BUILDING AN ENGAGED, COLLABORATIVE, AND IN-SPIRED TEACHING CULTURE

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co-authors John Nychka, Uttandaraman Sundararaj, and Suzanne Kresta led the Teaching Enhancement Committee at the University of Alberta which implemented a number of empowering changes to the teaching culture in the department and the faculty. Drs Sundararaj and Kresta initiated a number of early changes before Dr Nychka joined us from Kentucky, where he had a substantial impact.

Uttandaraman Sundararaj, University of Calgary

Uttandaraman (U.T.) Sundararaj is Professor and the Head of the Department of Chemical and Petroleum Engineering at the University of Calgary. Previously he was Professor at the University of Alberta for 12 years. He received his PhD from the University of Minnesota (1994) and his BSc from the University of Alberta, both in Chemical Engineering. He worked 4 years in R&D with the General Electric Company (GE Plastics) and was a Visiting Researcher at DuPont Experimental Station.

In 2010, he won the highest post-secondary teaching honor in Canada, the 3M National Teaching Fellowship from the Society for Teaching and Learning in Higher Education and 3M Company. He has received several other teaching awards, including the University of Alberta's Rutherford Award for Excellence in Undergraduate Teaching, the Excellence in Education Award from the Association of Professional Engineers of Alberta, and the Medal of Distinction for Engineering Education from the Canadian Council of Professional Engineers. Dr. Sundararaj's main research interests are in polymer blend and nanocomposite structure generation in twin-screw extruders, and modeling of polymer processes. In 2003, he received the prestigious Polymer Processing Society's Morand Lambla Award for research in polymer processing and in 2006, he received the Humboldt Research Fellowship (Germany). He has won three best paper awards and has given over twenty (20) plenary and keynote presentations at major conferences.

His interests outside work include basketball, gardening and chess.

John A. Nychka, University of Alberta

John was an assistant professor at the University of Kentucky for two years before returning to Canada and his alma mater, the University of Alberta, in 2007. He is an assistant professor in the Department of Chemical and Materials Engineering teaching and coordinating the second year introductory materials engineering service course to many disciplines of engineering. John is active in the departmental Teaching Enhancement Committee which is mandated with improving the quality of teaching within the department. He has organized and co-organized teaching workshops to bring international speakers to the University of Alberta on topics of Assessment,and he is very active in student outreach at all levels. John's passion is in the visualization of materials concepts through demonstrations and experiential learning through hands on exercises.

Building an Engaged, Collaborative, and Inspired Teaching Culture

In the early 1990's, the University of Alberta was already using teaching awards, peer consultation, and student course evaluations to motivate better teaching. While the culture was positive, it was not informed or intentional. Over the last twenty years, the faculty has grown dramatically, many new instructors have been hired, class sizes have increased, and the standard of teaching has changed dramatically. In this paper, we present some of the tools that have made a positive difference:

- New Faculty Forums, where each new instructor was given the basic tools of solid pedagogy in an active learning environment

- Workshops on Active Learning, Assessment, and Writing Well

- Formation of a Teaching Enhancement Committee

- Classroom Assessment Techniques, Midterm Course Evaluations, and Teaching Triads

- Development of a Teaching Statement

- Recent Changes to the Annual Report Form that include a substantial section on Scholarly Engagement with Teaching

The three co-authors have been involved with all of these initiatives, and foresee exciting further developments in the future: workshops on self-assessment and learning objectives, development of visual learning and demonstration of pedagogical skills and artistry, and a whole paradigm shift in the way we develop course materials and textbooks. We invite you to share our vision - dramatic improvement of teaching without the investment of punishing amounts of time!

New Faculty Forums

In conjunction with a wave of hirings into engineering in 1996, one of us was asked to design and lead a series of lunch hour forums on all aspects of being an academic that year. In 1996, we ran 20 sessions, with 10 of them devoted to teaching. While most of the sessions drew from a panel of 4 experts from inside and outside the faculty, 5 teaching fundamentals sessions were given by Kresta. Kresta continued to offer three of those sessions for eight of the next thirteen years. *Over the period these forums ran, over 120 new faculty members were introduced to basic knowledge about educational fundamentals, and more importantly to the idea that the Faculty of Engineering expects a well grounded approach to teaching.* The text by Wankat and Oreovicz[5] was provided to all participants while it was in print; the on-line version is now referenced.

The impact of these sessions was documented in two short articles, and shared with other colleagues in several conference presentations and invited talks [1,2]. A summary of the teaching sessions is included as an Appendix.

Active Learning Workshop

Dr. Sundararaj organized a two day workshop in May 2007 on active learning and effective teaching. In the traditional approach at universities, the professor lectures and the students watch and listen. The students work individually on assignments, and cooperation is discouraged. This instructional method is inferior to instruction that involves active learning, in which students

solve problems, answer questions, formulate questions of their own, discuss, explain, debate, or brainstorm during class, and cooperative learning, in which students work in teams on problems and projects under conditions that assure both positive interdependence and individual accountability. However, most professors continue to use the former method even though it leads to poorer mastery of the subject, limited depth of understanding, and little or no acquisition of critical thinking or creative problem-solving skills. The workshop was given to 90 professors and they have given feedback that it has helped them in the classroom use active learning to enhance student learning and interest.

Over the following two years, follow-up sessions were organized to help professors understand how to use active learning in engineering classrooms and how it can enhance student participation, student learning and teaching effectiveness. This was done via a University Teaching grant from the Provost's office. There was excellent attendance – over 90 professors attended the two day workshop and 25 to 40 professors have attended each follow-up session. Some of those who implemented active learning in their classrooms found:

- that they could teach more concepts
- that students were more willing to learn theory and
- that the students performed better overall in exams.

One thermodynamics professor shared that less than 10% of the students successfully completed the "Raoult's Law" question on the first midterm. After using active learning in the 2007-8 academic year, the entire class (100%) answered correctly. Another professor found he could cover more theory and more material in his course when he used active learning. In addition, the student ratings of his teaching increased by a full one point (out of five) after the change.

Teaching Enhancement Committee

In 2007, our Dept Chair, Dr. Fraser Forbes, struck the Teaching Enhancement Committee (TEC) with a mandate to energize and enhance teaching in the Department of Chemical and Materials Engineering, and eventually provide tools that would allow further improvement in and measurement of quality of teaching in the department. A range of activities indicating scholarly engagement with the teaching function were identified, and after discussion with individual faculty members, several of these initiatives were selected for implementation.

- We have launched a **visual teaching mission statement** for our department that incorporates elements of what the students can expect to learn, and what kind of teachers will be teaching them. These were developed in collaboration with the department, starting in 2009.

- **Teaching Triads** were implemented during the fall and winter terms of 2007/2008, and continue. In the triads, each of the faculty members' teaching is observed by two colleagues, and then the group meets to share observations in a supportive way. Some groups adopt a rule like, "Please be blunt enough to be clear and useful." while others select a ground rule like, "No negative criticism." As trust increases, the conversations tend to dig deeper. We have run these for three years, and now have faculty members from other departments calling to see if they could join a triad.

- **Mid-term course evaluations** – All of us adopted some form of this approach at the beginning of our own teaching careers and continued it as we mentored new professors,

sometimes with the help of the student club. Our current role is to facilitate this process and provide people with several sample forms to use on their own, rather than taking direct action.

- A University level Teaching and Learning Enhancement Fund (TLEF) proposal was awarded to support a **workshop on educational assessment** (2008-2009). Professor Royce Sadler (Griffith University, Australia) presented a plenary lecture and a two day workshop in April, 2009 along with individual and group meetings of the faculty within the department. Conversations with Professor Sadler provided new perspectives and ideas on teaching with respect to assessment of students and self. More details are presented below.

- *Writing Well[2] – Building Traction and Triumph into Co-authorship* a 4 hour workshop on teaching graduates students how to write. This was offered to faculty members in the department (10 attended and 3 department members spoke). The workshop description and abstract have been submitted to the ASEE meeting.

- **Annual report revisions** to include more detail about teaching quality and prompt reflective thought and assessment of new initiatives. Our task was to make suggestions on methods to better assess the quality of teaching in the faculty based on more than just standardized student-based teaching evaluation (USRI) results. More details on this work are given in the next section.

Workshop on Educational Assessment

The formative assessment workshop given by Professor Royce Sadler was an important nucleating event for change with regard to how we teach and how we evaluate teaching within our department. Much discussion occurred surrounding the quality and evaluation of learning and teaching. Potential ways to attack difficulties with current assessment practices were presented by Professor Royce Sadler at this workshop.

Most notably Professor Sadler suggested that faculty revisit the use of rubrics versus holistic judgment –what we consider objective judgment is often subjective judgment masked by numbers in attempt to quantify specific qualities. The increasing level of specificity in assessing student performance (both summative and formative) is of serious concern in light of losing the overall quality. "Is it good work?" Professor Sadler also mentioned to take the opportunity and take a step back from checklists and rubrics in an effort to ensure that quality is truly being met. As a group we really thought about how to identify high quality work, and how to give appropriate feedback so that students transparently realize the quality of their work. Professor Sadler's suggestions for identifying quality and framing feedback to aid in this process are:

- o What is the level of quality? Is it good?
- o Why was it good, or not so good?
- o What could be done to make the quality higher?

In engineering the determination of the level of quality is often achieved through comparison of student work to an acceptable worked solution and counting or identifying the number of missteps along the way, which is then interpreted as a numerical "grade" that signifies the quality. Such rubric does not allow for creative solutions, and does not implicitly require evaluative feedback so that the student recognizes their errors and how to improve upon them.

By realizing that students require feedback it becomes obvious that instructors be able and willing to offer such feedback. Additionally, it becomes more important, but less obvious, how to

structure questions so that appropriate feedback can be given. This solution to the latter point is different in every course for each instructor style, but we do offer a widespread approach. Formulating questions which offer clear opportunity for constructive feedback must be backed by a large investment in getting the original question or student task to be unambiguous and clear. Potential methods to aid in assessment of quality: get the assignment proofread by someone else; sign off on it after it has been debugged; pencil out a short solution to be sure it works! Many of these strategies seem obvious, but are often not followed.

Suggestions for the improvement of quality is critical for any feedback mechanism; without suggestions for improvement learning is extremely unlikely because the students can never internalize the spectrum of quality and where their work is located therein. For example, without appropriate feedback, and even in the presence of appropriate feedback, weaker students tend to overestimate their level of quality. The evaluative experience must be incorporated into assessment practices so as to ensure that performance levels can be interpreted and achieved by students, and that the students themselves can develop evaluative expertise without having to always rely upon the instructor [3].

The evaluation of teaching quality was also addressed in Professor Sadler's visit. Teaching evaluation is mandated at our institution to be multifaceted, yet most department chairs have said that student ratings of instruction play a large role, with little guidance from the institution (more on this in the next section). Sadler's basic premise is that students are *uncalibrated instruments* with regard to evaluation of teaching – they only really know what they like. Universal ratings of instruction (USRI) are good at rating the processes and what the teacher did rather than depict what was learned, or how well it was learned.

Students are *unable* to evaluate the following:
How thorough and up to date is the content of the course?
Does the lecturer really know their stuff?
How well have students achieved?
Does their work reveal learning? Who decides?
What are the learning standards?
How commensurate are grades with quality of work?
However, students are *capable* of evaluating the following:
Are the learning achievements in the course related to the instructor?
What is the experience of learning?
Are there serious concerns raised about the instructor?

Bottom line: ask fewer questions of students, and ask the right questions! Revisit the "compulsory" questions – do they apply to all cases and courses?

Institutional evaluation of teaching should be able to determine if there is **strong evidence of *learning* as a result of the instructor's *teaching***. The quality of teaching should be evidence-based. However, there are a 1000 ways to be a good teacher, so in evaluation of teaching for quality we cannot confuse:

Product with process
Teaching with method
Effort with quality
Dominant process(es) with high quality teaching

However, identity and integrity are definitely linked to high quality teaching but what are their measures? We have to be careful not to apply rubrics to the evaluation of teaching quality because we then have a tendency to count rather than ask if the quality is high. We can, however, and should keep track of the types of activities in which instructors are engaged that reflect on their quality of teaching, which is further expounded upon in the following section. For example, Chickering and Gamson [4] offer seven principles that when applied in undergraduate education employ six powerful forces in education: activity, diversity, interaction, cooperation, expectations, responsibility. By assessing faculty to see their level of quality surrounding such powerful forces teaching culture shifts are observed, especially in out department!

Annual Evaluation of Teaching in Engineering

In 1996 the Career Development Committee, which Kresta chaired, was charged with reviewing evaluation methods in the faculty of engineering. While parts of our report were adopted immediately, and others referred to the faculty contract negotiators with eventual implementation, the parts of the report related to multifaceted evaluation of teaching were resoundingly rejected. People did not believe it was possible to evaluate teaching in any manageable and objective way.

With massive hiring of new staff and formal introductions to good teaching practices and basic pedagogical ideas in the New Faculty Forums, the culture in the faculty began to shift. The forums continued for a number of years, with a quiet but dramatic impact on peoples' attitudes toward teaching throughout the faculty. Now half of the Department Chairs are alumni of the forums. Dr Sundararaj built on this foundation with the Felder and Brent workshop in 2006, which brought a number of senior colleagues into the conversation, and strengthened the foundations for many others. In 2007, the Teaching Enhancement Committee was charged with finding ways to increase faculty members' scholarly engagement with teaching. As a result, we were able to field test a number of methods for evaluating and improving teaching, and run a workshop on Assessment (Royce Sadler) in the spring of 2009. Two members of the TEC also served on university wide committees on assessment: one reviewing the student course evaluation system (Nychka) and the other reviewing assessment of students (Kresta) and a possible campus-wide mid-term course evaluation tool.

In January of 2010, we were asked to give provide input on how to incorporate multi-faceted evaluation of teaching in the engineering Annual Report form. While university policy mandates that faculty be evaluated in a multifaceted manner, our annual report did not give direction as to how such an evaluation is performed, or what kind of information that might include. The modified annual report form gathers information that indicates teaching quality (i.e., new initiatives and assessment thereof; historical teaching ratings; pedagogical development in courses and within the campus community) as well as student evaluations of teaching and number of contact hours. This part of the form was passed at Faculty Council as an obvious improvement, somewhat to the surprise of some senior members of faculty council. The key excerpts from the old and new forms are given below with the complete teaching pages from both reports included as pdf files:

Excerpt from Old form:

A half page of blank space was provided for free form writing.

Summary of Teaching Activities:

(Special efforts, course developments, etc.; continue on page 10 if necessary)
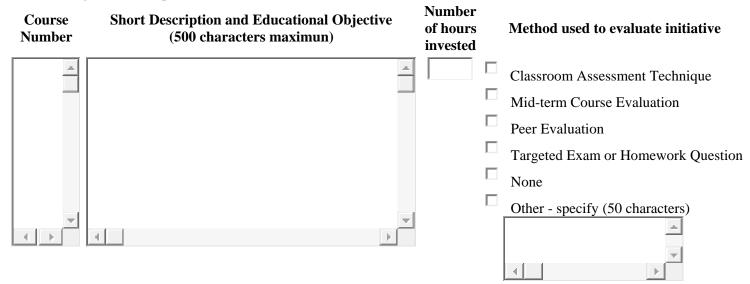
Excerpt from New Form:

Instructors are guided through the basic elements of good course design; sections are also available for educational mentoring and leadership, and a multi-year tracking of course evaluations to minimize the risk of taking on an educational experiment or a new teaching method.

2. EDUCATIONAL INITIATIVES

(a) Initiatives taken to improve your own teaching:

New teaching methods implemented

Course Number	Short Description and Educational Objective (500 characters maximun)	Number of hours invested	Method used to evaluate initiative
			☐ Classroom Assessment Technique
			☐ Mid-term Course Evaluation
			☐ Peer Evaluation
			☐ Targeted Exam or Homework Question
			☐ None
			☐ Other - specify (50 characters)

Conclusions

Through education of young faculty members, consistent recognition of excellent teaching, and building a culture of intelligent engagement with teaching in a non-threatening way, the culture in our faculty has shifted towards engagement. Our department chair reports that all of our new hires see the quality of teaching as a critical part of their job, and all member of the department now expect to be reprimanded on their annual evaluations if they have done a poor job in the classroom He reports that this is a very significant shift in the culture since the inception of the committee. Committee members regularly engage in informal discussions about the scholarship of teaching, over lunch, during office drop-in discussions, and over coffee. Having three committed faculty members is critical to the success of the endeavor, as it provides a forum for discussion, and a number of people to share the work. Change is possible, it is rewarding, and it ultimately improves student learning by creating an inspired teaching culture.

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Appendix – Teaching Sessions in New Faculty Forums

In reviewing the sessions on teaching, five major themes emerge. For each of these themes, a pair of sessions can be defined: one from a very practical perspective, and the other which examines the underlying educational theory. One of the difficulties associated with these topics was that it was sometimes difficult for the participants to see the application of the theory to their courses. Students always want more examples...even when they are professors!

Setting and marking exams is paired with *Fundamentals I: Cognitive levels and course objectives*. The major theoretical component is Bloom's Taxonomy, and using it as a guide to preparing appropriate course objectives. Without course objectives, it is difficult to develop fair and reasonable evaluation tools. The main theme which emerged from the setting and marking exams session was the importance of being fair, and the techniques needed to grade fairly.

Dealing with large classes, was addressed in *Fundamentals II: CAT's (Classroom Assessment Techniques)* and *Learning Styles*. The work by Angelo and Cross, it is one of the easiest and most efficient ways to objectively improve student learning in large classes. Measuring the learning styles in a class both informs teaching, and promotes team skills (and acceptance of diversity). The new professors all took the LSI in the session and found it illuminating that most of our students are sequential learners, while professors tend to be global learners.

Technology for teaching forms a part of *Fundamentals III: Alternate Teaching Styles*, although other important issues like problem based learning, think-pair-share and student directed learning need to be addressed. These topics took up two full sessions without any effort.

Developing assignments and examples and *Fundamentals IV: Problem Solving* form the core of engineering education. While we only ran a problem solving skills and methodology session, it would be useful to refocus this approach. This is a faculty specific topic. Other faculties focus on different core skills.

The Teaching Award Winners' Forum showcases excellent teachers in the faculty, many of whom have already participated in another session. *Fundamentals V: Evaluating excellence in teaching: the Teaching Dossier, Peer Consultations, and Student Evaluations* focussed on the measurement of excellence in teaching, working from the UTS brochures on Teaching Dossiers and Peer Consultations, and research on student evaluations.