Assessment Strategies for Engineering Design Graphics (EDG) Related Programs and Courses

John G. Nee
Central Michigan University

Abstract

Few education issues have received more scrutiny over the last decade than how to measure student achievement. Pressures from all levels of policy making - from local school boards to Congress - for higher academic and skill standards, more accountability and better certification of what students know have led to a flurry of activity in the realm of assessment. Faculty are experimenting with a variety of assessment strategies - and spending a lot more time responding to demands of university and accreditation expectations. This paper will share strategies and detailed examples of assessment methods that relate directly to engineering design graphics (EDG) programs and courses at the university level. Examples will include: standardized tests, transcript analysis, alumni opinions/follow-up surveys, portfolios, resume review, internship evaluations, and goals/objectives/mission statements.

I. Introduction

Universities across the county increasingly are engaging in activities to assess their students' learning and academic achievement. The intent of academic outcomes assessment is to enhance learning and achievement by increasing what is known about our students' progress and problems. If student learning is a fundamental mission of a university, then we as faculty have good reason for undertaking assessment activities.

Regional and professional accreditation agencies are committed to the assessment of academic outcomes and now mandate that institutions develop and submit an academic outcomes assessment plan prior to their campus accreditation visits. The agencies are convinced that assessing student learning and academic achievement is critical to the success of institutions and is interested in working with institutions to develop an "assessment culture" on campuses. With this in mind, assessment is seen as an ongoing process, rather than an exercise that occupies institutions only in the year or two prior to a campus visit. In other words, "we are in it for the long haul."

II. Assessment Plans

There are ten characteristics of an acceptable assessment plan. These characteristics, which have been cast in terms appropriate to individual programs rather than to the institutions as a whole, are presented below:

- The plan is linked to the program's goals and objectives for student learning and academic achievement;
- The plan has been articulated carefully and is comprehensive in its conceptualization and scope;
- Institutional goals of access, equity, and diversity are not inhibited or restricted by the plan;
- The plan is administered by the unit responsible for the program and has faculty ownership, responsibility, and support;
- Multiple measures are used to assess academic outcomes;
- The plan provided feedback to students and to the unit;
- The plan is being implemented according to a realistic and appropriate timeline;
- The plan leads to improvements in academic programs;
- The plan is demonstrably cost-effective;
- The process includes an evaluation of the assessment plan.

The material that follows in this paper is organized around these ten characteristics, which can form the basis for the evaluation of assessment plans.

III. Evaluation of Assessment Plans

Assessment plans must be reviewed and deemed acceptable when all of the characteristics of an acceptable plan are present. If one or more of these characteristics is missing, the plan should be revised by the department for correction of the problem.

Characteristics	Present	Absent	Comment
Statement of mission, goals, objectives, for student learning/academic achievement			
Link of plans to goals and objectives of program			
Comprehensive scope and conceptualization			
Evidence that access, equity, diversity goals maintained			
Administration of plan by unit			
Evidence of faculty ownership, responsibility, and support			
Feedback to students			
Feedback to the unit			
Realistic and appropriate timeline for implementation			
Mechanism to improve academic program based on assessment information			
Demonstrated cost-effectiveness			
Specific process for evaluating assessment plan			

IV. Summary of Key Components

A plan should:

- define your more general goals and more specific objectives for student learning and academic achievement for each of your EDG related programs in terms that allow for assessment;
- state explicitly how your EDG program goals and objectives articulate with the Academic Mission Statement for your university;
- discuss the links between your EDG goals and objectives for student learning and achievement, your curriculum, your teaching approaches, and your beginning assessment strategy;
- state explicitly how you are going to operationalize at least one of your objectives for the academic year;
- state explicitly how you are going to gather and analyze data during the academic year;
- be clear about the specific knowledge, attitudes, and/or behavior that you will consider acceptable in your students;
- speak more generally about the ways in which you are thinking about operationalizing your other EDG objectives and about the subsequent data collection and analysis activities. Discuss in general terms the types of evidence that will lead you to conclude the objectives of your program are being realized. This general discussion will necessarily be speculative at this point and may well be brief;
- be explicit in recognizing the diversity of students who are part of your EDG programs and ensuring that your strategies for assessing student learning do not give advantages or disadvantages to students based on extraneous factors;
- indicate clearly the ways in which faculty have been and will be involved in the assessment of student academic achievement;
- discuss the structures that you have put in place or that you will rely on to assure an ongoing departmental involvement in assessment tasks;
- identify clearly the specific charges and responsibilities of the individuals or groups in to department involved with assessment;
- speak to the issue of how faculty will routinely be informed about departmental assessment findings;
- speak to how departments will share assessment findings with students and will try to engage student's interest and commitment to the process;
- be explicit about the mechanisms that will exist within the department to review outcomes assessment information;
- be explicit about the structures that the department has in place or will create to use the findings from assessment studies to make informed decisions and to maintain or change programs appropriately;
- speak in very general terms about discussions you have had about the different ways -- the ways other than what you intend to implement in the current year -- you might approach the assessment of your objectives;
- be explicit in specifying which activities will take place and when throughout the remainder of this current academic year and through the next academic year;

- address ways in which you are attempting to share or use resources prudently; and
- indicate the process to be pursued to evaluate the success of your assessment efforts over time.

V. Standardized Tests for Assessment (One Example)

The Society of Manufacturing Engineers (SME) began the Manufacturing Engineering Certification program in 1972. This program is managed by the Manufacturing Engineering Certification Institute (MECI). The purpose of certification is to recognize acquired knowledge and education in the field and obtain increased acceptance of manufacturing engineering as a profession.

In 1976, SME instituted the Manufacturing Technologies Certification program which is designed to give documentation to those individuals with less education and/or experience than is required for Certified Manufacturing Engineers. Certification is peer recognition conferred by a technical and/or professional organization. In the case of manufacturing engineering, peer recognition is given by the Society of Manufacturing Engineers. This recognition attests to ones ability to meet a set of one or more of the many aspects of modern manufacturing engineering and technology.

Departments can administer the Technology Fundamentals Exam as part of the assessment effort. Students take the exam on a voluntary basis or it can be part of a senior level requirement. Individual scores are provided only to the candidate, however, the faculty advisor will receive a statistical report that includes high/low, mean score and score distribution. Reports also include information regarding the distribution of scores within the major topic areas as well. The exam has undergone revisions and modifications over the years with the last major revision completed in the fall of 1996.

The seven major concept areas tested include: 1) mathematics, 2) materials, 3) design/graphics, 4) manufacturing processes, 5) management/economics, 6) quality control, and 7) computer applications. Each of these seven concept areas have difficulty factors (coefficients) attached -- each topic under the concept also has difficulty factors. Each topical area is represented by multiple test items, so the individual concept areas are represented by the total of all topical questions.

VI. Transcript Analysis for Assessment

Registrars' Offices can be contacted and requested to provide transcripts for all graduates. GPAs, course comparisons, and course programming paths can be reviewed during the academic year. The review and resulting analysis should involve all faculty members.

Also, additional review and analysis of students entering during a given year can be considered important representative cohorts. Data for faculty and administration to review and analyze can include:

- GAP comparisons (average and range) between programs for yearly defined cohorts.
- Persistence of various majors, concentrations and programs (aggregate, white, minority, and gender).
- Scheduling and completion of general education and competencies classes.
- Persistence of transfer students.
- Completion of multiple majors and/or concentrations.
- Scheduling and completing required mathematics classes.
- Grade distribution of mathematics classes.
- Scheduling and completion of required major courses (EDG, etc.)
- Grade distributions for major courses (EDG, etc.)
- Cumulative GPAs for programs based on yearly cohort

VII. Alumni Opinions/Follow-up Surveys for Assessment

A survey form and a letter of transmittal can be developed in order to determine alumni assessment of their own learning.

Some basic issues and concerns can be addressed with a short two-page opinion which can be provided to alumni. The information should be sought out within 1-2 years after graduation. Examples of questions include:

- List the job titles you have had since graduation (most recent first).
- What is your major job responsibility at this time?
- List at least five (5) major skills/knowledge areas that you acquired from the program that have helped you in your work career (use an extra sheet if necessary).
- List at least five (5) major skills/knowledge areas that did not acquire from the program that you need in your present work career (use an extra sheet if necessary).
- What learning content/activities should have been (but were not) incorporated into your major/minor? List at least five (5) and use an extra sheet if necessary.
- Would you or someone in your organization be willing to serve on a technical program advisory committee? Please provide complete contact information.
- The following list presents a number of concept/knowledge/skills areas that may or may not have been important to you on the job in your career to date. Please indicate with a (x) as to your opinion for each. Use your actual job(s) responsibilities as a guide (a listing of concept areas and skills are provided along with choices: yes/no/no opinion).

VIII. Portfolios for Assessment

Educators in a variety of fields, including many in EDG are using portfolios as a way to collect and evaluate student work. The theory behind such portfolios is that examining a student's work over a period of time provides a holistic assessment that demonstrates whether a student is progressing toward and truly achieving educational goals. While the primary goal of student portfolios is assessment, portfolio formats can vary greatly, depending on who is assessing what.

The length of time a portfolio covers also varies. A particular faculty member may institute portfolios for assessment throughout a course. Or portfolios may be part of a larger assessment plan, led by the school or department, in which work is collected throughout the entire curriculum or for a specific area of the curriculum, such as EDG. While a portfolio that covers just one EDG course may include a majority of the student's work for that course, longer-term portfolios tend to be more selective.

Both types of portfolios can be valuable. The classwork samples (sometimes called artifacts) collected in a portfolio may include papers, projects, design work, CAD drawings, and videotapes of oral presentations. At some institutions this portfolio of work is used not only as an assessment tool but also as a marketing device for job searches and a reference aid for students to use in future courses or on the job.

IX. Resume Reviews for Assessment

Resume development and review can be used by faculty in conjunction with students' self assessment. The student resume allows the student and faculty advisor to reflect together on the accomplishments and learning by each student. The process requires that:

- A student presents a concise 1-3 sentence statement of the intended career goal.
- A basic description of academic programs (degree, major, concentration(s), GPAs, etc.) is provided.
- Detailed listing of courses related to the immediate and long term career goals is documented.
- Work experience (general and related) is documented by the student with an emphasis that relates to the career goals.
- Special documentation of university sponsored internships is provided.
- Extra curricular activities are documented with emphasis on those related to career goals (professional clubs, leadership positions, special projects, etc.).
- Professional references are listed in order to establish a network between the student, faculty, and future employers/supervisors.

X. Internship Evaluations for Assessment

Many departments, recognizing that there are important elements of industry which cannot adequately be taught within the four walls of university classrooms or laboratories have established an internship experience. The industrial internship is designed to provide on-the-job experience supervised by successful practitioners. The internship can directly contribute to the development of a student's technical skills and knowledge and be in direct support of the student's major or minor. The following elements can form the basis for assessment:

Weekly Reports: The purpose of the intern's weekly work experience report is to obtain a "diary" of important learning events which occurred during the week. In addition, it is an assessment verification of field experience hours needed for credit determination.

<u>Final Written Report</u>. One of the requirements of the internship involves preparing and submitting a written report of the internship experience. The purpose of the report is to serve as an incentive to the student to observe, investigate, and broaden understanding of: 1) the operation of the employing firm, 2) the technical information and manipulative skills required by the job, 3) the employment environment, 4) how well the internship experience serves present and future professional goals, and 5) a demonstration of the student's self assessment.

<u>On Campus Seminar.</u> Interns will be required to attend an on-campus seminar which will focus upon a review of individual work experience as they relate to specific career goals. This seminar will typically be scheduled at the end of the semester to avoid conflict with a student's work schedules.

<u>Employer Responsibilities.</u> The major responsibility of the employer is to provide a position for the intern. Such positions should be an essential component in producing a "profit" rather than just a "created" position with no contribution toward profit. Employers are asked to agree to four stipulations. These requirements include:

- Providing an immediate supervisor who is willing to observe and evaluate the intern's job performance. This external assessment can provide very important feedback to the EDG faculty.
- Agreeing to allow on-site visitation by the Intern Coordinator for purposes of evaluation.
- Assisting the intern in obtaining the objectives he/she has identified.
- Completing the "Employer Internship Evaluation" at the conclusion of the intern experience.

XI. Summary

The intent of academic outcomes assessment is to gauge the extent to which students have developed the knowledge, attitudes, and behaviors that faculty believe they should have developed. What is essential, then, is that faculty define specifically what it is that they want the students in <u>their programs</u> to know, to think, and to be able to do. Although faculty routinely define the objectives of their own particular courses, the emphasis of outcomes assessment shifts discussion from the courses taught by any particular faculty member to the academic program as a whole. Given the pressing demands on faculty time, it is unlikely that faculty will approach the tasks of assessment with glee, but the futures of EDG programs require our attention. This paper has been written with three general themes in mind:

- Keep the process for assessing academic outcomes simple and manageable (it cannot be the tail wagging the dog);
- Keep academic outcomes assessment in faculty and departmental hands;
- Ensure that the activities surrounding assessment result in collegial discussions and in information gathering useful to departments and relevant to what they want to know about their students and their programs.

Bibliography

1. Miller, Mark R. Characteristics of exemplary manufacturing engineering programs. *Journal of Engineering Technology*. pp. 8-13. (Spring 1996)
2. Nichols, James O. *The Departmental Guide to Implementation of Student Outcomes Assessment and Institutional Effectiveness*. New York, NY: Agathon Press. (1991).
3. Pamity, Beth. The Student Portfolio: A Powerful Assessment Tool. *ASEE Prism*. pp. 24-29. (March 1996).
4. Senter, Mary S., Dolley, Diane. *Preparing Your Academic Outcomes Assessment Plan: A Guide for Interdisciplinary Programs.* Mount Pleasant, MI: Central Michigan University. (1994).
5. Senter, Mary S., Dolley, Diane. *Preparing Your Academic Outcomes Assessment Plan: A Guide for Departments.* Mount Pleasant, MI: Central Michigan University. (1994).

JOHN G. NEE
John G. Nee is currently a professor in the Department of Industrial and Engineering Technology at Central Michigan University (CMU). He earned his doctorate from the University of Minnesota. His teaching experience includes over 34 years at the community college, technical institute, and university levels. His specialty area is design/engineering graphics/CAD. Nee has had articles published in more than 125 publications; he has also published four textbooks in design and engineering graphics, and engineering technology. He has directed or coordinated a number of state and national level grants and curriculum projects. He is currently directing a NSF project related to undergraduate faculty enhancement. A Certified Senior Engineering Technologist and a Certified Manufacturing Engineer, Nee has work experience in machine design at the 3M Company, the Beloit Corporation, and various consulting engineering firms. He regularly consults/reviews/ edits for design/engineering graphics textbook publishers.

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