

## **Ideas to Measure and Reward Efforts to Improve Student Learning**

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I thank ConocoPhillips Company for having the vision and initiative to create this award in 1967. I am grateful to the Department of Chemical Engineering, Oklahoma State University for granting me this award. It's a great honour. I'm pleased to share ideas about engineering education.

Three elements usually are considered for tenure, promotion and annual performance review: research/scholarship, teaching and service/administration. Regrettably, only the first has recognized and accepted criteria for judging prowess at research. One could argue that teaching is assessed by the student evaluations. However, many of the evaluations used are poorly designed. In this paper, let's explore some myths related to teaching, some research evidence about the characteristics of good teachers and good teaching, some 20 options for measuring effective teaching and some action we might take to improve student learning.

### **1. Myths**

Here are four myths about university teaching.

#### **1.1 Myth #1: Institutional prestige and reputation reflect educational quality**

**Reality:** Terenzini and Pascarella [1] found that prestige, reputation and resources attributed to a university bear negligible relationship to the quality of the student learning. The measures that relate to student learning are [1]:

- the nature and cohesiveness of the student's curricular experiences,
- the student's course-taking patterns,
- the quality of teaching they receive and the extent to which the faculty involve students actively in the teaching-learning process,
- the frequency, purpose and quality of students' non-classroom interactions with the faculty,
- the nature of the student peer group interactions and extracurricular activities and
- the extent to which institutional structures promote cohesive environments that value the life of the mind and high degrees of student academic and social involvement.

The National Survey of Student Engagement, NSSE, uses five indicators of effective educational practice. These are level of academic challenge, extent of active and collaborative learning, student-faculty interaction, enriching educational experiences available and supportive campus environment.[2]

#### **1.2 Myth #2: The good teachers are good researchers**

**Reality:** Research has shown that there is no correlation between student ratings of teaching effectiveness and measures of research productivity [1, 3, 4]. For example, Figure 1 shows the student ratings from course evaluations (averaged over a four-year period) versus the publication of scholarly papers in refereed journals for the faculty members in one Department [5].

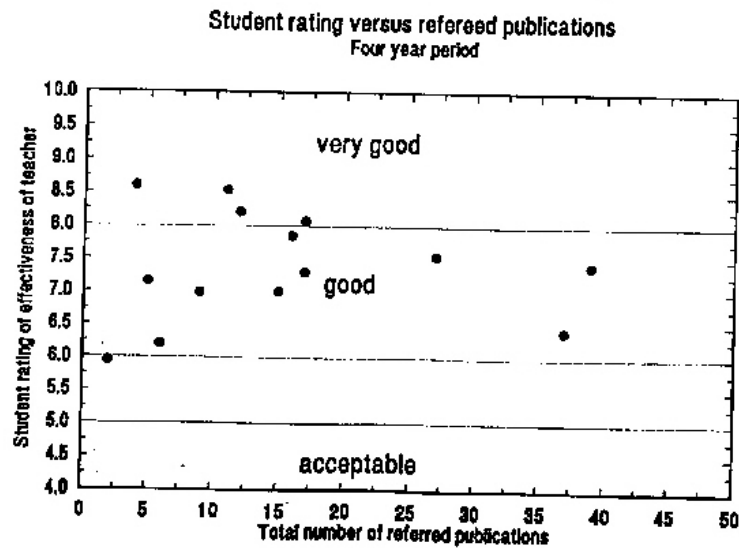


Figure 1,  
Teaching effectiveness and number of research publications for a

Department[5]

**2.3 Myth #3: To improve teaching we need to give more workshops on “how to teach.” This is particularly true for new faculty.**

**Reality:** Giving workshops on teaching is an important option to improving teaching. Wright’s [6] survey (of 960 deans, chairs, directors and of directors of *Centers for Teaching* in 58 Canadian universities) reported that “to improve teaching” the issue that ranked first was the “*recognition of teaching in tenure and promotion decisions.*” The option “Giving workshops on teaching methods to targeted groups” was ranked #3 by deans and #5 by instructional developers. In other words, if teaching is not recognized and rewarded in tenure and promotion decisions, then terrific workshops on teaching methods may not be as effective as they might.

For **new faculty**, in particular, the practical realities for getting tenure are:

- it takes an immense effort to get a viable research program going,
- simple things that take a minimal effort can have a dramatic positive impact on teaching effectiveness.

Indeed, Brew and Boud [7] and Candy [8] suggest that faculty should concentrate on specific roles over time. For untenured faculty, the role is primarily a researcher. Since the tenure decision is made after about six years, the practical realities point to the importance of the publications and grants. Indeed, 61 percent of young faculty surveyed see the most difficult requirement to obtain tenure is “obtaining research funding”[9]. “Publishing” is rated the most difficult for 23% of the respondents and only 6% see “teaching”

as the most difficult requirement. Even if teaching is highly valued and the methods of measuring it are accepted, the realities about research are:

- it usually takes a minimum of three years to get a first PhD graduate student out the gate,
- it usually takes a total elapsed time of about five years to get the first three to five publications from that thesis into print in refereed publications,
- to get funding from current agencies usually extensive documentation is required such that one almost has to have completed the research before funding is given, and
- young faculty need to submit numerous grant applications to get one funded.

On the other hand, for teaching, the key is to learn the simple things that make a major impact. The realities for teaching are:

- teacher attitude has probably the greatest impact on student learning. This is relatively easy to change and inexpensive. Teachers can focus on learning (not teaching), expect students to succeed, care about their students as individuals and learn their names [10].
- do simple things that have major impacts: use “ombudspersons” or one-minute papers to get feedback about how well their course is progressing [10]. “Ombudspersons” are class representatives who systematically and periodically give instructors feedback about how well the course is going. For one-minute papers, take one to two minutes at the end of some classes, and ask each student to anonymously write 1) the main ideas he/she learned and 2) the points that are unclear and confusing. The teacher collects the responses and use this feedback to clear up misunderstandings, adjust deadlines, and spend more time working on identified difficulties [11].
- limit teacher talk to 20 minute spurts separated by active reflection or diad activity [12].

## **2.4 Myth #4: Excellence in research can be measured; excellence in teaching cannot be measured**

**Reality:** Excellence in teaching can be measured. The approach is to apply the principles of assessment

Step 1. create observable, unambiguous goals for excellence in teaching.

Step 2. add consistent, measurable criteria.

Step 3. identify forms of evidence that are consistent with the goals and criteria.

For student ratings, research evidence shows that overall questions (such as “rate the overall effectiveness of the instructor”) provide valid and useful evidence for the purpose of making decisions [13]. However, student ratings alone are inadequate evidence about teaching [13, 14]. Later in this paper we outline 20 options for measuring effective student learning.

Consider next the characteristics of good teachers.

## **2. Characteristics of Good Teachers**

Four of the seven factors (identified as being important for academic success) are not normally used to assess performance [15]. These four are 1) enthusiasm, 2) integrity and trust, 3) having good process skills (such as communication and problem solving), and 4) subject expertise. In addition, each academic should contribute explicitly to the vitality of the institution. These five basic skills are important in their own right and should probably be included as measures for effective teaching.

### **A. Enthusiasm:**

- a) Enthusiasm for the subject.
- b) Enthusiasm for teaching.
- c) Enthusiasm for students.

B. Integrity and Trust:

- a) Integrity. Sincere honesty by teacher and students.
- b) Trust. Trust includes keeping commitments to oneself and others, clarifying expectations, showing personal integrity; being competent for the tasks undertaken and being benevolent by not talking behind another's back. A self-rating form is available [16].

C. Process skills (for which self-rating forms are available [16])

- a) Communication skill.
- b) Critical thinking and problem solving.
- c) Assessment skill. .

D. Keeping up-to-date by being a proactive lifelong learner. A self-rating is given by Woods [16].

E. Contributing to the vitality of the Department and University. All participate in activities related to the Department, academic and social, and the undergraduate and graduate clubs. All are proud of the accomplishments of their colleagues and their students.

Evidence about these five aspects can be used to measure effectiveness in improving student learning.

### 3. Characteristics of Good Teaching

Twelve characteristics of effective learning are summarized [1, 10, 17- 24].

#### 1. Teacher's attitude.

We surveyed 75 students from all branches of Engineering asking "What is your greatest frustration about the university." We expected the answer to be "food in the dorm" or "parking." To our surprise 80% of the responses listed the #1 complaint to be "attitude of the profs." Table 2 summarizes their frustration, and offers positive actions we can take.

| Table 2: attitudes of teachers as perceived by students   |  |
|---|--|
| Debilitating attitudes of faculty   | Change to..  |
| <b>Cover material!</b> Don't interrupt, don't you know that I have to cover a lot of material in this lecture, or course.                   | I'm here to <i>uncover</i> material; to help you learn. We take as long as we need to ensure that all understand. I want you to succeed.                               |
| <b>Weed 'em out!</b> I'm here to weed you out. My course is tough; many fail, that's my job. After all we have tough standards to maintain. | Some of the material previous students have found difficult. I'm here to help you succeed; to help you learn the really difficult stuff.                               |
| <b>Research.</b> This teachin' stuff interferes with my research contracts.   | Research is learning at the cutting edge; let me tell you about some of the exciting things we are learning in our research.   |
| <b>Who are you?</b> Don't ask me to know who you are. I just come in, face the board, write and leave when the class is over.               | Know their names, know them, take an interest in them and be concerned that they succeed. "A little bit of me goes out into the world with every one of my graduates." |

This attitude extends to include the creation of a sense of a “learning community,” and mutual trust (as opposed to “do/learn what I tell you”).

2. **Course in continuum.** Course content (or component in the graduate student’s experience) fits clearly into the continuum of the development of the knowledge and skills given as the published outcomes of the overall program; course content is up-to-date. Content is consistent with pre and post requisites.

3. **Learning goals & objectives** are well done. The learning goals/objectives are published and observable with measurable criteria. Usually there are about 5 to 10 overall objectives and about 30 to 50 detailed objectives for a course.

4. **Assessment** of student’s performance is fair, valid and reliable. Assessment is consistent with the learning objectives and promotes deep learning and should include a wide variety of evidence (as opposed to a single written final examination, or final oral defence). Bloom’s taxonomy [25, 26] can be a useful guide in helping instructors create questions that call on the full range of expectations.

5. **Learning environment** is effective and appropriate. Activities should be carefully selected to promote learning. At the graduate level, the research supervisor should not treat the research student as a technician, or as someone completing a contract for a funding agency.

6. Efforts are made to **monitor and evaluate** the learning environment and the effectiveness.

7. **Improve and Share.** The goal is to monitor progress, decide what worked and what was unsuccessful and continually improve. The ideas can and should be shared with others: through informal luncheon meetings, in friendly discussion, in more formal triad teaching, at conferences, electronically, and by papers.

8. **Expert in subject.**

9. **Address the “whole person.”** Our task is not simply to share the subject knowledge in our discipline.

10. **Integrate “teaching” and “research” and develop skill in “research.”** We are excited about our research and work with graduate students in pushing back the frontiers of knowledge. That excitement can and should be shared with our undergraduates. In addition, graduate education, although usually one-on-one, should follow educational principles with goals, milestones, skill development and confidence building.

11. **Basic skills.** These are described in Section 2: a teacher demonstrates integrity, is trustworthy and is skilled in communication, problem solving, critical thinking, listening and assessment.

12. **Learning goals achieved.** The students succeed.

Consider next 20 forms of evidence and how these relate to the items in Sections 2 and 3.

#### 4. Forms of evidence

Here are 20 different forms of evidence that can be used to measure excellent teaching. The relationship is given of each form to the numbered issues about effective teaching (listed in Section 3) and to the characteristics of good teachers (listed in Section 2). Where appropriate, measurable criteria are given.

#### 4.1 Student ratings

Student ratings provide valuable evidence for decision-making. Data from only certain questions about the *overall effectiveness* of the course have proven valid for promotion, tenure and merit decisions. Cashin's [13] summary of research shows the statistically valid questions to ask students are:

- the overall effectiveness of the instructor,
- the overall value of the course to you,
- the overall amount learned.

These questions ask about "absolute" measures (where the student establishes an internal set of criteria) instead of "relative" measures (comparing this course with other courses).

Each rating option should have a word descriptor. For example, we obtain less reliability if the student is to select a rating from 0 to 10 with 0 = very poor and 10 = excellent than if each rating is described: 0 = very poor; 1 = poor, 2 = inadequate, etc.

The environment used for gathering the data should include student anonymity, absence of the instructor from the room, the rationale and the use of a well-designed, standard set of instructions with descriptors for each rating option. The ratings should be interpreted in the context of a variety of courses, for two or more courses for every semester for at least two years, totalling at least five courses.

Given the correct questions, the correct environment and the correct context for interpretation, then student ratings are valued evidence upon which to make decisions about promotion and merit [4, 13, 14, 27, 28].

Student ratings provide evidence for items #1 and #5 listed in Section 3 and item #Cb in Section 2. An example of a well-defined student rating form is available [16].

#### 4.2 Student feedback about the learning environment: the CPQ.

**The CPQ, the Course Perceptions Questionnaire.** (Sometimes called the Course Experience Questionnaire). Ramsden and Entwistle [18] found the key factors in learning environments that promote deep instead of rote learning include good teaching, openness to students, the clarity of the goals and assessment, student's freedom in learning, the vocational relevance of the course and the social climate. The negative factors are the workload and the degree of formal didactic lectures. The CPQ has been used as input for funding decisions by Higher Education Funding Agencies in Australia since the mid1980s [24].

The CPQ provides evidence for items given in Section 3. Here are the items and the criteria:

#1, CPQ social climate >7; #2, CPQ vocational relevance > 7; #3, CPQ clear goals and assessment >7; #4, CPQ clear goals and assessment > 7; #5, Overall CPQ value should be >20 and CPQ formal methods <6. Data and details are available [16].

#### 4.3 Student feedback via Lancaster Approaches to Studying (ASQ) and Perry

When our goals are to develop higher-order thinking, two inventories or questionnaires are useful: the Lancaster Approaches to Studying Questionnaire, ASQ, and Perry's inventory.

**The ASQ.** Most teachers want to create learning environments to promote “deep” learning. The Lancaster Approaches to Study Questionnaire, ASQ, [29] helps identify the student's preference from among three different approaches:

- "deep learning" where students search for meaning and relate ideas together to construct new ideas,
- "rote learning" where students focus on memorizing details,
- “strategic or flexible learning” where students work hard and use whatever approach to learning is required to succeed.

An overall measure of the preference suggested by Ramsden is the “total” sum of strategic plus deep minus surface that has values in the range -24 to 48.

ASQ gives evidence for items #4, #5, and #12. Based on pre- and post- tests with ASQ, the goal is that the ratio of the rote to (strategic plus deep) should decrease while strategic plus deep should increase.

**Perry.** Another instrument that provides insight about the student's approaches to learning is the Perry inventory [30]. Perry's Model of Intellectual Development (or an equivalent model such as King and Kitchener's [31, 32] Model of Reflective Judgement) classifies student's attitudes about the learning environment into four major levels. The attitudes are about *knowledge*, the *roles* of the student and the teacher and about *assessment*. Details are given [32, 33].

In general, students often are at level two or three on this Perry scale. We might hope they would graduate at level five. The student's Perry level before and after the course could provide evidence about the development of intellectual growth.

The Perry inventory serves as evidence for items #4, #5 and #12. Perry levels should increase and be >4. Data and the instrument are available [16].

#### 4.4 Peer assessment of the syllabus/course outline

The course outline or syllabus provides excellent evidence. First, it is a document that must be produced in most institutions. Secondly, it provides evidence about teaching skills. The assessment can be made by colleagues from the *Center for Teaching* or from subject specialists. Regrettably, few academics create excellent syllabi. Research on how to create an effective syllabus is available [34-36]. Usually the syllabi surveyed were about two to five pages in length and included only about 20 out of 57 key types of information. Most supply the basic information: course number, name, semester, prerequisites, location, day and time, professor's name, title, office location, accessibility, office phone, e-mail address, office hours, home phone, when to phone at home plus similar information for the Teaching Assistants, policies about missed or late assignment, academic dishonesty, types of calculators accepted for exams, grading criteria and weighting of the final grade, the required text and resources and some general goals and topics to be covered in the course.

None linked the particular course with the Department or College published outcomes. Rarely did any instructor provide information about teaching philosophy, teaching methods or rationale for those choices. A few included

- *Assignments*: required books, schedule of readings, assignments described, projects described, project due dates, papers described, exam dates and exam content.
- *Caveat*: a statement indicating that the details are “subject to change” or “tentative.”
- *Student services on campus*: information about such services and how to take advantage of them.

The syllabus provides an opportunity for the instructor to provide evidence about issues #1, 2, 3, 4, 5, 8,

11. Peers can judge that 90% of published syllabus items relate to published program outcomes, the assessment components and process, integrity and trust and the teacher's attitude.

The syllabus gives evidence for the basic skills, #11, such as communication and assessment, #Ca and Cc. The syllabus can show the teacher's enthusiasm for the subject and learning, #Aa and Ab, and address integrity and trust, #Ba and Bb especially by providing clear expectations, unambiguous learning objectives, and personal statements about trust and integrity that are consistent with the published calendar, University policy, calendar and website. There should be explicit statements about collaborative work and some rationale about the forms of assessment used.

#### **4.5. Peer assessment via PEEP**

The Peer Evaluation of Educational Programs, PEEP, was developed by Stone [19] and extended by Woods [10] for peer evaluations of courses. The course could be presented as lectures, problem-based learning, cooperative learning or via any learning environment. The criteria are:

- attitude of the instructor,
- overall course content and how this particular course fits into the larger context of the Mission of the Program, Department and Faculty,
- specific learning objectives of the course,
- methods of assessment to be used,
- learning environment and learning activities selected and rationale, and
- efforts by instructor to monitor and evaluate the effectiveness of the instruction.

Stone recommends three peers evaluate the course based on the syllabus and the learning objectives. This can be augmented by discussions with the teacher. An overall rating of three or less is the target. Courses with ratings above four should be revised before they are given. The form is flexible. For different programs, different priorities can be assigned to the elements used in the evaluation.

PEEP gives evidence about elements from section 3, #1, 2, 3, 4, 5 and 6. A small value of PEEP is the goal with ratings <4. The PEEP instrument is available [16].

#### **4.6 Peer assessment of course learning objectives and criteria**

Whereas the overall goals and outcomes are described in the syllabus, the specific learning objectives are often published separately. The learning objectives use observable action verbs and give measurable criteria to tell how student's achievement will be measured.

The objectives are the key part in the student assessment. The learning objectives may be included with the syllabus but 15 to 30 pages of objectives are not uncommon. Some instructors, for example Jim Stice, University of Texas at Austin, hands out sets of objectives for the different sections as the course progresses. In the McMaster Problem Solving program (MPS program), we have about eight general goals and ten learning objectives for each of 15 topics or units in a course [37]. The objectives are included with each unit. Suggestions on how to create effective objectives are available [10, 38, 39]. The learning objectives can include career/process skills that are expected by ABET (2000) [40, 41, 42] such as problem solving, team work, self-assessment. Some example learning objectives are available [42, 43].

This provides evidence for issues #3, #4, and #5 as well as item #Cc in Section 2. For problem-based



learning, the students create the learning objectives for the subject knowledge based on the problems. The problems are designed and cued such that the student groups of five consistently list 100% of the teacher's learning issues.

#### 4.7 Peer assessment of tests, exams and sampling of student work

The peer assessment should consider the degree to which the assessment activities agree with the learning objectives and criteria.

Other criteria that could be used to assess tests and examinations include:

- *the clarity of instruction*, lack of typing mistakes, completeness of the instructions.
- *the consistency in the application* of the marking scheme, consistency between the syllabus and the exam, between the criteria and the exam and consistency across all student responses.
- *the clarity and reasonableness of the expectations*: an indication of the amount of time or the relative number of marks given to each question, project or assignment; the reasonableness of the time the teacher allowed the students to complete the task. For example, Stice [44] recommends that the teacher allow students five times the amount of time it takes the teacher to answer the question. Wankat [45] suggests four times.
- *the appropriateness of the intellectual challenge*. The tasks require a mix of thinking skills from “comprehension” to “higher order thinking” consistent with the goals of the course. The taxonomy for cognitive development proposed by Bloom et al. [25] and updated/revised by Anderson et al. [26] provides a good way to assess the level of thinking skills. In general, examinations should be a mix of levels with perhaps five questions at Levels 1 and 2, three questions at Level 3, two questions at Level 4 and one question at Level 5 and 6.
- *the complexity of the task (the string effect)*. This has two forms. Form one occurs where questions are posed that require the student to string together a series of concepts and equations. If the number in the string exceeds five, then Johnstone and El-Banna [46] suggest that the exam is testing the student's ability to “chunk” information more than it is to show competence in the subject. Form two has a sequence of parts to the question but the student cannot complete a subsequent part if the precursor is wrong.
- *the appropriateness of the degree of explicitness* or “tightness” in the task description. A “loose” set of instructions asks the student to do a task without suggesting the steps to take, the criteria to apply or without suggestions or hints about “how to do the task”. A “tight” set of instructions lists the steps the student is expected to take in solving the problem. Kimbell et al. [47] found that providing “loose” descriptions gives a greater divergence in marks between poor and good students than if the task description is “tight.”

This provides evidence related to items #4, #5, #8 and #11 and items #Aa, Ac, Bb and #Cc in Section 2. Peers judge that there is 100% consistency between the learning objectives and assessment tasks. There should be 100% consistency between the marking script and marks on all assignments and no “put down” comments on marked assignment as judged by independent assessor. Exams, projects and tests do not use the same questions year to year over a five-year period. Exams and tests have questions that have a range of difficulty as judged by Bloom's taxonomy [25, 26]. The types of questions asked can demonstrate the instructor's enthusiasm for the subject and his/her expertise.

#### **4.8 Peer assessment of course materials: assignments, projects and enrichment notes.**

One of the challenges is to have interesting and challenging problems that are appropriate for the level. These are not easy to locate or develop. Some texts offer such a variety; others do not. Even if the text is superb, instructors usually want to add pertinent projects from their own research or consulting experience or from everyday or newsworthy events. What problems and projects were used? Were they pertinent? Did they bridge the undergraduate-graduate research gap?

One Department's approach to encourage instructors to keep the course up-to-date and to make enrichment notes was to allow time to revise 1/3 of one course every four years [48] fulfilling items # D and # 8. Such updating and revisions usually result in enrichment notes that can be peer-assessed based on:

- the number of pages provided.
- the purpose of the enrichment notes: to update, to clarify difficult sections in the text, to express the text in the teacher's words, to link to the teacher's research, to provide worked examples, to provide a clearer understanding of the limitations or to highlight the knowledge structure and how this information relates to the "big picture" (issue #10).
- the quality of the citations and knowledge included.
- how well the notes were integrated with the required text: symbols the same? terminology the same?
- how well the research and consulting experience are integrated into the notes.
- coherence and communication skills (issue #C).
- completeness of the references (issues #8 and # D).
- the way credit and copyright were handled (issue #Bb).

A target might be for 50 pages of enrichment notes per annum prepared by the instructor.

#### **4.9 Published papers.**

Once we reflect on what we have done in the classroom, we often want to share that excitement and achievement with others. We prepare papers and have them published. Typically the paper describes the context, what was done and our general satisfaction with the approach. We refer to such papers as *descriptive*, to distinguish them from *scholarly*.

This provides evidence for issue #7. Acknowledgements and coauthorship provide evidence about interactions with others, issue #9.

#### **4.10 Student feedback about bridging research interests into the classroom learning experience.**

The course material described in Section 4.8 might be used to bridge the research and consulting into the classroom. Most instructors are researchers and consult with government and industry about their latest findings. We hope that each instructor brings the perspective of research and the latest, cutting-edge findings into the classroom. Teachers should explain to undergraduate students their areas of research and consulting and take the time to elaborate on recent conferences attended and papers presented. Evidence that they do this should be written by the teacher. A simple questionnaire for students about the extent this is done in the classroom could also provide evidence [16]. This gives evidence for issue #10.

Enrichment notes, examples used in class or as assignments provide other evidence.

#### **4.11 Assessment of activities to enrich the “whole person.”**

We know the development of the whole person, not just the intellect, is important. We can foster the development of the “whole person” by meeting with students informally at community events, attending student functions, guiding students and helping them acquire “skills for living” or taking a few minutes to chat briefly with a student in the hall. We foster the development, and improve the learning of the intellectual skills, by getting to know our students by name and as individuals. We learn of and talk to them about their interests, hobbies and aspirations. The evidence will come partly from the academic’s description of his/her role and partly from a brief description of the types of events initiated, events attended, number and nature of student “drop ins” just to say “Hi” and the interactions with students outside of class. Thank you letters and acknowledgments in theses and papers also are evidence. A major form of evidence can be the annual performance summary (§ 4.15).

Another source of evidence is the “acknowledgment section” of undergraduate project reports, Masters, and PhD theses and papers. Academics, other than the supervisory committee, are often acknowledged for the encouragement they provide.

What is vital is that:

- such contributions are valued,
- such contributions are recorded,
- such contributions are correctly included as evidence for “excellence in teaching” and not hidden away in “service” or as “other things I do”.

The assessment can be self-assessment or peer assessment of the annual performance summary (§ 4.15). This is evidence for issue #9.

#### **4.12 Effectiveness with graduate student education.**

Eight types of evidence are useful:

- the number of years it took to complete the degree (target 16 months for a Masters and four years for a PhD).
- the number of refereed publications resulting from the work (one for a Masters and five for a PhD).
- self reflection and enrichment notes on 1) helping students manage their time, 2) project planning activities and 3) how to read the literature critically.
- the number and quality of the reviews of grant proposals and papers completed by the PhD students.
- the external evaluator’s judgement of the thesis.
- the number of positive citations of the published work.
- the details provided for the formal education: the planning and milestones for the these (see, for example Davidson [49]), the activities to develop skill in critically reading papers, the quality of the supervisory progress-report meetings, the frequency and style of research group meetings.
- papers written to describe graduate education.

These are evidence for most issues in graduate student education, #1, #2, #3, #4, #5, #6, #7, #8, #12 as well as issues #A, B, C, D and E.

#### 4.13 Feedback from industrial and organizational short courses and workshops.

Since teaching skills are also used in presenting short courses and workshops, course evaluations, the number of repeat requests, the follow-up by the client and personal letters of thanks from the participants are all useful forms of evidence. This can be documented in the annual performance summary (§4.15) or in the *Teaching Dossier* (§4.14). This provides evidence related to issue #5. Usually outcomes are presented but not with the rigour usually used for undergraduate or graduate courses with published syllabi.

#### 4.14 Self-assessment and reflection via *The Teaching Dossier*.

Personal reflections and self-assessment of skill in teaching provide valuable evidence. A *Teaching Dossier* is a convenient summary document where such evidence can be synthesized.

A *Teaching Dossier* is prepared to help others make decisions about a teacher's performance. Because the *Teaching Dossier* is becoming acknowledged as an important form of evidence for the assessment of performance, a standard format is preferred so as to make assessment easier and more consistent. (Those authors who suggest that *Teaching Dossiers* be individualized, such as Seldin [50], are describing a different document prepared for a completely different purpose.)

In preparing a *Teaching Dossier* the key ideas are:

- only each individual knows about some of the things he/she does as an effective teacher. These contributions should be described without bragging and without self-consciousness.
- peers need written evidence, some of which is only available through self-assessment, so as to make judgements about performance.

A recommended 10-section format for a *Teaching Dossier* is:

Preamble

1. Summary of Teaching Responsibilities.
2. Course development and modification.
3. Relationship between your courses and the outcomes of the Program and of the Vision and Mission of the University.
4. Reflective statement on teaching philosophy, practices and goals.
5. Goals, achievements and major contributions.
6. Activities to keep up-to-date in the subjects taught and with teaching and learning.
7. Evidence about monitoring and evaluating effectiveness.
8. Evidence about your interaction with your students and developing the whole person.
9. Evidence about effectiveness.
10. Awards and recognition.

Details of how to write and examples are available [16].

As a sidenote, I have waded through *Teaching Dossiers* that included, for example, 50 to 150 pages of individual student ratings of the instructor (with no summary); letters that say "nice things" but do not clearly identify expertise in teaching. If this trend continues, then *Dossiers* will become so unwieldy, bulky and filled with trivia that they will lose their impact and usefulness. Indeed, these sentiments have been reported by both Bligh [51] and by Gibbs [52].

The *Teaching Dossier* provides evidence for most of the issues: #1, #2, #3, #5, #6, #7, #8, #9, #10 and

issues #A, #Ca and #Cc and #D.

#### 4.15 Annual performance summary.

Most Universities require the submission of an annual performance summary. Usually the format is specified:

Section 1, Instructional activities:

- 1.1 Teaching: courses taught with hours, credit weighting and numbers of students.
- 1.2 Supervision of undergraduate students graduate students and post doctorates.
- 1.3 Participation in supervisory and examination committees.
- 1.4 Special instructional activities related to undergraduate and graduate teaching.
- 1.5 Other instructional activities which you feel are noteworthy.

Section 2, Research activities:

- 2.1 Grants and contracts received.
- 2.2 Research publications and presentations.
- 2.3 Other research related activities.

Section 3, Service activities:

- 3.1 Citizenship through service on Departmental, Faculty and University Committees.
- 3.2 Current administrative appointments.
- 3.3 External and international service.

Yes, this provides a convenient summary of the three traditionally-rewarded contributions, and this form considers instruction at undergraduate and graduate level as “instruction.”

Yet, there are so many other activities that provide important evidence about student learning that are not asked for explicitly. These include invitations that were turned down, visitors who came to observe classes or discuss teaching, awards, e-mail inquiries, hits on the website (> 300 hits/ month), citations related to teaching, visiting professors, reviewing papers or grants > 15 per year; subscribing to > 5 journals (hard copy or on-line) and attending > 2 workshops on education and conferences annually.

In other words, this annual summary is an excellent place to document evidence about most of the issues listed in Sections 2 and 3: #6, #7, #8 and #9 and #Ac, #E. In particular, activities that should be included are

- activities to keep up-to-date.
- contributions to the institution’s vitality and interact with the students to address the “whole” person (that should not be included under *service*). Example documentation includes attend > 80% of student functions during the semester, attend and contribute to > 90% of Departmental and Faculty meetings, attend student graduation, attend > 80% of departmental social get-togethers.
- outside guests visiting class.
- invitations received and turned down.
- >3 people use your teaching approach elsewhere.
- >1 request to serve as external evaluator for a case for promotion and tenure.
- >\$1,000/annum of unsolicited donation identified for “teaching” sent to the Department from companies or alumni.

The evidence can be enriched by adding additional pages that summarize the annual contributions and include these missing elements. This also helps the decision-making. At most institutions this annual summary is used to decide on the annual merit increase; an example weighting is teaching worth 9; research worth 9 and service worth 7 [48].

#### **4.16 Student performance including Concept Tests.**

Elements can include student's marks, students' awards and student retention. In subsequent courses for which the course is a prerequisite, the instructors and the students can report that no unexpected background knowledge was required. Peers in subsequent courses say "students are well-prepared." For subject knowledge, data from pre- and post-tests on Concept tests are very useful. Such tests are available for thermodynamics, fluid mechanics, heat transfer [53, 54]. Students should have > 60% on an appropriate Concept test. In addition, a target might be that 10% of the students receive awards for their work or for their grades.

For the career skill development, the evidence can be an increase in ASQ for strategic plus deep and or an increase in Perry values. Values from the Billing-Moos [55] and Heppner PSI [56] inventories can show increases in confidence and skill in problem solving.

For graduates, the evidence can be that 90% of the students looking for employment are employed in related work within three months after graduation. For the career skills, the exit survey (§ 4.20) shows high ratings of achievement. The Department receives two letters per year from alumni or from recruiters about the quality of education. Alumni donations dedicated to your department, and sons and daughters of alumni that register in your university are other evidence.

For graduate education, the external evaluator of thesis rates it > "good" for contribution to knowledge and there are >5 positive citations of students paper within five years.

The evidence is related to issue #12.

#### **4.17 Input from alumni.**

Input of alumni is an often-overlooked form of evidence. The evidence can include surveys, solicited and unsolicited letters, donations and children from alumni attending your school.

This evidence usually supports issue #2 and enthusiasm for the subject, #Aa, and for teaching #Ab. and for students #Ac.

#### **4.18 Student surveys.**

Anonymous surveys of students are extremely useful. For example, noteworthy data would be if 80% of the students in class, or the students being supervised, rate that the teacher took an interest in them as a person and wants them to succeed.

#### **4.19 Input from the *Center for Teaching and Learning*.**

Peers from *Center for Teaching* can provide input on most of the issues listed in Sections 2 and 3.

#### **4.20 Exit survey.**

Exit survey of all the graduates of the Department, the Faculty and/or the University can give feedback about both the Quality of the Learning experience and Contribution to skills and development. The criteria might be that the target responses for your Program outcomes would have > 50% rate positive.

An excellent example exit survey from Queen's University is available [16]. This provides evidence for issues #9 and #10.

#### **4.21 Other forms of evidence.**

Some other forms are given by Felder and Brent [42].

### **5. An Action Plan**

Our goal may be to improve our teaching or to be an excellent teacher, or to be rewarded in the annual performance review for our outstanding teaching or to receive tenure and promotion. For each, an assessment of our performance will be made. Assessment is a decision about the degree to which published goals have been achieved based on measurable criteria and evidence. The following principles of assessment apply:

Principle 1: Assessment is about performance - not personalities.

Principle 2: Assessment is based on evidence - not feelings.

Principle 3: Assessment should be done for a purpose with clearly defined performance conditions.

Principle 4: Assessment should be done in the context of published goals, measurable criteria and pertinent agreed-upon forms of evidence.

Principle 5: Assessment should be based on a wide range of evidence.

Our goal might be "to identify excellent teaching." The forms of evidence and some criteria for each have been given in Section 4.

The general action plan to improve student learning and to improve the reward system might be:

1. Start with one individual: be intrinsically motivated to do one thing to improve student learning. The seven steps in intrinsic motivation are 1) identify the context, 2) set goals and note the difference between current situation and the goal, 3) accept ambiguity, 4) overcome ambiguity, 5) build confidence that "I can make it happen," 6) plan, and 7) do it and celebrate milestones [16].
2. Use evidence to monitor and improve your students' learning.
3. Share enthusiasm, convince others and the Department; students are our strongest allies. Create an open culture that emphasizes student learning.
4. As individuals and Departments be intrinsically motivated to have improved recognition of teaching by colleagues, the Department, Faculty and the University. Some steps might include the following:
5. Continue to build credibility for excellence in teaching. Include additional documentation to the chair. Gently suggest Departmental activities that can have a major impact on student learning.
6. Modify the documentation and criteria in the reward systems.
7. Change the reward system (annual performance review, tenure and promotion extrinsic rewards).

#### **5.1 Individual**

Step 1. Select a goal to improve student learning, such as: attitude check, write a syllabus that communicates your role, learn student names, implement an action suggested by Chickering and Gamson [17] and others [10, 12, 16, 32, 38, 42] or monitor the teacher-student learning team via an option suggested by Angelo and Cross [11]. For example, a relatively easy goal is to communicate an attitude to the students that we expect them to succeed (issue #1 in Section 3).

In developing confidence (step 5 toward intrinsic motivation) draw on the expertise of the local *Center of Teaching and Learning* or Departmental or Faculty initiatives [57].

Step 2. Gather evidence to document success. Consider using ones given in Section 4, such as CPQ, Perry, NSSE, syllabus, PEEP, pre- and post- Concept tests, Billings-Moos CRI and Heppner's PSI. In addition, improve record keeping and documentation. Too often we don't include, in performance summaries, the invitations we turned down or the visitors we had. It also is embarrassing (when we are being nominated for an award) that we have not kept a record of, for example, the student course evaluations over the past ten years, or the enthusiastic letter from an alumnus saying they "couldn't have succeeded without the training you provided!" Call it an ego file if you wish; but keep records.

Step 3. Share enthusiasm, with peers, with the Chair and the Dean. It is vital that we keep the Chair and Dean informed. For example, one group of students was not happy with an approach I was taking. They sent a petition to the Dean suggesting I be fired. He told them, "I know what Woods is doing; you are lucky to have him." What might have happened if I hadn't informed the Dean? Build a support network. Perhaps use triad teaching, as used at the University of Alberta [57]. Actively promote the use of measures of excellence in teaching with colleagues, your support system and within your Department. Mentor young/new faculty and encourage them to do simple things related to effective student learning. Nominate others for awards. Based on a suggestion from one faculty member, the Dean at the University of Alberta started a New Faculty Forum. The forum meets over lunch, and there are ten sessions with the main emphasis being that "excellent teaching is expected of all faculty and here's how to do that." [57]

Contribute to the vitality of the institution by attending student and faculty events, know your students names, mingle with them and attend convocation.

4. Use the seven-step approach to intrinsic motivation to change the way excellent teaching is acknowledged, recognized and extrinsically rewarded. For an individual the plan might be as follows.

5. Start within the Department. Understand the context. Ask the chair about the relative weightings and criteria for annual performance review. Then add covering pages to your submission to address each one. For example, only you know how to interpret "a workshop given on teaching and learning... is it service? or teaching? Include the evidence you gathered about your course.

Encourage the Department to publish the program outcomes, to use effective syllabi, to survey alumni every five years and to use the CPQ.

Convince the Department to collect NSSE data, and to use exit survey [16]. At one University, they tried the exit survey and found their values were much lower than benchmark data, and so they discontinued. Don't be discouraged.

Within the University, seek election to the P&T and nudge the process to measure and document effective teaching. On the P&T be the person who the Vice President turns to to ask questions about teaching and learning. Gently press for improved documentation for teaching.

Actively work to change the attitudes and policies to overcome Myth #4. Good teaching can be measured; criteria and forms of evidence are available. Suggestions for identifying stakeholders, overcoming resistance and getting a buy-in are available [43, 58-60].

As an elected member of Senate, work for formal inclusion of measurements of effective learning.

Within the community, write articles and stories about effective teaching; present papers in the



Education Division of the AIChE.

## 5.2. Administrator.

Some of the seven-step general approach given at the beginning of this section apply to administrators.

Step 1. To promote intrinsic motivation, the Chair and Dean can create an atmosphere that helps faculty have confidence that they can improve their teaching. Learn their goals and help individuals see how the Department/Faculty/University's culture can help them achieve personal goals (step 1 in intrinsic motivation described earlier). Help them develop confidence (step 5, in the intrinsic motivation process): by instilling a sense of competence through support and praise, by celebrating and publicizing achievements, by giving visibility to teaching improvement activities, by encouraging individuals to attend workshops in the educational area of focus. Provide autonomy. Promote "relatedness" between each individual and the Department/ Faculty[16]. Create an environment of trust and equitability. One successful idea toward this might be the use of the course-loading approach where the Department as a whole considers all the courses, the commitment each is willing to give so that each had a load of 550 hours per year for the teaching of the graduate and undergraduate courses [16,48]. This approach also gives time credit to improve courses.

Be aware of developments on campus and seek input about ideas to improve learning that might be effective for your Department. For example, we had obtained the survey results given in Table 2. Most Science and Engineering Departments could not believe the results. Departments invited students from other Departments to elaborate on their responses. The impact was dramatic. The point was that most teachers felt they had a positive attitude toward the students and that they did not display any of the negatives. But what was missing was being able to communicate their attitude correctly to the students.

Step 2. Monitor, keep up-to-date about progress and encourage. Celebrate.

Step 3. Perhaps create a fund to help purchase such inventories as Heppner's PSI and sponsor workshops to facilitate the creativity.

Step 4. Encourage and support ideas from faculty colleagues as listed in Step 4 for individuals. If these ideas are not forthcoming, then you initiate them. The key evidence might be CPQ, ASQ, the exit survey, a five-year survey of alumni, PEEP, syllabi, the publication of program outcomes, *Teaching Dossiers*, the use of ombudspersons/one-minute papers/or mid-term student course evaluations. As a Department, take individual photographs of all students entering the program and give these to all faculty. Encourage all to learn the students names. Create an atmosphere where all faculty contribute to the vitality of the Department. Help faculty understand and appreciate the Departmental, Faculty and University culture. Create awards for faculty, within the Faculty and within the Department for outstanding teachers. For example, at the University of Alberta within the Faculty of Engineering there are four faculty awards per year and four TA awards per year. At the University level there are five awards for outstanding undergraduate teachers.

Once a form of evidence has been selected as policy, then adhere to the policy. In one institution it was decreed that the *Teaching Dossier* would be important evidence to be used for P&T decisions. Candidates submitted their documents. They were never read or used as evidence because "what good is a *Teaching Dossier*? They are just so much hot air."

An example of effective implementation of ideas to motivate and reward improvements in student learning is at the University of Alberta. The Department of Chemical Engineering created a Departmental Teaching Enrichment Committee to energize and enhance teaching [57]. Some of the products from the

committee were the publication of the Department's outcomes from the program (including what students can expect from the faculty), the use of teaching triads (where three colleagues sit in on each other's courses and offer support and suggestions) and the use of mid-term informal student evaluations (that were run by the students). The Faculty changed the annual performance summary to include explicit requests for more evidence for improved student learning.

Yes, individuals and administrators can make a great improvement in encouraging, documenting and rewarding efforts to improve student learning.

## 6. Summary

If there is one thing, good teaching and good student learning can and should be measured.

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