PROGRAMMATIC ASSESSMENT WITHIN AN ENGINEERING TECHNOLOGY PROGRAM

Cliff Mirman[1] and Promod Vohra[2]

Abstract - Programmatic Assessment plays an important role within any educational program. It is important to constantly determine whether the program satisfies the goals and missions for which it was developed. This need for assessment is of critical importance in the area of Engineering Technology, which consists of both basic theory and application. Due to the constant change that occurs in industry it is important to both assess whether the program teaches current information and applications and if the courses and laboratories deliver the prescribed outcomes. To provide feedback on both of these important aspects, the Northern Illinois University College of Engineering and Engineering Technology and the Department of Technology has instituted a comprehensive assessment plan.

Initially, the Departmental faculty developed a set of programmatic outcomes for each emphasis. The Department has adopted the Accreditation Board of Engineering and Technology (ABET) learning outcome criteria as educational objectives since the department, now accredited by NAIT, will obtain ABET (TAC) accreditation in the future. From the developed outcomes, a programmatic curriculum and laboratory structure, based upon these outcomes, was developed. To determine whether the outcomes, curriculum, and laboratory structure satisfy the needs of industry, the Departmental assessment plan includes a component that determines the needs of industry. The departmental assessment plan also examines how graduates assimilate into industry based upon the knowledge and skills obtained at NIU. Lastly, the assessment plan examines the course outcomes and learned knowledge that current students obtain. The assessment plan, which has been developed, utilizes numerous methods, applied to groups of current students, graduates, and industry representatives, to arrive at data. Information, which is collected through program assessment, is analyzed and presented to the departmental faculty. This paper will present the NIU Technology Department assessment procedure, data collected, and instruments utilized, as well as modifications that have been implemented as a result of the data collected, thus insuring consistency between teaching and learning

Introduction

The role that assessment plays in an educational program has always been of major importance in the development process (1-4). Today, there is much more emphasis placed on documentation of the assessment process. Courses and programs are altered for any number of reasons, most of which center around some assessment process. Typically, the impetus for change comes from input provided by faculty, alumni, current students, industry, or other sources. This information is then processed and changes are made at either the course or program level. The assessment process is complex in the manner in which information is obtained, reduced, disseminated, and utilized. The goal of any assessment plan is to determine how well the educational program conforms to the outcomes that are developed. Representing the departmental leadership, the goal of assessment is much deeper. From an administrators viewpoint the process of assessment is the complete circle of program development, determination of how the program fits a desired need, and to implement change where change is needed. It is this complete view of assessment that develops strong programs and keeps the faculty aware of the current and future needs and trends. In addition, programmatic assessment must be comprised of many aspects that examine all areas of the program, including employers, alumni, intern assignments, capstone experiences, industry needs, among others (5,6). This assessment process is of great importance in the Engineering Technology area, where both the theoretical curriculum and laboratory experiences must provide students with current material. This paper outlines the comprehensive assessment program that is used by the Northern Illinois University Department of Technology.

Departmental Programmatic Outcomes

The basis of any program is the set of learning outcomes that the program strives to achieve. In the Engineering Technology area, the 14 ABET outcomes can be utilized. These outcomes are:

[1] Cliff Mirman, Department of Technology, 204 Still Gym, Northern Illinois University, Dekalb, Ill., mirman@ceet.niu.edu
[2] Promod Vohra, CEET, 331B Engineering Bldg, Northern Illinois University, Dekalb, Ill., vohra@ceet.niu.edu

An engineering technology program must demonstrate that graduates have:

A. An appropriate mastery of the knowledge, techniques, skills and tools of their disciplines.
B. An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology.
C. An ability to conduct, analyze and interpret experiments and apply experimental results to improve processes.
D. An ability to apply creativity in the design of systems, components or processes appropriate to program objectives.
E. An ability to function effectively on teams.
F. An ability to identify, analyze and solve technical problems.
G. An ability to communicate effectively in writing.
H. An ability to communicate effectively orally.
I. A recognition of the need for, and an ability to engage in lifelong learning.
J. An ability to understand professional, ethical and social responsibilities.
K. A respect for diversity and a knowledge of contemporary professional, societal and global issues.
L. A commitment to quality, timeliness, and continuous improvement.
M. An ability to program computers and/or utilize computer applications effectively.
N. An ability to use modern laboratory techniques, skills, and/or equipment effectively.

From the above outcomes, it can be determined how each is covered within the course and laboratory work in the given curriculum. Using these inclusive outcomes, the department faculty can develop learning objectives within the course work that encompass some subset outcomes. The ultimate goal of the program is to ensure that each of the above outcomes are covered in a subset of courses. To determine which outcomes will be included in which courses, it is left to the department faculty. The department faculty then create course syllabi which outline the learning objectives and their specific association to the learning outcomes. The syllabus also describes the tools of assessment that are utilized to gage the level of understanding for the specific learning objectives. Table 1 shows a portion of a syllabus for the Departmental Strength of Materials course that includes the learning objectives and related outcomes for the course. Using this syllabus, the students and instructor have a map which outlines the course goals and how the goals fit within the program structure, and are be assessed.

Departmental Assessment Plan and Tools

To provide a platform for revision in curriculum or laboratory exercises within the program, it is important that all of the parties involved in the process have a means for assessment and access to the data produced. This assessment can, and should, take on many forms, and reach out to many constituent groups for input. The information that is obtained from each group is diverse and unique, and it contains vital information for revision. This information includes dealing with student needs to providing students with skill sets that will make them marketable in industry. The NIU Department of Technology bases our assessment on constituent groups comprised of Departmental students

Learning Objectives	Relational ABET Learning Outcomes	Performance Assessment
Ability to determine axial and bending stress and strain, as well as torsional stress and strain and Hookes law	A. An appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines. B. An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology. C. An ability to conduct, analyze and interpret experiments and apply experimental results to improve processes. F. An ability to identify, analyze and solve technical problems.	Quizzes, Homework, Laboratory write-ups, tests, Class questions
Ability to utilize factor of safety in performing failure calculations	A. An appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines. B. An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology. C. An ability to conduct, analyze and interpret experiments and applies experimental results to improve processes. F. An ability to identify, analyze and solve technical problems. J. An ability to understand professional, ethical and social responsibilities.	Quizzes, Homework, Laboratory write-ups, tests, Class questions

Table 1 – Portion of Syllabus that relates learning objectives, outcomes, and assessment

and faculty, alumni, employers, and select industry groups.

The information which is collected from current faculty and students assists in the instructional aspects of the program, specifically providing information as to the development of knowledge and instruction in class and laboratory and also, how outcomes are covered within courses and through the entire curriculum. One of the assessment tools that is used examines how the ABET learning outcomes are met within specific courses and across the entire program. Table 2 shows the results of the programmatic outcomes matrix which is assembled for one given program. The information is based upon the specific outcomes covered in each course, provided through faculty syllabus input. This programmatic outcomes matrix is modified yearly, and discussed with the faculty involved in the program. Using the matrix, the faculty members can gage which outcomes need to be covered reemphasized with the curriculum. At the end of each semester, the students in each course are surveyed to determine whether the predetermined outcomes were fulfilled. The alumni, at varying time spans after graduation, provide very important information dealing with the depth, breadth, and currency of knowledge that is developed during the years at school. The information that is provided through industry contact assists the department in programmatic development. Through advisory board meetings, plant visits, and intern visits much information is acquired as to the future direction of the program, and the future laboratory needs. The Department needs to know if the material presented to the students is relevant to the needs of broad spectrum of regional employers. To assess all of constituent groups and identify the areas of need, the Department of Technology has a wide range of assessment tools, as shown in Table 3. It is this assessment model that provides very inclusive data as to revisions and directions for the Department.

Dissemination of Departmental Assessment Results – Closing the loop

All of the assessment data that is collected, from all of the constituent groups, is useless unless it utilized, in some form, to improve various aspects of the given program. In general, different information from the assessment process is utilized differently by the

Department of Technology Undergraduate Emphasis in Electrical Engineering Technology -

ABET outcome Description		A	B	C	D	E	F	G	H	I	J	K	L	M	N
Required Technology Courses															
TECH 175	ELECTRICITY AND ELECTRONICS FUNDAMENTALS	■	■			■		■		■		■	■	■	■
TECH 211	COMPUTER-AIDED DESIGN	■	■		■	■	■	■			■	■	■		
TECH 265	BASIC MANUFACTURING PROCESSES	■	■	■			■	■	■	■			■	■	
TECH 270	ELECTRICAL FUNDAMENTALS AND CIRCUIT ANAL I	■	■	■		■	■	■			■			■	■
TECH 271	ELECTRICAL FUNDAMENTALS AND CIRCUIT ANALYSIS II	■	■	■		■	■	■			■			■	■
TECH 276	ELECTRONICS I	■	■	■	■	■	■	■		■			■	■	■
TECH 277	DIGITAL LOGIC DESIGN		■		■	■	■	■		■	■	■	■	■	■
TECH 375	CONTROL SYSTEMS	■	■	■	■		■			■			■		
TECH 376	ELECTRONICS II	■	■	■	■	■	■	■		■			■	■	■
TECH 377	MICROPROCESSORS AND INTERFACING	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Table 2 – Course outcomes matrix as outlined by Departmental faculty

ASSESSMENT METHOD	USAGE OF METHOD	TIMELINE	RESPONSIBLE PARTIES	OBJECTIVES ADDRESSED
Capstone Experience	Senior design projects evaluated by faculty and industry	Senior year, all students	Faculty involved in Tech 477/478	ET - A through N
Portfolio (as pre-post test)	Infrastructure in place to initiate e-portfolio compilation	Currently in use in capstone exp.	Designated department faculty	ET - A through N, excluding I, and K
Lab Performance	Assessment of competence in labs	Every lab class, each semester	Instructional faculty of record	ET - A through N
Peer Review	1) Industrial advisory discussions 2) Alumni partners	Regularly through the year	Chair and Dept faculty	ET - A through N
Student Survey	1) Course-level surv. of criteria	1) Every	Chair/College	ET - A through N

	covered 2) Senior design project day survey 3) Senior exit survey	course, every semester 2 & 3) First Friday in May		
Faculty Survey	Course-level survey of ABET crit. covered	Every course, every semester	Chair	ET - A through N
Alumni Survey	1) University Assessment Office 2) Supplemental CEET survey	coinciding with university-wide survey, one, five, & ten years after grad.	1) NIU Assessment Services Office 2) CEET Assess. Coord. with Chair	ET - A through N
Internship Employer Survey	Outcome surveys to supervisors of coop & intern participants	Every semester for coop/internship participants	Department Chair	ET - A through N
Program Accreditation	Programmatic Assessment	Every six years	Complete Department	ET - A through N
Transcripts	Compilation of entering profile, courses taken, and performance	Every semester, ongoing	Chair with Institutional Research office input	General program performance
Placement Information	Tracking employment & related information of graduates – initial & subsequent	During summer	Chair in coordination with alumni office	Post-academic employment
Advisory Board Participation	Discussion of dept. curriculum and lab	Once per year – time varies	Chair and faculty in the respective areas.	General program issues

Table 3 – Assessment timeline for fall semester

individuals within the Department. The faculty members use the information to enhance the learning opportunities and cover material differently, or alter the laboratories needed in a particular course. The Department as a whole uses the information to determine the new directions for the curriculum or new laboratory skills that are needed within the given curriculum. No matter who uses this assessment information, or how it is used, the information must be presented and discussed as a departmental group. Figures 1 and 2 show assessment information obtained from our department alumni and intern supervisors

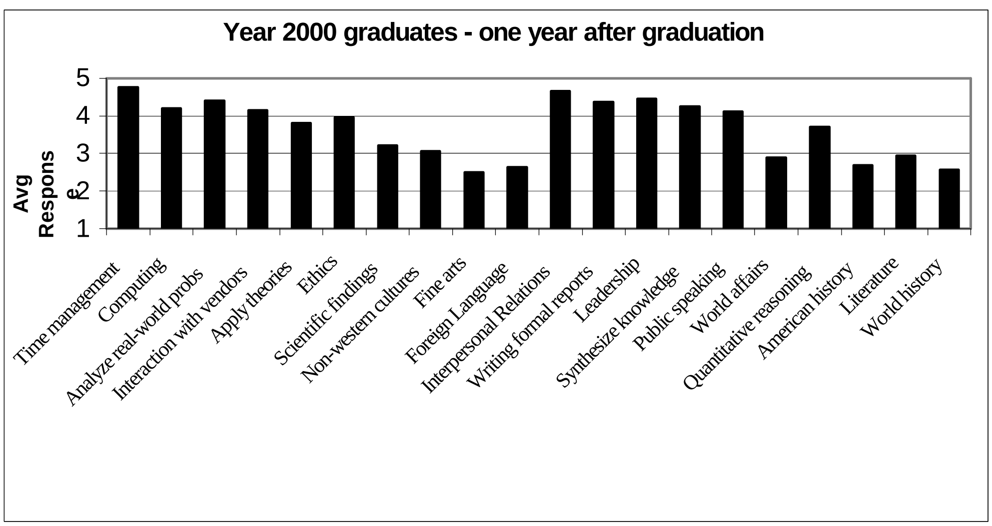

Figure 1 – Sample assessment results from Departmental Alumni – one year after graduation

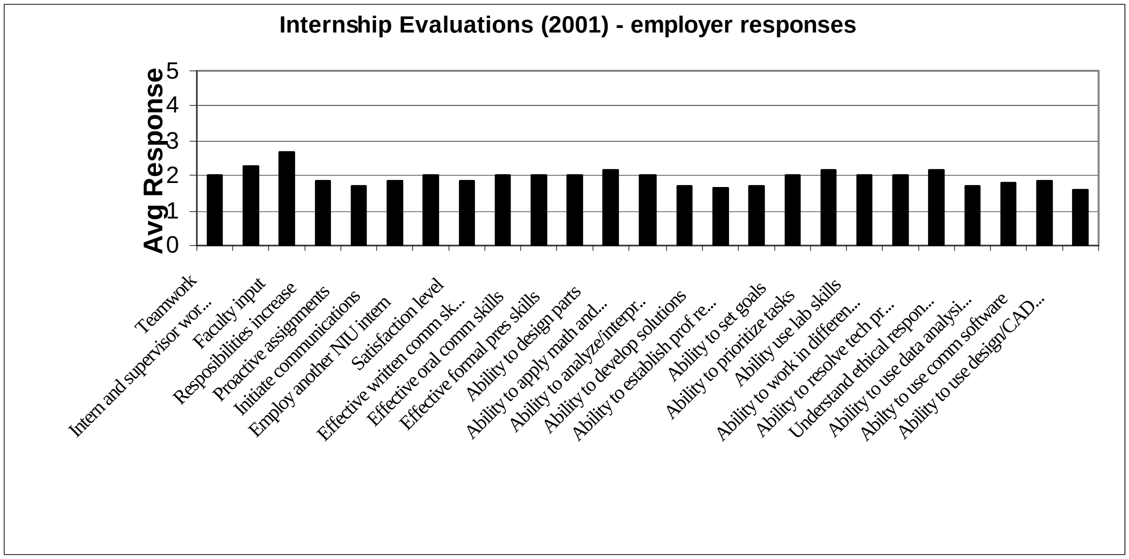

Figure 2 – Sample assessment results from Departmental internships – employer results

during one particular year. This type of numerical response is generated through the various types of surveys that are completed by the different groups. With other assessment methods like portfolio analysis, lab performance, program accreditation, and advisory board participation the faculty is involved in the assessment. Each year, the department faculty meets with industrial representatives and the Departmental advisory boards, and thus, they are constantly involved in this feedback loop. In addition, Department faculty is presented with the data developed from student assessment in courses, laboratories, through transcript evaluation, and through placement information. All assessment data is shared and discussed, and then, as needed, used in some mode to alter and upgrade courses or laboratories, or even to add new courses or laboratories to the given program. It is the role of the faculty in conjunction with the administration to develop a road map for making these changes. The course, laboratory, and programmatic alterations must be documented, and this documentation must include the mode of assessment utilized to determine how and why changes are made. Table 4 shows the documentation for the assessment and revision for two courses within the NIU Department of Technology. It should also be noted that the department assessment tools are currently in place, however, the faculty are encouraged to develop their own modes of assessment for their particular courses. In many cases in the areas of Engineering Technology, industrial input, either through discussions or plant visits tends to be one of the most useful means of assessing the areas of need in ones courses and also in determining the needed new directions within the overall program.

Conclusion

The need for revision and update is of major importance within an Engineering Technology program, since the program must strive to produce students that excel in industry upon graduation. In order to satisfy this daunting task, and make the needed alterations within course work and curriculum, the Department and it's faculty must have input from the various constituencies. Therefore, an active and comprehensive assessment plan is a necessity. In addition, the assessment plan must include input from a wide variety of sources. The assessment plan that has been developed by the College of Engineering and Engineering Technology and Department of Technology at Northern Illinois University is such a plan. Current students, alumni, faculty, and industry all play an important role in assessment, and each have needs which must be taken into consideration. Through this plan, which was presented, information obtained through assessment is analyzed and presented to all of the parties. This information provides a valuable platform for initiating program and course revision.

Tech 211 - COMPUTER-AIDED DESIGN

When	Cause for change	Change made
Fall 1999	Faculty assessment	Increased emphasis on 2D-3D visualization
Fall 1999	Industry input	Course implemented as initial CAD course and altered structure to include coverage of CAD and drafting principles
Fall 2000	Industry trend	Move to AutoCAD 2000
Fall 2000	Student need	Altered delivery from sole lab to lab/lecture to accommodate student numbers
Fall 2001	Instructor evaluation	Increased fee to cover added required supplies

Tech 265 - BASIC MANUFACTURING PROCESSES

Fall 00	Student feedback	Improve instructor/student assessment
Fall 00	Instructor Initiative	Integrate computer and visual presentations into course delivery
Spring 2001	Instructor Initiative	Introduce Blackboard course delivery for various assignments and discussions
Each term	Instructor Initiative based upon Industry feedback	Introduce new topics in emerging areas within manufacturing

Table 4 – Sample course revisions and assessment tool used to determine change

References

1. Best Assessment Process in Engineering Education II, A Working Symposium, Rose-Hulman Institute of Technology, Terre Haute, IN, USA, October 16-17, 1998.

2. Piket-May, M J., Chang, J L., and Avery, J P.: Understanding What "Success" Means in Assessment, Proceedings of Frontiers in Engineering Conference, Tempe, Arizona, 1998.

3. McGourty, J., Dominick, P., and Reilly, R.: Incorporating Student Peer Review and Feedback into the Assessment Process, Proceedings of Frontiers in Engineering Conference, Tempe, Arizona, 1998.

4. McGourty, Jack: Strategies for Developing, Implementing, and Institutionalizing a Comprehensive Assessment Process for Engineering Education, Proceedings of Frontiers in Engineering Conference, Tempe, Arizona, 1998.

5. Land, R. and Hager, W.: Pilot Survey: Graduate Satisfaction with ET Education at Penn State. Proceedings of 2002 Annual ASEE conference, Montreal, Canada, paper, session 2647.

6. M. Patricia Brackin, M.P. and Gibson, J.D.: Methods of Assessing Student Learning in Capstone Design Projects with Industry: A Five Year Review. Proceedings of 2002 Annual ASEE conference, Montreal, Canada, session 3566.