked to assessment
- Most schools change a-k language at least a little
- Evaluation is typically easier if:
  - Program Outcomes are fairly similar to a-k

  Or

  - Program Objectives are mapped to a-k

Criterion 4—Professional Component

- Professional components consistent with objectives of program and institution
- Curriculum devotes adequate attention and time to each professional component
- Subject areas appropriate to engineering
- Preparation for engineering practice:
  - Major design experience

Criterion 4—Professional Component

Major Design Experience

- Culminating experience, based on knowledge and skills acquired in earlier coursework
  - Occurs late in the curriculum
  - Not just scattered design experiences
- Incorporates standards and realistic constraints
- Includes consideration of: economics, environmental, sustainability, manufacturability, ethical, health and safety, social, political

Criterion 4—Professional Component

Subject Areas

- One year combination of college level mathematics and basic sciences
  - Some experimental experience
  - Appropriate to the discipline
- One and one-half year of engineering topics
  - Includes engineering science and design
  - Appropriate to the discipline
- General education component that complements the technical component and is consistent with Program and Institutional Objectives

Criterion 5—Faculty

- Faculty sufficient to:
  - Provide adequate level of student interaction
  - Provide student advising and counseling
  - Support university service activities
  - Interact with industry
  - Support professional development
- Reviewer will likely interview students
- Competent to cover all curricular areas
- Provide proper guidance to program and its evaluation, development, and sustainability

Criterion 6—Facilities

- Opportunity for students to learn use of modern engineering tools
- Classrooms, laboratories, and equipment:
  - Accomplish program objectives
  - Foster student-faculty interaction
  - Encourage professional development
  - Well maintained, safe conditions, safety plan in place
- Computing and information infrastructure:
  - Support activities of students and faculty
  - Relate to educational objectives
  - Well maintained

Criterion 7—Support and Resources

- Constructive leadership
- Financial resources:
  - Acquire, maintain, operate facilities
  - Attract, retain, and provide professional development for faculty
- Technical and clerical services
- Reviewer will likely seek several opinions at various levels

Criterion 8—Program Criteria

- Current Program Criteria listed on ABET web site:

  www.abet.org

- Must satisfy and document all criteria associated with the title of the program
- Program Criteria cover:
  - Curricular topics
  - Faculty qualifications

Computing Programs Criteria

I. Objectives and Assessments
II. Student Support
III. Faculty
IV. Curriculum
V. Laboratories and Computing Facilities
VI. Institutional Support and Financial Resources
VII. Institutional Facilities

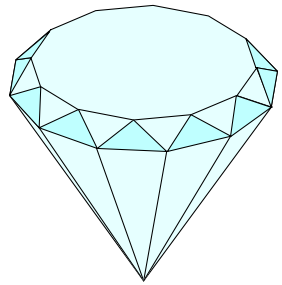
Each criterion has a set of listed Standards

Computing Programs

Guidance for Interpreting the Criteria for Accrediting Computing Programs

Provides generally acknowledged ways to satisfy a Standard

Four Gems of Wisdom



- Adopt a common language
- Content experts must determine the objectives and outcomes
- Align assessment with objectives and outcomes up-front!
- Show how assessment enables change

References

- Duerden, S. J., & Garland, J. (1998). *Goals, objectives, & performance criteria: A useful assessment tool for students and teachers*, Proceeding 1998 Frontiers in Education (FIE) Conference, November, Tempe, AZ.
- Lockwood, F. (1992), *Activities in Self-instructional Texts*, Kogan Page, London:UK
- McGourty, J. *Academic subcommittee workshop*, ASU, May 18-21, 1998 (Columbia and the Gateway Coalition). Also see: McGourty, J (1998). Strategies for Developing, Implementing, and Institutionalizing a Comprehensive Assessment Process for Engineering Education, Proceedings 1998 Frontiers in Education (FIE) Conference, November, Tempe, AZ.
- Maryland, P. (1990). Distance learners' interactions with text while studying, *Distance Education*, 11(1), 71-91.
- O'Reilly, M., Saenger, H., & Brooks, L. (1997). Students' responses to optional study activities in distance education materials, in *Research in distance Education* , 4.
- Parer, M. (1998). *Textual Design and Students' Learning*. Centre for Distance Learning, Gippsland Institute, Victoria
- Rogers, G.M., & Sando, J.K. (1996). *Stepping Ahead: An assessment plan development guide,* Foundation Coalition, Terre haute, IN.