AC 2011-2630: THE ROLE OF CENTERS FOR TEACHING AND LEARNING IN IMPROVEMENT OF UNDERGRADUATE ENGINEERING EDUCATION

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The Role of Centers for Teaching and Learning in Improvement of Undergraduate Engineering Education

Abstract

Many higher education institutions have a Center for Teaching and Learning (CTL) whose mission is to advance teaching excellence, foster innovation, and translate educational research into practice. However, those Centers may be underutilized by the faculty and schools they serve. This poster will report recommendations coming from an NSF-funded workshop "The Role of Centers for Teaching and Learning in Improvement of Undergraduate Engineering Education." The two-day CTL/Engineering Education workshop brought together teaching center directors, engineering faculty, and engineering school administrators. The workshop agenda was to outline strategies for enhancing partnerships between CTLs and schools of engineering to improve undergraduate engineering education. This poster will present insights and strategies gained from the workshop, an overview of the discussion strands, and recommendations and implications for policy, practice, and future research.

Introduction: Purpose of Workshop

The primary mission of the CTLs is to advance teaching excellence at their institutions while supporting faculty through a collaborative approach. The CTLs offer a wide array of programs, events, and services that foster innovation and translation of educational research into practice. However, schools of engineering often do not draw upon the expertise of the CTL staff and their knowledge of learning theory; perhaps this is because engineering faculty are disciplinary experts first, and may not see the value in professional development activities that are not tied to their content [1]. To address this concern, we conducted a workshop with relevant stakeholders.

The Role of Centers for Teaching and Learning in Improvement of Undergraduate Engineering Education workshop was held July 1-2, 2010 in Arlington, Virginia. The workshop brought together over 40 professionals representing the directors of CTLs, engineering faculty, and administrators of schools of engineering; there were also 9 NSF program officers and other stakeholders in attendance.

The principal goals of the workshop were:

1. To outline strategies for leveraging resources and expertise at existing CTLs to enhance undergraduate engineering education;
2. To identify programs, support and resources from CTLs appropriate for engineering faculty to enhance lifelong development as educators;
3. To identify ways of utilizing faculty insight into student learning issues and difficulties with content to inform the planning of professional development programs; and
4. To prepare recommendations for how engineering administrators could support and recognize educational innovation and professional development through a partnership with CTLs.

Overview of the Discussion Strands

The agenda for the workshop and the questions discussed were developed based on the results of a survey sent out to CTL directors of 100 schools with undergraduate engineering programs. Participants in this workshop were assigned rotating discussion groups for four hour-long working sessions. Each working session had a facilitator, scribe, and spokesperson, and each group generated answers to focused questions related to the topic of each session. An overview of the working sessions and focused questions is provided below.

Working Session I: *Identifying Ways of Using Engineering Faculty Understanding of Student Learning Issues to Inform the Planning of Professional Development Programs*

Questions addressed in this session included:
1. What are student learning issues in engineering?
2. How can engineering faculty insight inform the planning of professional development programs?
3. How can engineering faculty and CTL staff partner to create learning environments more supportive of all students?

Working Session II: *Identifying Needed Supports for Development of Engineering Faculty as Educators*

Questions addressed in this session included:
1. What kinds of opportunities do engineering faculty members need for lifelong development as educators?
2. How do we motivate engineering faculty to participate in these opportunities and reward them for doing so?
3. What campus partnerships need to be formed or enhanced to support these outcomes?

Working Session III: *Outlining Strategies for Leveraging Resources at CTLs to Enhance Undergraduate Engineering Education*

Questions addressed in this session included:
1. What kinds of collaborations between CTLs and engineering faculty would have the most positive impact on undergraduate engineering education?
2. How can engineering faculty, administrators, and CTL directors promote collaborations between CTLs and engineering faculty?
3. How can CTLs from multiple institutions work together to meet common challenges in improving undergraduate engineering education?

Working Session IV: *Preparing Recommendations for How Engineering Administrators can Support Educational Innovation and Professional Development*

Questions addressed in this session included:
1. How can university and school of engineering administrators support and recognize educational innovation and professional development?

2. How can CTLs help administrators accomplish their agenda?
3. What types of teaching and learning outcomes would be considered appropriate to include in promotion and tenure dossiers?

Summary of Findings from Workshop Discussion Strands

Working Session I: *Identifying Ways of Using Engineering Faculty Understanding of Student Learning Issues to Inform the Planning of Professional Development Programs*

A summary of findings from this discussion strand is organized by: (1) student learning issues in engineering; (2) engineering faculty insights into planning professional development programs; and (3) how engineering faculty/CTL partnerships can facilitate supportive learning environments for students.

1. Student learning issues in engineering

Content issues which could be addressed in the classroom include the need for students to be able to: solve open ended interdisciplinary problems; engage in deep learning that leads to retention and transfer of knowledge; apply design skills; integrate knowledge and transfer knowledge across different courses; work on diverse teams; and develop ethical frameworks for decision-making.

Structural issues inherent in engineering undergraduate education include the adequacy of labs, facilities, infrastructure, and space on campuses to support programs; a lack of diversity in engineering and the ongoing need to appeal to and attract a diverse group of students; and more in-depth focus on implementation of ABET outcomes.

Student characteristics that impact their learning include backgrounds may make it hard to foster great gains in learning and development; their motivation for learning; the lack of sufficient preparedness in math, science, critical thinking skills, and hands-on/application-oriented learning; and a conflict between the students' real vs. perceived abilities.

Finally, *instructor characteristics* include low expectations of students; a rigid teaching style; the need to respect the interdisciplinary nature of engineering; and a lack of educational training and understanding of appropriate teaching techniques that can foster learning.

2. Engineering faculty insights into planning professional development programs

Engineering "traditions" in the classroom may result in resistance to change and thus pose a challenge in planning professional development programs for this faculty group. Nevertheless, faculty in engineering disciplines have a sense of content issues that may be problematic for students, as well as the strategies that work effectively or don't work for them in the classroom . Thus, there is a need to deliberately engage faculty at various levels of their career to help in the planning of professional development programs targeted to needs at various points of a career lifecycle.

To do so, a change model structure needs to be considered, one that includes: building an awareness of what is happening in the classroom; creating a plan for how to address the issues; and developing the necessary programming for engineering faculty. This can be accomplished through strategies such as: implementing faculty surveys, mentoring, focus groups, etc.; taking advantage of faculty experts/expertise; engaging faculty, particularly those who are not already engaged and leveraging faculty to engage others who are unengaged; using assessment data, analyses, and discussions to develop insights and improve practice; and developing learning outcomes for professional development and tying them explicitly to the needs of engineering faculty.

3. How engineering faculty/CTL partnerships can facilitate supportive learning environments for students

Partnerships are naturally needed between engineering faculty and CTLs, because engineering faculty may not be experts in teaching, learning, and assessment, while CTLs have a skillset offered by staff that can be adapted to and adopted for engineering contexts. CTLs can help by framing ideas to faculty in the context of scholarship and data, and driven by an assessment of professional development needs of engineering faculty.

Specific strategies for partnerships between engineering faculty and CTLs include: instructional development grants; showcase of faculty accomplishments in teaching-learning; have CTL and experienced faculty attend classes together in order to gain insights into student learning issues; have activities where engineering faculty and CTL colleagues get to know each other; leverage CTL resources to help develop better assessment of student learning; ensure that engineering faculty presence is on a CTL advisory board; and audit programs, resources, and interventions to determine when and how support for engineering faculty is needed.

Working Session II: *Identifying Needed Supports for Development of Engineering Faculty as Educators*

A summary of findings from this discussion strand is organized by: (1) opportunities engineering faculty need for lifelong development; (2) how engineering faculty are motivated and rewarded for these opportunities; and (3) campus partnerships needed to support these outcomes.

1. Opportunities engineering faculty need for lifelong development

There is a need for lifelong development of engineering faculty at all stages of a career lifecycle: beginning career, mid-career, and late-career. Some of the specific strategies for *beginning career development* include: auditing "superstar" teachers in engineering contexts; working efficiently (e.g. balancing priorities; managing time; seeking mentors); grabbing the "low-hanging fruit" such as the betterment of teaching and a focus on student learning outcomes; getting involved in engineering education organizations (e.g. ASEE); and bridging the gap between content expertise and student learning.

Mid-career development opportunities include: having dedicated time for major retooling of courses and curricula (e.g. reduced teaching load); engaging in education as a research problem through grant writing and publications (e.g. Scholarship of Teaching and Learning); and collaborating with colleagues both inside and outside of engineering disciplines.
Finally, *late-career development* opportunities include: having senior faculty serve as mentors to junior faculty; providing training on how to mentor; and keeping pace with technology, trends, tools, etc. – something that should reasonably occur throughout the career.

2. How engineering faculty are motivated and rewarded for these opportunities

Faculty need: real-world, practical experience that can *inform* their teaching; time and technology resources to *enhance* their teaching; and awareness and understanding of the criteria by which to *evaluate* their teaching. As such, engineering administrators should: allow opportunities for faculty to take teaching-related risks; be held accountable for their faculty's development as educators; provide sustained recognition, showcase, and support for developing engineering faculty as educators; include teaching effectiveness and professional development a part of the standard for evaluating annual reports and promotion and tenure portfolios; and be able to define the outcomes/goals of what engineering faculty are expected to achieve, in terms of teaching and student learning impacts.

3. Campus partnerships needed to support these outcomes

Some of the partnerships and considerations needed include: *faculty and administration*, to ensure mutual goals are met; *CTLs and administration*, to ensure CTL work is "valued" and "validated"; *CTLs and other related "Centers" or support/related/academic units*, to promote collaboration and integration of faculty work; *Consideration that learning as a "revenue/profit" generation activity for campus*, for grants, Scholarship of Teaching and Learning, integration with research, etc.; *Faculty and CTLs*, to ensure reciprocity of learning relationships, priorities, etc.; *Students and CTL*s, to get end-user perspectives and input into programming; and *Multi-campus and external stakeholder (e.g. employer) collaborations*, for synergy, feedback, leveraging, etc.

Working Session III: *Outlining Strategies for Leveraging Resources at CTLs to Enhance Undergraduate Engineering Education*

A summary of findings from this discussion strand is organized by: (1) collaborations that would have the most impact on undergraduate engineering education; (2) how collaborations between CTLs and engineering faculty can be promoted; and (3) how CTLs from multiple institutions can work together.

1. Collaborations that would have the most impact on undergraduate engineering education

Collaborations can occur on a continuum from informal to formal and can be either group or individual in nature. Examples of *informal collaborations* include: investigations in a classroom based on consultation; targeted workshops that are based on something that faculty bring to work on and leave with a tangible project; and mentor work with several people. Examples of *formal*

collaborations include: interventions designed and implemented at the program level using data from student evaluations and learning outcomes to inform professional development activities; CTL working with faculty to engage in systemic educational research on promising pedagogic practices; CTL generalizing professional development to a variety of disciplines, including engineering; and when CTLs partner with engineering faculty on grant proposal development for teaching-learning projects

Group functions in collaboration include: continuing education seminars and book/discussion groups; long-term working groups by faculty interests or needs (e.g. teaching large classes); and conducting curricular or course redesign. *Individual functions* include: mentoring and an ongoing relationship with individual faculty (in this context, CTL professional serves as mentor); consultant, short-term relationship; scholarly collaborator; and support for assessment of student learning.

2. How collaborations between CTLs and engineering faculty can be promoted

Collaborations can be promoted through communication and recognition. *Communication strategies* include: marketing and advertising; changing the connotation that faculty development is meant to be a "punishment" or "remediation" for faculty; testimonials of positive results from CTL collaborations; confidential consultations; faculty led seminars; and building a database and network of "who does what" in engineering education on campus (and elsewhere).

Recognition strategies include: awards for faculty engaging in professional development; designation as "faculty scholars" in educational research; formal recognition of the strategic importance of CTLs and their impact on faculty development and student learning; documentation of professional development activities; and helping with the evidence associated with promotion and tenure activities for faculty.

3. How CTLs from multiple institutions can work together

CTLs from multiple institutions can work together through national networks and intentional collaboration. *National networks* include: American Society for Engineering Education; Professional and Organizational Development Network; and the Center for the Advancement of Scholarship on Engineering Education.

Intentional collaborations between CTLs include: developing resources and tools on teaching and assessment; developing a group of workshops that can be offered jointly and electronically; sharing education or engineering education graduate students across and among institutions for teaching and curricular innovation; and joining together and submitting grants that address large-scale engineering education initiatives.

Working Session IV: *Preparing Recommendations for How Engineering Administrators can Support Educational Innovation and Professional Development*

A summary of findings from this discussion strand is organized by: (1) how administrators can support and recognize educational innovation and professional development; (2) how CTLs can

help administrators accomplish their agenda; and (3) types of teaching and learning outcomes appropriate for inclusion in promotion/tenure dossiers.

1. How administrators can support and recognize educational innovation and professional development

Educational innovation and professional development can be recognized by administrators through both financial and policy/culture supports. Financial supports include: travel funds; funds for teaching assistants; staffing resources within the CTL that have a connection to engineering education; include resources for new (startup packages) and mid-career faculty to improve teaching; and provide financial rewards for teaching-related accomplishments (e.g. teaching awards).

Policy/culture supports include: aligning the mission of institution with the mission of the department and innovation in teaching; providing leadership to curricular change; keeping professional development activities front-and-center on the agendas of appropriate committees; "counting" educational research grants and publications for tenure and/or promotion; making teaching clearly part of written documents on merit pay, promotion, tenure, etc.; and ensuring that faculty who are promoted/tenured are, in fact, good teachers (in addition to being good researchers).

2. How CTLs can help administrators accomplish their agenda

CTL professionals need to establish relationships with engineering administrators (typically defined as deans and department chairs). In doing so, CTL professionals can ask about the engineering unit's mission and ways the CTL can support that mission, including the types of teaching-related performance metrics valued by the engineering unit.

Other specific ways CTLs can help administrators include: providing administrators talking points about abilities and accomplishments of CTLs; providing professional development programs for administrators; aligning CTL programs with goals of administrators; providing literature research support, sometimes through a graduate student; supporting faculty success in promotion and tenure; and building CTL-administrator contact into structure (e.g. CTL representative serving on appropriate engineering unit committees).

3. Types of teaching and learning outcomes appropriate for inclusion in promotion/tenure dossiers

In many ways, teaching and learning outcomes are similar to the outcomes for discipline-specific research, including: peer-reviewed publications; conference publications; evidence of teaching effectiveness; evidence of learning growth; grants; new course development documentation; and evidence of the impacts of teaching and learning within and outside of the university.

The teaching portfolio was noted as an appropriate vehicle to document, reflect, and organize teaching-related activities of faculty. Items in such a portfolio would include: teaching philosophy that is informed by the scholarship of the field; student accomplishments; student

evaluations; documentation of new things tried in the classroom; peer observation program documentation; and a description of service on policy committees regarding teaching and learning.

Recommendations and Implications for Policy, Practice, and Future Research

There are several recommendations and implications for policy, practice, and future research that emerge from the summary of workshop discussion strands[2]. These include: leveraging partnerships and communication between CTLs and engineering faculty, administrators, and students[3]; enhancing teaching effectiveness, including how is it defined, measured, developed, practiced, used, rewarded, and supported[1]; identifying and using promising teaching and learning practices that are evidence-based[4]; promoting a culture change for valuing teaching and learning in engineering disciplines[5]; organizing professional development for faculty that is targeted to career lifecycle needs[6]; helping faculty become more efficient in their teaching[7]; facilitating multi-institutional collaborations to support scalable and sustainable professional development opportunities across campuses[8]; and ensuring the ongoing assessment of assessment of students, learning outcomes, courses, programs, and related items[9].

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