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THE ENGINEERING STUDY GROUP INITIATIVE AT VIRGINIA TECH: INVOLVING ENGINEERING FACULTY IN THE DISCUSSION AND EXPLORATION OF EDUCATIONAL ISSUES

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Abstract

An initiative to promote the formation of voluntary study groups amongst engineering faculty at Virginia Tech is described. The groups provide an opportunity for faculty to freely discuss and exchange their teaching ideas and collaborate with more and less experienced colleagues, thus reducing the isolation they often experience when facing instructional challenges. The formation of study groups centered in engineering departments has been encouraged through a structure independent of the normal department administration. As a result of this effort participation in study groups has rapidly risen and currently over one third of all engineering faculty participate. If only by this measure the initiative has had an impact on the overall quality of teaching in the College of Engineering

Introduction

Engineering faculty at Virginia Tech, as at most universities, are expected to simultaneously perform a range of responsibilities in teaching, research and service. The emphasis on research responsibilities is often the strongest. The promotion, tenure and salary systems in place at most institutions strongly encourage faculty to develop funded research programs that produce publications and graduate degrees. The financial difficulties faced by many schools in recent years have only acted to further increase the focus on research or, more specifically, on the winning of research dollars.

While the focus on research may be an economic and competitive necessity, it does not change the reality that the primary job function of most faculty is education and that (by student numbers at least) the dominant component of that takes place in traditional classroom settings, and is not directly related to research. In contrast to the collaborative nature of research and the committee atmosphere that dominates service, classroom teaching is often carried out by the faculty member alone. Of course, the development of curricula and the choices about course content, sequencing and goals are usually carried out by faculty committees. However, these important tasks have little to do with the real challenges of classroom teaching – of communicating with, of motivating the interests of, and of evaluating, students.

The relative isolation of faculty in meeting these challenges becomes a particular problem if they are not provided with an opportunity to freely discuss and exchange their teaching ideas and collaborate with more and less experienced colleagues. Without such interaction and the flow of ideas it promotes, faculty face a much harder task in developing new courses, or their own teaching style, and have little reason to be interested in enhancing their courses or teaching methods beyond the minimum required to produce satisfactory student evaluations.

Providing the environment for open discussions and exchanges and getting faculty to participate is not easy. The formal structure of many engineering departments and its reflection of promotion, tenure, and academic and administrative rank, makes it difficult for faculty to meet in a departmental setting that is free of politics. In any case the other demands on faculty time, not least from research, make it unlikely that faculty will participate willingly unless they see real value in the activity

The purpose of this paper is to describe an initiative that has been underway at Virginia Tech for the last three years, designed to address these issues. The goals of the initiative are

- to foster the development of groups where faculty can freely discuss and exchange their teaching ideas in an environment that encourages collaboration and exploration to improve teaching,
- to encourage the participation of a large proportion of the engineering faculty in these groups.

Below we describe the faculty-study group concept and program that is at the core of this initiative. We then describe how the concept was promoted amongst engineering faculty and the success of that promotion in terms of the participation of faculty in each of the first three years of the initiative. We conclude with some examples illustrating the activities of the several study groups.

The Faculty Study Group Concept and Program

The current Engineering Study Group Initiative grew out of the Faculty Study Group Program described in detail by Wildman et al.[1] This campus-wide program was initiated at Virginia Tech in 1996 by the Center for Excellence in Undergraduate Teaching (CEUT).

The faculty study group was envisioned by Wildman *et al*. as a means by which faculty could join with colleagues to regularly study and reflect upon their teaching, not only to advance their own teaching, but to enhance the quality of teaching across the university. As inspiration they cite the importance of the reflective component of professional learning as discussed by Schön[2] and of the development of communities of learners amongst educators, as well as earlier efforts employing faculty study groups.[3]

In 1996, Wildman *et al.* and the CEUT initiated the program by inviting faculty from across the university to form and participate in faculty study groups with the following specific objectives:[1]

1. *study and improve each participant's teaching practice*
2. *examine teaching strategies related to student success*
3. *build a process of enquiry about ones own teaching*
4. *create a teaching portfolio to support reflection and document teaching strategies.*

As an incentive, participants were offered a $300 stipend to spend as they saw fit, but especially on teaching resources or activities related to the study group. Faculty study groups of 5 to 8 participants were encouraged to meet on a regular schedule and define specific goals. The goals and activities of each group were defined by the members, but assistance inside and outside of meetings was provided by CEUT in providing resource materials, conference information or the scheduling of guest speakers relevant to the groups activities. At the end of the academic year participants in all the groups met together and presented summaries of their activities and achievements.

Wildman *et al.* surveyed study group participants on their reasons for joining and the benefits that resulted. They found that faculty joined to connect with colleagues who valued teaching, and to break their isolation. New untenured faculty joined as a means to become involved in the university community. Tenured faculty were looking for ways to renew their teaching. Wildman *et al.* also mention the interdisciplinary composition of the groups (members from different colleges and departments) as being a positive factor because of the resulting diversity of perspectives.

Virginia Tech is a large land grant university with some 1600 faculty (260 in engineering departments) serving 25000 students. During its first year the program attracted 42 faculty (of which 3 were from Engineering) from across all colleges in the university. In subsequent academic years (from 1997-1998 through 2000-01) similar numbers of faculty participated, some in new groups, and some in groups that continued for multiple years.

The Opportunity

The study group program, as originally conceived by Wildman *et al.,*[1] has a number of important strengths when seen from the perspective of engineering education. First, and most obviously, the program strives to provide exactly the type of environment to freely discuss and exchange teaching ideas that is often not available to engineering faculty and thus a means to reduce their isolation as instructors. Second, the freedom of study groups to choose their own direction enables them to focus on the particular interests and ideas of their faculty members without the sense that they must conform to any broader agenda. This is key in an area such as engineering where faculty may be quite independent and education is very diverse, encompassing many fields involving many types and levels of material, educational goals, student backgrounds and outlook. Third, the entirely voluntary nature of group membership, and a structure independent of the normal university administration, help to insure a group environment free of the usual politics. As a result the groups tend to provide a place a natural setting where faculty feel they can discuss the specific teaching problems they face, without fear of the judgment of colleagues. The groups thus also provide a natural setting for the mentoring of younger faculty.

Despite these strengths the participation by engineering faculty in the study group program through the 2000-01 academic year, as a percentage of the total number of engineering faculty, was disappointingly low. This did not seem to be the result of any miss-match in the program with the needs of engineering faculty. Instead we suspect this was the result of the lack of awareness amongst faculty of this program, and also some cynicism in research-busy faculty about the value such broadly based groups in resolving the specific educational challenges faced by engineering educators. It therefore seemed that there was an opportunity. If these factors could be overcome, it might be possible to dramatically increase the participation of engineering faculty in the study group program. Indeed, if participation could be increased to include a large fraction of engineering faculty, this could have a significant positive impact on the overall quality of engineering education at Virginia Tech. In other words, we saw an opportunity to fulfill the broadest reaching objective of the study group program.

Promoting the Formation of Study Groups Centered in Engineering

At the beginning of the 2001-2002 academic year the authors began promoting the study group program explicitly to engineering faculty. The basic idea was to encourage the formation of CEUT study groups centered in engineering departments while maintaining a structure independent of the department administration. It was hoped that this would result in groups focused on issues of specific relevance to engineers while maintaining an essentially apolitical environment within those groups.

During this first year the initiative was implemented entirely by informal contacts established with specific faculty in different engineering departments. Through discussions these faculty were convinced of the value of the study group program and then encouraged, not to join a group, but to form their own, primarily from faculty within their department. Table 1 shows the faculty participation that resulted and the groups formed, broken down by department. Despite its rather informal nature, this effort resulted in the successful initiation of 6 study groups centered in 4 of the existing 11 engineering departments, involving some 13% of the engineering faculty.

	2001 - 2002		2002 - 2003		2003 - 2004[1]	
Department	**Number of groups**	**Number of participants**	**Number of groups**	**Number of participants**	**Number of groups**	**Number of participants**
Aerospace and Ocean Engineering	2	11	2	10	3	19
Biological Systems Engineering			1	10	1	13
Chemical Engineering			1	5	1	5
Civil and Environmental Engineering			1	7	1	11
Computer Science[2]					1	6
Electrical and Computer Engineering	2	12	2	14	2	16
Engineering Fundamentals			1	7	1	9
Engineering Science and Mechanics	1	10	1	10	1	5
Industrial and Systems Engineering			1	4	1	4
Materials Science and Engineering			1	8	1	7
Mechanical Engineering	1	4	1	9	?	?
Mining Engineering			1	6	1	6
Totals	**6**	**37**	**13**	**90**	**14**	**101**

Table 1 Participation in the Engineering Study Group Program

[1] Participation to date
[2] Computer Science joined the College of Engineering at the start of the 2003-2004 year.

In an attempt to increase the interest further, a more organized structure was put in place for the 2002-2003 year. Specifically, selected faculty members from each of the 11 departments were approached about the possibility of becoming study group program representatives. The sole responsibility of the representatives was to stimulate the formation of CEUT study groups centered within their department. Funding was provided from CEUT, the W.S. “Pete” White Chair, and the SUCCEED program. In return representatives were provided with a $1000 grant to spend in any way they saw fit. Just like the $300 stipend provided to faculty study group participants, most representatives did not feel that the $1000 grant was a significant incentive. However, it is the subjective opinion of the authors that these small financial rewards play an important role in reducing the initial apprehension of potential participants or representatives. The representatives were recruited and administered by the holder of the W.S. “Pete” White Chair – this process not being connected in any way with the administrative structure of the departments or college.

This more formal organization provided a substantial boost to the incentive resulting in a significant expansion, see Table 1. In the 2002-2003 year a total of 13 study groups were formed with at least one centered in each of the engineering departments. These groups involve 90 participants, representing close to 30% of all engineering faculty. As a whole the engineering initiative accounted for half the study group program participation university wide.

The success of the program in the 2002-03 academic year lead to a decision by the College of Engineering to provide a more permanent foundation. Because the W. S. “Pete” White Chair is a rotating chair, transferred to a new honoree every 2 to 3 years, the decision was made to appoint an Engineering Study Group Program Coordinator independent of the chair. The coordinator was to take over the recruitment and administration of departmental representatives, and provided with a $3000 stipend. Furthermore the College assumed complete responsibility for the funding of the departmental representatives and coordinator.

With these further changes in place the engineering study group program has continued to grow. Reporting so far this academic year shows that some 14 groups have been formed with over 100 participants, representing over one third of all engineering tenured or tenure track faculty.

One interesting statistic that is not apparent in Table 1 concerns cross-department and out of college participants in study groups. In the 2002-2003 year a total of 3 engineering faculty participated in engineering groups outside their department and only one non-engineer participated. As a result an explicit attempt was made for the 2003-2004 academic year to get more interdisciplinary involvement in engineering groups. This attempt has had almost no effect, and yet the program continues to grow. It may simply be that department centered groups are too specialized to permit much outside involvement. However, the groups seem of no less value to the participants.

Activities of Engineering Centered Groups

Table 2 lists the topics addressed by the 13 study groups formed in the 2002-2003 year. The activities of these groups, as well as some accomplishments they have achieved, are quite diverse. These accomplishments range from the completion of a conference paper, to the streamlining of ABET procedures, to successful proposals for funding related to course or curriculum development. Below we describe in more detail the activities and accomplishments of two of these groups **Assessing Conceptual Knowledge** and **The Educational Benefits of Information Technology and Learning Styles**. Additional information regarding other groups can be found at http://www.eng.vt.edu/odlc/irs/. .

Department	Topic
Aerospace and Ocean Engineering	Assessing conceptual knowledge
	Teaching of Vehicle Design
Biological Systems Engineering	Active learning techniques in engineering instruction
Chemical Engineering	Teaching Effectiveness - sharing experiences with the goal of improving the results of teaching and teaching satisfaction
Civil and Environmental Engineering	Sharing and developing personal philosophies for success in teaching.
Electrical and Computer Engineering	Technology in the classroom and learning styles (how to use technology in consideration of learning styles to best enhance learning)
	Engaging and motivating students to participate and utilize educational tools available to them
Engineering Fundamentals	Planning a core course for non engineering majors
Engineering Science and Mechanics	Delivery of Statics and Dynamics Courses in the ESM Department
Industrial and Systems Engineering	Topics in teaching
Materials Science and Engineering	Topics in teaching
Mechanical Engineering	Teaching large classes
Mining Engineering	Assessment of learning objectives in undergraduate courses

Table 2 Study group topics for the 2002-2003 academic year

The Assessing Conceptual Knowledge study group focused on understanding and improving the assessment of higher learning, or conceptual knowledge, in technical courses. The group was formed during the 2001-2002 academic year with a makeup of two assistant professors, one associate and one full professor, all from the Department of Aerospace and Ocean Engineering and one instructor from the university library. Initially, meetings centered on informal discussions of the challenges faced by different group members in assessing students in a variety of course environments, from day courses, to semester-long undergraduate and graduate classroom courses, to undergraduate laboratory courses, these in turn being a mix of required, elective and non-credit courses. The group continued activities in 2002-2003 formalizing its efforts into four case studies detailing the implementation and effect of innovative assessment techniques in an engineering classroom.[4] The case studies involve courses taught in Virginia Tech's Aerospace and Ocean Engineering Department.

The first case study focused on conceptual knowledge assessment in a required sophomore level lecture course. Innovative assessment techniques were implemented to measure the acquisition of conceptual knowledge in student groups as well as individual students using an exam based format. A comparison of current course performance with past student performance revealed that the assessment techniques had a positive impact on students with traditionally low grade point averages. The second case study addressed changes made to the laboratory component of a required junior level laboratory course. In an attempt to improve conceptual learning, prescribed procedures for each experiment were eliminated, and students were encouraged to develop their own measurement goals and plans. Student reporting of their work was modified to include an electronic log book – essentially a running diary of the experiment - as well as a formal technical report. Required student evaluations, submitted electronically after each lab, provided a means to qualitatively assess these changes which, on the whole, seemed to instill a sense of excitement and interest in the students that had not previously been present. Quantitative assessment of the effect of changes on student learning was hampered by the difficulty of establishing consistent grading standards across the 14 teaching assistants used in this course. An attempt was made to improve consistency by having the teaching assistants grade standardized reports and then adjust their grading styles accordingly. However, this produced only marginal improvements. The third case study explored the use of broad, open-ended homework problems to assess conceptual knowledge in a lecture format course. The results underscored the students' conditioning toward more standard assessment techniques, evidenced by the clustering of grades for traditional homework problems and the wide range of grades for open-ended problems. The fourth case study described project-based assessment of conceptual knowledge in an advanced graduate course. In this case, the traditional, comprehensive final exam was replaced with an individual or team project related to the course material. Recognizing that they elected to take the course, presumably to aid their graduate research, students were encouraged to pursue topics directly related to their research. The complete projects were deeply insightful, indicating a level of conceptual knowledge gain which could not have been measured using a final exam. Project-based assessment was very effective in this advanced graduate elective, where students were compelled by a personal desire to learn.

Like most faculty study groups, the faculty participating in the Assessing Conceptual Knowledge Group did not plan such detailed activities at the outset – indeed the initial intent was merely to meet monthly for discussions. However, such discussions inevitably lead to renewed interest by the participants in their teaching methods which, in turn leads to a greater investment of time and effort in their classes – these feeding back into the activities of the study group. This positive feedback effect appears to be one of the most important mechanisms in the functioning and success of the study group concept.

The **Educational Benefits of Information Technology and Learning Styles group** in the department of Electrical and Computing Engineering has been working together for three years on a variety of topics. The participants in this group studied learning styles and how to apply instructional strategies to accommodate different learners. By participating in the study groups, faculty had a supportive environment to try new ideas, receive feedback, and incorporate new ideas into their teaching practices. Given that the expertise of the faculty were in areas other than education, they were exposed to a vocabulary that allowed them to discuss educational research and gain insight into the diversity of learners in the classroom. Many of the study group participants were able to apply what they learned immediately to the classroom experience. Several study group participants were successful with winning an NSF curriculum development award that includes applying research on learning styles.

The success of this group stems from participants wanting to improve their teaching and working with their peers to create a community of learners among themselves. According to Dr. Bill Baumann, the leader of the group, "The faculty study group initiative has been a very valuable experience. By working with a group of colleagues interested in improving their teaching, the group affords me the opportunity to learn from others and to immediately try new instructional strategies."

Summary

This paper has presented an overview of how the College of Engineering at Virginia Tech implemented faculty study groups that focused on teaching and learning discussions in every department. With numerous responsibilities placed upon faculty finding time to identify and implement new teaching strategies may seem impossible for many. However, with the introduction of the faculty study group combined with a departmental faculty study group representative the College of Engineering was able to increase faculty participation. Faculty engaged in discussions about teaching and learning as well as implemented new teaching methods.

Overall the implementation of the faculty study groups in the College of Engineering was a tremendous success. With the addition of a faculty representative to coordinate and invite members to the meetings the number of study groups in the college moved from less than 5 groups to groups in all 11 department. Most important, the Dean of the college reviewed the results of the pilot and committed reoccurring funding to support the faculty study group representatives. This type of support is very encouraging and one way to highlight the importance of teaching and learning in the College of Engineering.

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