(Food Science) Curriculum Evaluation Based on Competencies, Outcomes, and Assessment

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Paradigm shift in evaluation of academic curriculums and programs.

It used to be based on coursework, facilities, and faculty.

Now focus is on outcomes and assessment.

ABET requires that engineering programs must demonstrate that their Graduates have:

- **An ability to apply knowledge of mathematics, science, & engineering**
- **An ability to design and conduct experiments as well analyze and interpret data**
- **An ability to design systems, component, or processes to meet desired needs**
- **An ability to function on multi-disciplinary teams**
- **An ability to identify, formulate, and solve engineering problems**
- **An understanding of professional and ethical responsibility**

- **An ability to communicate effectively**
- **The broad education necessary to understand the impact of engineering solutions in a global and societal context**
- **A recognition of the need for, and an ability to engage in life-long learning**
- **A knowledge of contemporary issues**
- **An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.**

Assessment

Each program must have an assessment process with documented results. Evidence must be given that the results are applied to further the development and improvement of the program. The assessment process must demonstrate that the outcomes of the program are being measured.

Institute of Food Technologists Committee on Higher Education evaluates the Food Science programs based on

- **Facilities and faculty**
- **Competencies**
- **Outcomes**
- **Assessment**
- **Revision/Curricular modifications**

to improve student learning

Competencies

Competencies define the general categories of knowledge in a given field. These are similar to learning objectives and not necessarily written in terms that can be directly measured.

All topics in the core competency grid must be covered somewhere in the curriculum, and all essential background prerequisites must be covered.

Outcomes

Outcomes are statements of learning expectations for students, written in terms that can be measured using some assessment tool.

Learning outcomes must written for all required (Food Science) courses and for the curriculum as a whole (programmatic outcomes).

Outcome

A true learning outcome is one that can be assessed.

For example ‘To understand a *physical principle*’ is not very specific. Better way is to use an active verb from Bloom’s taxonomy.

Bloom's Taxonomy

Bloom's taxonomy is a widely-recognized sequence of learning, from the lowest level of understanding to the most advanced level of analysis and synthesis.

Bloom's Taxonomy

(Bloom, B.S. Ed. 1956. Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook 1: Cognitive Domain. Longman, White Plains, NY)

I. Knowledge. Remembering information.

Key words: Define, identify, label, state, list, match

II. Comprehension. Explaining the meaning of information.

Key words: Describe, paraphrase, summarize, estimate

III. Application. Using abstracts in concrete situations.

Key words: Determine, chart, implement, prepare, solve, use, develop

IV. Analysis. Breaking down a whole into component parts.

Key words: Point out, differentiate, distinguish, discriminate, compare

V. Synthesis. Putting parts together to form a new and integrated whole. *Key words:* Create, design, plan, organize, generate, write

VI. Evaluation. Making judgments about the merits of ideas, materials or phenomena. *Key words:* Appraise, critique, judge, weigh, evaluate, select

Outcome

A true learning outcome is one that can be assessed.

For example ‘To understand a *physical principle*’ is not very specific. Better way is to use an active verb from Bloom’s taxonomy.

For example, using Bloom’s level III (Application), the outcome can be stated something like ‘student should be able to set up equations and solve problems for different systems’

Assessment

"Assessment is the systematic collection, review, and use of information about educational programs undertaken for the purpose of improving student learning and development" (Palomba, C.W. and T.W. Banta. 1999. Assessment Essentials . Jossey-Bass, San Francisco, CA).

Appropriate assessment methods must be used to evaluate student learning at both course and program levels, i.e., measurement of outcomes.

Assessment

There must be a clear evidence that there is commitment from faculty, administration, and students to meaningful assessment of learning outcomes *to promote excellence in education.*

Deep assessment: **beyond (exams, quizzes), especially at higher level classes where higher levels of Bloom's taxonomy are developed.**

9 Principles of Good Practice for Assessing Student Learning

From: Assessment in Practice: Putting Principles to Work on College Campuses

by T.W. Bunta, J.P. Lund, K.E. Black, and F.W. Oblander

1) The assessment of student learning begins with educational values

Educational values should drive what and how we choose to assess

Not trying to measure what is easy but a process of improving what we really care about (educational mission, purpose, and values)

2) Assessment is most effective when it reflects an understanding of learning as multi-dimensional, integrated, and revealed in performance over time

Learning is a complex process: What students know and what they can do with what they know

Not only knowledge and abilities but also values, attitudes, habits

3) Assessment works best when programs it seeks to improve have clear, explicitly stated purposes

Goal oriented process

Clear, shared, implementable goals

Compare educational performance with educational purposes & expectations

4) Assessment requires attention to outcomes but also to experiences that lead to those outcomes.

Student experience along the way

Which students learn best under what conditions

5) Assessment works best when it is ongoing and not episodic

One shot assessment is better than no assessment but

Improvement is best fostered when assessment has series of activities over time

6) Assessment fosters wider improvement when done across the educational community

Faculty + student affair educators + administrators + librarians + ..

7) Assessment makes a difference when it begins with issues that people really care about.

Think in advance how the information will be used and by whom

Not just gather data and generate results, but interpretation of data to guide continuous improvements

A plan must be in place for continual program improvement based on assessment data collected.

8) Assessment is likely to lead to improvements when it is a part of larger set of conditions that promote change

Value quality of teaching and learning

Buy-in from higher ups

9) Through assessment, educators meet responsibilities to students and to the public.

Assessment tools and resources

Assessment Tools
(from the University of Wisconsin LEAD Center; ww.cae.wisc.edu/~lead)

Direct indicators of learning
- **capstone course evaluation**
- **courses with embedded assessment**
- **tests and examinations**
- **portfolio evaluation**
- **thesis evaluation**
- **internship report**
- **videotape/audiotape evaluation of performance**
- **project evaluation**
- **exit competency exam**

Indirect indicators of learning

- external reviewers
- student surveys/exit interviews
- alumni surveys
- employer surveys
- curriculum/syllabus analysis

Example of competencies in Food Chemistry and Analysis

Competency	FS 104	FS 201	FS 202	FS 304	FS 314	FS 401	FS 402	FS 411	FS 412	FS 419	FS 423	FS 424
1.1.a. Understand how molecular structure influences the properties and chemical reactions of the chemical components of foods.	O	X	X	X	O	O		X	O	X	O	O
1.1.b. Understand how the molecular properties of different food components and interactions among these components modulate the specific quality attributes of food systems.	X	X	X	X				X	X	X	O	O

Example of competencies in Success Skills

Competency	FS 104	FS 201	FS 202	FS 304	FS 314	FS 401	FS 402	FS 405	FS 411	FS 412	FS 419	FS 421	FS 423	FS 424
3.5.a. Define a problem, identify causes and solutions, and make thoughtful recommendations	X	X	X	X		X		X	X	X	O	X	X	X
3.5.c. Independently research scientific and nonscientific information	X	O		O	X	O		O	X	X	X	X	X	X
3.5.e. Demonstrate the use of oral and written communication skills	X	X	X	X	X	X		X	X	X	X	X	X	X
3.5.f. Provide leadership in a variety of situations						O		X	X	X		O	O	X
3.5.i. Facilitate group project						X		X	X	X	O	X	O	X

Example of Course Outcomes

11:400:419 Food Physical Systems (3 credits) Lectures Taught every fall semester Instructor: Richard Ludescher				
Course Outcome	Bloom Levels	Instructional Activities	Assessment	Core Competency Addressed (Refer to Tables 1.1-3.5)
Be able to apply the thermodynamic principles of enthalpy, entropy and free energy to food systems	1-3	Lectures (3), group discussions & problem solving	Quizzes; exam; written assignment	1.1.a, 1.1.b, 1.1.d; 1.4.a; 1.5.b, 1.5.c, 1.5.e, 1.5.j
Be able to analyze the thermodynamic and physical properties of simple water solutions	1-5	Lectures (4), group discussions & problem solving; case study	Quizzes; exam; problem set	1.1.a, 1.1.b, 1.1.d, 1.1.f; 1.2.a; 1.4.a, 1.4.b; 1.5.b, 1.5.e, 1.5.j

Summary of Assessment Results for Food Physical Systems Course

Development of novel supplementary materials to enhance comprehension of conceptually difficult material and its application to foods.

Nearly every class begins with a short (1 question) quiz. Quizzes are graded in class by the students themselves. Nearly every class thus begins with a 15-20 minute assessment, clarification, and review of a major concept from the previous class.

Coverage of material is evaluated in every class by extensive discussion and question and answer periods.

Evaluation of student performance on problem sets and written assignments serves both to evaluate (assign a course grade) but also to assess the extent to which a difficult concept has been covered in class or through the readings.

Take home exams are used to teach as well as evaluate student learning. In the long (usually seven day) period available, students can be asked to investigate a novel application of a specific concept by, for example, pursuing an application that relates to but goes beyond the material covered in class.

The specific outcomes of the undergraduate Food Science program at Rutgers are:

- **To have fundamental knowledge of Food Science and exposure to a broad cross section of knowledge in Food Science &Technology**
- **To have quantitative understanding in Food Science and Technology**
- **To possess food product development experience**
- **To be prepared for possible graduate studies**
- **To be successful in food industry and government jobs**
- **An ability to understand food commodities as types of Food Systems**
- **To be able to function effectively in any commodity oriented food industry (basic science and understanding of food systems).**
- **An ability to come up with new and creative applications of Food Science**
- **An ability to self learn, be innovative, be able to apply existing principles in novel ways**
- **To be able to work in a team**
- **To be able to lead a team**
- **To possess good oral and written communication skills**
- **Awareness of ethical, legal, and safety issues with foods**

Student Learning Assessment Philosophy

Emphasize basic principles and their relevance to foods and food processing operations rather than the specific properties of individual foods or commodities.

Emphasize conceptual knowledge and problem solving, rather than memorization and recitation of facts.

We realize that students can also have very different learning styles. Our faculty members use a variety of evaluative methods to assess student learning including short writing assignments (lab reports, critiques) as well as more comprehensive writing tasks (review papers).

Oral communication skills are developed through in-class presentations and organized group-discussions.

Quality of each course and the teaching effectiveness of the course instructor

Student Instructional Rating Form (CAT)

Mid-term feedback from students (CAT)

Peer review evaluations for teaching in the classroom

Endel Karmas Teaching Excellence Award

The instructional quality of Teaching Assistants (TA) is evaluated by students. The Department recognizes excellence in teaching of a TA every year by awarding the Endel Karmas Teaching Excellence Award for the best TA of the year.

Assessment of Food Science Undergraduate Program Outcomes

1. Graduate school
2. Job offers and placement of our graduates
3. On-site recruitment by employers
4. Food Science Student Advisory Council
5. Chair's Food Science Advisory Council
6. On-line alumni feedback
7. Exit interviews of graduating students
8. Employer survey
9. External Review of the Department

Alumni Feedback on UG Food Science Program at Rutgers

Rutgers Food Science Alumni: We want to hear from you. *Please click on the following link*: **http://teachx.rutgers.edu/surveys/foodscience.html** *and give us your feedback. It is anonymous.*

Curriculum revision is an on-going process, driven by perceived needs, opportunities, and feedback.

Solicitation of input and comments from alumni working in the food industry and from the Food Science Advisory Council

New courses, revised courses

New Options: Food Science & Management Economics, Culinology*

Resources

USU web site on assessment
www.usu.edu/~famlife/nfs/assessment/index.htm
Field-tested Learning Assessment Guide (FLAG)
www.wcer.wisc.edu/nise/cl1/flag/default.asp
Alverno College web site (http://www.alverno.edu/)
Alverno College (Milwaukee, WI) assesses student abilities using a variety of techniques instead of assigning grades
American Association of Higher Education (AAHE)
http://www.aahe.org/
Angelo, T. and P. Cross. 1993. **Classroom Assessment Techniques: A Guide for College Teachers** (2nd Ed.). Jossey-Bass, San Francisco, CA.
Diamond, R. 1998. **Designing and Assessing Courses and Curricula: A Practical Guide** . Jossey-Bass, San Francisco, CA.
Palomba, C.A. and T.W. Banta. 1999. **Assessment Essentials** , Jossey-Bass, San Francisco, CA.

Resources for learning outcomes

•Benchmarks for Science Literacy. 1993. AAAS, project 2061, Oxford University Press, NY

•National Science Education Standards. 1996. National Academy Press, Washington, DC

•Erwin, T. D. 1991. **Assessing Student Learning and Development: A Guide to the Principles, Goals, and Methods of Determining College Outcomes**. San Francisco: Jossey-Bass.

•Kendall, J. S., Marzano, R. J. 1997. **Content Knowledge**. Aurora, CO: Mid-Continent Regional Educational Laboratory.

•Diamond, R. 1998. **Designing and Assessing Courses and Curricula: A Practical Guide**. Jossey-Bass, San Francisco, CA.

•Glatthorn, A. A. 1999. **Performance Standards and Authentic Learning**. Larchmont, NY: Eye on Education.

•Palomba, C.A. and T.W. Banta. 1999. **Assessment Essentials**. San Francisco: Jossey-Bass.

•Huba, M. E. , Freed, J. E. 2000. L**earner-Centered Assessment on College Campuses: Shifting the Focus from Teaching to Learning**. Boston, MA: Allyn and Bacon.

•Maki, P. L. 2002. **Developing an Assessment Plan to Learn about Student Learning**. Assessment Forum. A complete copy can be accessed on-line from the American Association for Higher Education at http://www.aahe.org/Assessment/assessmentplan.htm.