Collaborative Learning About the Meaning of Professionalism

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Introduction

Engineering educators strive to promote a professional orientation among their undergraduates. The task is difficult, given the range of subjects and goals, both on and off campus, that crowd the four-year curriculum. Yet the effort is extremely important, so much so that the ABET Engineering Criteria 2000 give new impetus for engineering schools to develop courses that foster professional development. This paper outlines a collaborative learning experiment at the University of Virginia that leveraged the experiences and expectations of first-year and fourth-year engineering students in existing courses offered by the Division of Technology, Culture, and Communication to create a novel avenue to explore the meaning of professionalism.

What is Collaborative Learning?

Although active learning has been around since at least the time of Plato, the past couple of decades have brought renewed interest in active learning methods, especially cooperative and collaborative learning. In cooperative learning, which is used primarily in elementary and secondary education, student groups work closely with a faculty member to tackle various course-related projects within the classroom. In contrast, collaborative learning, which is more widespread in higher education, entails a faculty member acting as a mentor or facilitator to student groups that do most of their work outside of the classroom (Matthews, Cooper, Davidson, and Hawkes). Collaborative learning promotes discussion, peer teaching, and critical thinking (Russo).

The primary difference between active learning and older models of learning is that the teacher is no longer the sole source of knowledge in the classroom. Much of the recent fascination with collaborative learning has, in fact, grown out of our changing view of what knowledge is--our assumptions about the source and control of knowledge. Social constructionist views made popular by philosopher Richard Rorty and anthropologist Clifford Geertz suggest that the way we think today differs from how we thought in the past. Knowledge is a social construct, directly related to the culture in which it is found. It is the product of the group, rather than an individual effort (Bruffee 1994). Collaborative learning reflects these new ideas about knowledge. Collaborative learning does not assume that the teacher is the sole authority on a

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subject; it is much more dependent on the input of students (Bruffee 1995).

Although critics of collaborative learning worry about the difficulty of assigning grades for group work, especially in writing classes, scholars who have studied collaborative learning stress that its benefits far outweigh its drawbacks (Marx; O'Loughlin). Proponents emphasize that collaborative learning improves student performance (Bonwell, cited in Simkins; Claxton and Murrell; Johnson, Johnson, and Smith; Myers and Jones). Learning is maximized when students work with information in a way that gives it more meaning. Further, the group dynamic in collaborations can serve as a great motivational force, while dialogue among group members shapes the information in a way that gives it more social context for the students (Rubin and Hebert). In fact, feminist scholars laud it as a feminist pedagogical model (Berling). In addition to problem solving and the application of concepts, students gain valuable teamwork and leadership skills (McKeachie, Pintrich, Lin, and Smith, cited in Rubin and Hebert). In short, collaborative learning enhances students' intellectual and social development (Gerlach, cited in Rubin and Hebert).

During the past decade, scholars in a variety of fields have recognized that the old-fashioned "chalk and talk" methods are not the best way to prepare students to operate in the workplace of the twenty-first century. As one economist notes, "chalk and talk" is an effective teaching method if we assume that our "graduates will work in old buildings with poor lighting and uncomfortable seating" in a workplace in which "tasks rely on use of old books written by dead people that are found within reach on office shelves, and workers produce handwritten documents in isolation" (Manning). College and university faculty have reported on successful collaborative learning experiments that have been conducted in subject areas that range from art history (Russo) and ethnography (Trujillo) to physical chemistry (Towns, Kereke, and Fields), economics (Simkins), physiology (Collins et al.), and statistics (Potthast). One recent trend is to have students use sources on the World Wide Web in conjunction with their collaborative work on projects (Simkins).

Collaborative Learning and Engineering Education

That engineering educators have been slow to adopt collaborative learning techniques should come as no surprise given the open-ended nature of the method. Yet, the trend in engineering education is also to include more cooperative and collaborative learning activities. At the University of Arizona, electrical and computer engineering faculty have teamed up with English composition faculty to teach a combined six-credit course to freshmen. The faculty concluded that the approach "resulted in more collaborative learning and holistic thinking" (Ostheimer, Mylrea, and Lonsdale). Cornell University's College of Engineering added a program of Academic Excellence Workshops, one-hour electives in which the students work in groups to solve problems that parallel those presented in their classes. The student groups are mentored by seniors or first-year graduate students who are trained to be facilitators. The facilitators' work is limited to helping the groups work together; they do not help the groups with answers. Paul Kintner, associate director of electrical engineering at Cornell emphasized, "The point is for the students to learn, not just to be taught." Kintner also noted that since the creation of the

Workshops, there had been improvement in students' performance—"a half grade to a grade." Although initially offered with introductory math and physics courses, they have been offered with advanced courses as well (Santo).

Collaborative Learning about Professions and ABET 2000

All of the collaborative learning experiments mentioned thus far in this paper have involved collaboration of groups of students in a single course or workshop. The focus was generally on outside work that complemented the in-class work. The project that we conducted differed from these experiments in a significant way: in our case, students from two different classes--and, significantly, from two different academic levels--were paired to work on a project that highlighted the dynamic nature of professionalism.

The project also promoted the development of many of the outcomes put forth in the ABET 2000 Engineering Criteria. In particular, the project work fostered students' growth in a number of the areas listed under Criterion 3, Program Outcomes and Assessment. These include (d) an ability to function on multi-disciplinary teams; (e) an ability to identify, formulate, and solve engineering problems; (f) an understanding of professional and ethical responsibility; (g) an ability to communicate effectively; (h) the broad education necessary to understand the impact of engineering solutions in a global and society context; (I) a recognition of the need for, and an ability to engage in life-long learning; and (j) a knowledge of contemporary issues.

Description of the Project

First-year students entering UVA's engineering program must take TCC101, a communications class that also explores the engineering sub-disciplines to help prepare students to declare their majors. During the first half of the semester, students are involved in the Research Interview Project in which they each interview an engineer to learn more about engineering careers, as well as a typical research project. The students then use the information obtained in the interview to complete a number of assignments, ranging from a simple summary memo to a research proposal and oral presentation. Fourth-year students are required to take TCC401 and TCC402, a two-semester sequence in which they write their senior theses and explore the ethical, cultural, and social contexts of engineering practice.

Examining the meanings of professionalism is one of the many goals in each course. In isolation, however, students in TCC101 or TCC401 lack the chance to explore the dynamic and ongoing professionalizing experience encompassed in a four-year undergraduate curriculum that often includes internships and summer jobs as well as classroom learning. To give students this perspective on professionalism as a dynamic process, we paired up each TCC101 student interested in a given major with a TCC401 student in the midst of senior thesis research within that major. Each team pursued a series of assignments:

1. Brainstorming about professions: Using handouts of key questions, provided by their instructors as guides, the TCC101 and TCC401 students met for one hour to brainstorm about the

meaning of professionalism. The students had to contact each other and schedule this meeting, as well as any other meetings, outside of class time. The TCC401 students had spent some time in class discussing professionalism, but the TCC101 students had not. The TCC101 students, in fact, were told that they should not do any research in preparation for the meeting. This setup meant that the TCC101 students were more likely to reflect the views of the general public with respect to engineering and professionalism in the team meeting, while the TCC401 students brought a keener sense of professions and professionalism. In the session, the students explored such questions as: How do professions differ from occupations? What fundamental presumptions does society have about professions? What duties, if any, do professionals owe society?

2. Researching the meaning of professionalism: After their brainstorming sessions, each student pursued independent research on the meaning of professionalism. At this point the TCC101 students were given some materials on professions and professionalism. These included a short passage from Monte Calvert's *The Mechanical Engineer in American, 1830-1910: Professional Cultures in Conflict* (xv-xvi) and the National Society of Professional Engineers Code of Ethics. The TCC 401 students read a chapter, "The Engineer and Business" from Edwin T. Layton's classic work, *The Revolt of the Engineers, Social Responsibility and the American Engineering Profession*. The following questions guided their research: What are the codes of ethics for an engineering society? What light do those codes shed on the meaning of professionalism? What are other recognized professions in society? What happens to practitioners who violate their professional codes? Is professionalism rising or waning in society today?

3. Discussing professionalism: In a second meeting, the first-year students sought to draw out the fourth-year students on their evolving sense of professionalism as it has developed in their classes and on their jobs over the past four years. In turn, the fourth-year students were tasked with exploring the fundamental assumptions or mythic beliefs of first-year students on these topics: engineers' relations to management, engineering's role in society, and cultural views of the professions.

4. Describing professionalism: In the final aspect of this exercise, all the students involved wrote essays (independently) as part of their final exams on a topic related to the project. Students from both classes had to respond to the statement: "Engineering is not a true profession." Their charge in this assignment was to craft an essay with a theme of their own devising that supported or denied that assertion, using evidence derived from their interviews and research.

At the end of the project, all of the students submitted their essays. The content and quality of those essays gave us plenty of insight into the tangible information that the students had learned through their work on the project. In addition, the students completed a questionnaire that we had devised to learn more about the less tangible aspects of the project: the students' responses to what they had learned and how they had learned it.

First-year Students and the Project

As noted earlier in this paper, the first-year students were asked to respond to the statement: "Engineering is not a true profession." Generally the first-year students submitted essays that indicated that they had taken the project very seriously. While all of them had explored a number of sources, especially Web-based materials, in search of information about engineering and professionalism, it was also obvious that they had learned a lot from their fourth-year team partners.

Only two of the fifty first-year students chose to argue that engineering is not a true profession. One of these noted that "engineering is simply a broad field of study, not a legitimate profession," while the other noted that engineering is an "all-encompassing field" without "self-regulation" or a "colleague orientation." Here, however, is where the two students split. While one underscored that even though engineering is too broad to be a profession, "one can be a professional engineer," the other asserted that he thought that most engineers were more interested in profits than a professional orientation. Apparently this student was greatly affected by his interview with his fourth-year partner who described his summer job at a semiconductor plant where "none of the engineers there ever thought about how their product would effect [*sic*] the community and people," but were focused on profits.

It is significant to note that the sour note sounded by the latter student was not expressed by any of the other first-year students. Most, in fact, focused on the aspects of professionalism that were addressed in the handout from Monte Calvert's *The Mechanical Engineer in America* – a systematic technical knowledge base, prolonged and specialized training, self-regulation, a service orientation, consciousness of status and role, and an orientation toward colleague rather than client – highlighting ethics as a key attribute of professionalism. Frequently offering comparisons with law and medicine, these students commented on the positive experiences with ethics that their fourth-year partners had described to them. One, for example, recalled hearing about his partner's internship at International Paper, "where she saw the ethical standard of professionals through their commitment to environmental protection and self-regulation." Most of the first-year students commented that professionalism meant serving the best interests of society, a sense of responsibility to society, or a sense of purpose. As one very eloquently concluded, "The incalculable value of human life demands nothing less than the highest moral consideration from those who might otherwise risk it. Handling ethical dilemmas and making ethical decisions are very important elements of being a professional."

No doubt some of the emphasis on the ethical dimensions of professionalism was a consequence of the first-year students having spent quite a bit of time earlier in the semester discussing essays from Morton E. Winston and Ralph D. Edelbach's *Society, Ethics, and Technology*. It also reflected much of the material that they had read on the Web. When discussing some of the Web sites in class, the students noted that they were truly amazed by the amount of attention engineers pay to codes of ethics. It is also apparent that their essays were influenced by the idealism projected on many of the engineering Web sites. This idealism led, at times, to some overblown and lofty prose. "Engineers deserve commendation for their impeccable work ethic and drive to better society," declared one of the enthusiastic students. "I for one look forward to being able to call myself an engineer."

The one negative point that many of the students mentioned related to the status of engineering vis-à-vis other professions. They were particularly upset with the image of engineering held by much of the general public. Several pointed to inaccurate stereotypes, such as the one exhibited in the Microsoft clipart gallery where "an engineer is depicted as a blue-collar worker wearing a hardhat." One student concluded that "the average American thinks engineers work on highways and in construction sites and that an electrical engineer is just an electrician." Another noted, however, that the image of engineers was improving. He pointed to computer engineering, which he thought had helped to "change the way people look at engineers." A few even thought that the engineers' lack of acclaim was a good thing. One declared that the "great thing about engineering" is that "most engineers are not driven to succeed by the acclaim that they will receive from the public." He continued, "The fact that engineers have more influence on people's lives than any other profession, and that they do it without recognition makes engineers the truest of all the professions."

The quality of the essays reflected the overall sense of satisfaction that the first-year students had with the project. This conclusion was reinforced by the results of the questionnaire, which were as follows:

1. In gauging the value of meeting with a senior, the first-year students offered these results: Of the 42 students who completed the questionnaire, 28.6 percent said the meeting was "very helpful," 52.3 percent said "moderately helpful," 9.5 percent said "slightly helpful," and the remaining 9.6 percent found the experience of neutral or no value.

2. In gauging the value of their independent research on professionalism, the 101 students offered these results: 19 percent said their research was "very helpful," 47.6 percent said "moderately helpful," 21.4 percent said "slightly helpful," and only 11.9 percent believed that the research was of neutral or no value.

3. When asked what aspects of the project were most useful, the TCC 101 students responded in expectable ways, with 36 (total) pointing to "knowledge about professions and professionalism," 27 noting "the experience of collaborating with a[nother] student," 20 indicating "knowledge about careers," and 1 noting value in "the experience of mentoring another student."

4. When these students had to narrow their response to one of these choices, 64.3 percent selected as most significant "knowledge about professions and professionalism," while 31 percent pointed to "the experience of collaborating with a[nother] student," with 7.1 percent selecting "knowledge about careers," and 2.4 percent valuing "the experience of mentoring a[nother] student."

5. Overall the TCC 101 students thought the project was worthwhile, with 16.7 percent indicating it was "very worthwhile," 42.9 percent saying it was "moderately worthwhile," 30.9 percent chose "slightly worthwhile," and 9.5 percent believed that the project was of neutral or no value.

Fourth-year Students and the Project

The seniors (students in TCC 401) wrote very high quality essays on the professionalism assignment as part of their final exam. Their specific charge was to: "Develop an original thematic essay where you explore whether engineering in America today is a true profession." The three keys to success in this endeavor, as most students realized, were to define the attributes of a "true profession," to draw evidence from "the real world" (as students are wont to say) rather than portraying an idealized goal, and to take a clear stance.

So what verdict did these seniors offer on the professional status of engineering in America today? Of 53 essays, 39.6 percent argued a strongly affirmative case. For these students, key support derived from: accredited professional education, clear ethical duties, high social status and pay, and active professional societies. On the other hand, 28.3 percent asserted that engineering is not a true profession in the US today. For this group the crucial shortcomings arose from their sense that: engineers lack real autonomy relative to management, and that the educational criteria for entrance into the profession are too permeable. Those on either side of this divide made good use of contemporary evidence, pointing particularly to the Bridgestone-Firestone recall then in the news, but also exploring a range of secondary sources.

As engineering educators, however, we were disturbed to see very few sources in their bibliographies that consider engineering professionalism in any context outside of ethical training. Ethical behavior is merely one aspect of a truly professional orientation, and is mostly a burdensome element in the eyes of students. Young engineers can and should derive real support and satisfaction in joining a profession whose members can rightly claim high competence, mastery of esoteric knowledge, intensely rewarding satisfactions in creating technologies and improving society at large (i.e.: non-monetary compensations), great mental rigor, and the satisfactions of life-long learning.

The seniors did note many of these elements, but their support came from their own academic and co-op experiences, not from written sources. This dynamic learning derived over the course of their own education contrasted greatly in their eyes with the perspectives on professionalism that they saw in the first-year students. As their essays recounted, the seniors found that the first-year students had a highly circumscribed view of professionalism, centered largely on high pay, social status, and technical mastery. Many seniors commented that their interviews with first-years provided telling reflections on their own inchoate sense of engineering when they entered college. On the one hand, this suggests that the seniors offered more to the first-year students than they derived in these interviews – the conclusion one would expect. But as engineering educators, we are gratified that the totality of the undergraduate experience seems to bolster the kind of professional orientation that our institutions are charged with providing.

But what of the remaining third? What stance did their essays reveal? A mere 7.5 percent offered up muddy meanderings rather than honed, thematic essays – a gratifyingly small dross yield as most liberal studies educators will agree. But 24.5 percent could accept neither

conclusion. For these students, engineering ought to be a true profession, but falls short of its ideals. These seniors offered realistic analyses of the tensions that confront the profession: between loyalty to employers, to individual career advancement, and to the public; between managerial, social, and professional imperatives; and between high pay and often invisible social status. Rather than seeing this as a group that could or would not take a clear stance, we find this cohort has garnered a realistic sense of the tensions that will demarcate their professional lives. The ability to understand and navigate within such conflicting realities also strikes us as a truly useful attainment in undergraduate education.

The seniors also completed the same survey given to the first-year students evaluating the utility of the professionalism project, with these results:

1. In gauging the value of meeting with a first-year student, the seniors offered these verdicts (out of 53 respondants): 3.8 percent said the meeting was "very helpful," 30.2 percent said "moderately helpful," 41.5 percent said "slightly helpful," and the remaining 24.6 percent found the experience of neutral or no value.

2. In gauging the value of their independent research on professionalism, the seniors offered these results: 15.4 percent said their research was "very helpful," 46.2 percent said "moderately helpful," 30.8 percent said "slightly helpful," and 7.7 percent believed that the research was of neutral or no value.

3. When asked what aspects of the project were most useful, the TCC 401 students responded in expectable ways, with 41 pointing to "knowledge about professions and professionalism," 27 noting "the experience of collaborating with a[nother] student," 16 noting value in "the experience of mentoring another student," and 13 indicating "knowledge about careers."

4. When these students had to narrow their response to one of these choices, 57.4 percent selected as most significant "knowledge about professions and professionalism," while 27.8 percent pointed to "the experience of collaborating with a[nother] student," with 11.1 percent valuing "the experience of mentoring a[nother] student," and 3.1 percent selecting "knowledge about careers."

5. Overall the TCC 401 students thought the project was worthwhile, with 7.5 percent indicating it was "very worthwhile," 34 percent saying it was "moderately worthwhile," 35.8 percent chose "slightly worthwhile," and 21.6 percent believed that the project was of neutral or no value.

A comparison of these results with the 101 student surveys reveals that the first-year students derived greater value from the interviews and from the direct knowledge the seniors provided. A clear majority in both groups found their independent research was valuable. Both groups also valued the perspectives they gained on professionalism, although the seniors placed a higher value on collaboration and mentoring than the first years. A high proportion of 101 students gave the overall project a favorable rating, but the 401 students felt less favorable about the project. In sum the seniors were good teachers and the first-years were appreciative learners.

Another element of the survey revealed a broad consensus among students from both cohorts about the key constituent elements of professionalism. In selecting the three most important attributes (in order of importance) that confer professional status on any occupation, the 101 students picked specialized knowledge and education (30 respondents), ethics and ethical values (16), and social responsibility (8). The 401 students ascribed these priorities in the elements of professionalism: specialized knowledge and education (35 respondents), social awareness and responsibility (13), and ethical autonomy for individual practitioners (13). This consensus, notwithstanding the divergences in age and educational attainment, suggests to us our 101 and 401 classes succeed in sketching the disciplinary and ethical foundations essential to professionalism.

Conclusions

This experiment in collaborative learning has proven worthwhile to us as instructors, and we believe it offered real educational value to students. TCC 101 students are taking their very first steps into a profession that they can only dimly perceive, yet they must acculturate very rapidly given the pressures of the curriculum. The 401 students proved to be valuable guides. The seniors had less to learn directly from the first-year students. But the collaboration opened their eyes to their own attainments in professional knowledge and orientation over the course of their education. Much of that acculturation has taken the form of tacit knowledge and unstated perspectives. Their collaborations with the 101 students, however, revealed just how far the seniors have come in joining the professional community of engineering. As instructors, we draw much satisfaction in watching our students mature over time. But that is a transformation they seldom see for themselves. Through these collaborations, our 101 and 401 students have directly experienced their own dynamic learning – the key goal of undergraduate education and a crucial foundation for life-long professionalism.

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