

**AC 2007-1195: TEN YEARS OF EXPERIENCE WITH A PROFESSIONAL
DEVELOPMENT COURSE SEQUENCE FOR ENGINEERS — LESSONS
LEARNED**

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Ten Years of Experience with a Professional Development Course Sequence for Engineers—Lessons Learned

Abstract

Over the past decade, the School of Engineering at Rensselaer Polytechnic Institute has developed a unique educational component in Professional Development and Leadership for all Engineering undergraduates. Taught by the professional staff at the Archer Center for Student Leadership Development, the two 1-credit experiences (**Professional Development I—PD-1** and **Professional Development III—PD-3**, respectively) have become an indispensable part of the engineering educational experience of our students. A third part of this experience (**Professional Development II—PD-2**) is taught independently by faculty from the School of Humanities and Social Sciences. Development began in the mid 1990s, and starting with the Class of 2001, these courses have been taken by all engineering students. The present paper describes our experiences in developing this experience and incorporating it into the curriculum, the assessment process that has been used to redesign the curricular content on a continuous basis, and some of the lessons that have been learned along the way.

Background

During the mid-1980s, there arose an increased concern with the marketability of engineering graduates. In concert with a very competitive job market, industry recruiters began to seek graduates who were not only technically capable, but who were also proficient in “people skills” and “communication skills.” At the same time, engineering programs began to expand and enhance design education experiences, including significant opportunities for team-based activities. Success in these depended strongly on productive interpersonal relationships among team members as well as clear understanding of customer needs and communication. Other factors that have influenced the need for leadership in the last decade include the evolution of the global workforce, the influence of information technology on the interaction among virtual teams, and the recognition that understanding of ethical implications of engineering is paramount to long-term professional development.

The idea to formalize activities related to student leadership at Rensselaer actually was initiated by the Rensselaer Union, which is the self-supporting and self-governing *student* organization that controls, finances, and organizes student activities on the campus. In 1988, the Executive Board of the Union proposed to the Vice President for Student Affairs that Rensselaer form a Center for Student Leadership Development on the campus. Early activities focused on leadership training for student clubs and organizations, with specifically designed instructional modules for various groups. The Center grew rapidly with an increasing demand for on-campus workshops and conferences. These included out of classroom programs, “Slice of Leadership” presentations and panels, a Professional Leadership Program for juniors, and a Professional Leadership Series for engineering and science graduate students. In 1992, the Center received a bequest toward a future endowment and was renamed the **Mary Jane and Hugh Archer ’37**

Center for Student Leadership Development. This gave the Center heightened visibility on campus and extracurricular leadership programs flourished.

At the same time, many courses themselves were becoming more team-based; most projects involved some team component; and often the teams faced obstacles associated with interpersonal interaction. Faculty began asking Archer Center staff to provide some assistance, and short leadership exercises gave way to full class periods devoted to team building or communication development. In 1994, the Archer Center taught a course entitled **Art of Leadership** to freshman majors in the School of Management. The course, since re-named **Management Leadership**, now comprises a 2-credit, two course sequence for sophomores and is required of all Management majors and minors. In 1996, at the request of the School of Engineering, the Archer Center offered a very successful 3-credit elective entitled **Engineering Leadership**. Interestingly, students recommended that the course remain an elective opportunity only, as they feared a deterioration if less-enthusiastic colleagues were required to become involved. This issue has been central to on-going assessment activities, as will be noted below.

Beginning in that same year, Rensselaer began a major curriculum restructuring. During the re-design process, the School of Engineering decided to require a leadership component as part of the Engineering Core Curriculum. There were clear indications that this component of engineering education would be required as part of the EC2000 requirements for ABET accreditation. All engineering students began taking a course called **Introduction to Engineering Design** during the sophomore or junior year. One credit of that four-credit course would be entitled **Professional Development I** and would be taught by the Archer Center. In addition, the Archer Center would teach a culminating course, **Professional Development III**, for students who were simultaneously enrolled in the Capstone Design Course. The responsibility for a third course, **Professional Development II**, was assumed by the School of Humanities and Social Science; it was organized to be completely independent of the Archer Center sequence. All three of these experiences are described below in greater detail.

The addition of these curricular components to the School of Engineering did not occur without controversy, despite the emergence of the Archer Center as a significant force on the Rensselaer campus. We prided ourselves as being a technological university, so that the need for focus on people skills within the Engineering curriculum was not clear to all. Some felt that such training should be done later after the graduate had entered industry, despite the increased emphasis from our Key Executives and other corporate partners that Rensselaer graduates needed to emerge with leadership skills. The fact that Archer Center instructors were not technically trained was questioned. Further, engineering faculty were “successful” without such training in their backgrounds—why would there be a need to impose this added burden on an already tight curriculum. The most prevalent reaction is that these skills are essentially “common sense” so that no academic (credit hour) component is really needed. Lastly, the entire notion of what “leadership” means in a modern technological environment, distinct from how to function as the “person in charge,” needed clarification.

However, over the past 7 years, careful and continuous assessment of these courses and how they serve to improve the educational experience of all our engineering students has led to broad acceptance, and their place in the curriculum is no longer a controversy. The present paper,

based on an earlier version presented in a poster session at the 2006 ASEE Conference¹ will proceed with a more detailed description of the two courses taught by the Archer Center and the assessment process, which has been a key component of every activity. (A briefer description of the **PD-2** courses follows.) The Archer Center leadership and staff continually revise these courses to make them increasingly relevant to our graduates and to strengthen the engineering curriculum as a whole. These assessment processes will then be described in greater detail along with the specific examples of how the courses have been improved over the years. The assessment instruments themselves have also evolved significantly, as well.

To conclude this background discussion, we note that the Archer Center is currently housed in the Office of Student Life and the Director, Linda McCloskey, reports directly to the Vice-President for Student Life. The mission statement for the Archer Center is as follows:

The Archer Center for Student Leadership Development provides skill-based, interactive leadership education for the Rensselaer students and community that complements the institute's education mission. We work with our colleagues and corporate partners to promote leadership practices that foster teamwork and integrity in professional and personal development.

The Director and Professional Staff maintain close cooperation with the Associate Deans in the School of Engineering and the School of Management, as well as the Provost. The Director also reports to the Rensselaer Student Union Executive Board, which funds many of the leadership and professional development activities that are extra-curricular on the campus. The Center staff are comprised of an Associate Director and Senior Educator (Christine Allard) and 7 Educator/Lecturers who are full time staff in the Center.

Course Descriptions

Professional Development I (PD-1) provides students with an introduction to a simulated professional environment where they can be exposed to the body of knowledge on effective teams. Coursework consists primarily of skills-based learning designed to foster effective teamwork abilities. Skills and topics include: collaboration, effective communication and feedback, conflict management, and team development. Coursework and assignments are designed for students to gain topical knowledge, analyze and apply basic concepts, and expand written and oral communication skills. An early description of the course was reported by McCloskey, et al.²

Students take and also evaluate the use of the Myers Briggs Type Indicator³. Corporate guests from ExxonMobil and the Knolls Atomic Power Laboratory participate in some of the classes to reinforce some of the concepts and applications in industry. PD-1 is integrated into the Second Year Introduction to Engineering Design (IED) course, which for most students is the first major experience in working in multidisciplinary teams, and they are crucially interdependent for success. It is important to understand that the course emphasizes how students with different values can work together productively. Team members must learn to respect the differing values among their members. For example, students who perform at different academic levels and with different degrees of personal motivation have to be able to work effectively together to complete

their design projects successfully. Likewise, the course does not attempt to enforce politically correct attitudes; however, students must understand how expressions of sexist or racial insensitivity or bias may affect their professional future. The students also are asked to evaluate what these issues mean in terms of a diverse/global workforce. Each semester, over 300 Engineering majors take PD-1 in 10 to 15 sections of about 28 students each.

An important indication of the acceptance of these instructional components by students is provided by specific responses students have provided in the end-of-semester course evaluations. For **PD-1**, key questions and responses from the 06-07 academic year are as follows:

Question	Strongly Agree or Agree	Neutral	Disagree or Strongly Disagree
4. Overall, this course added value to my understanding of teamwork & leadership.	67% (F05) 75% (S06)	23% (F05) 17% (S06)	12% (F05) 8% (S06)
10. The instructor encouraged students to make links between PD-1 and IED.	89% (F05) 91% (S06)	9% (F05) 5% (S06)	3% (F05) 4% (S06)

Professional Development III (PD-3) complements **PD-1** by providing a model of professional leadership that students may apply while determining their future after graduation and in their work as new engineering professionals. Through experiential learning, students are exposed to professional skills including ethical decision-making, extemporaneous speaking, critical thinking, and tools to succeed in a diverse organizational culture. The Global Sullivan Principles of Social Responsibility are captured throughout the PD-3 curriculum, so that students are exposed to the global framework for social responsibility for companies large and small. The topics presented in the course are depicted in the Digraph of Figure 1.

The interactive learning approach, in addition to discussions, exams and presentations, is designed to promote further development of students' leadership abilities. By design, PD3 is taken at the same time as the Fourth Year culminating design experience for Engineering students; however, it is not tied specifically to the capstone course, and it represents an independent educational outcome for our students. The goal is to begin to connect the graduating student to the workplace (or graduate school or military)—not to the teamwork activities associated with the capstone course.

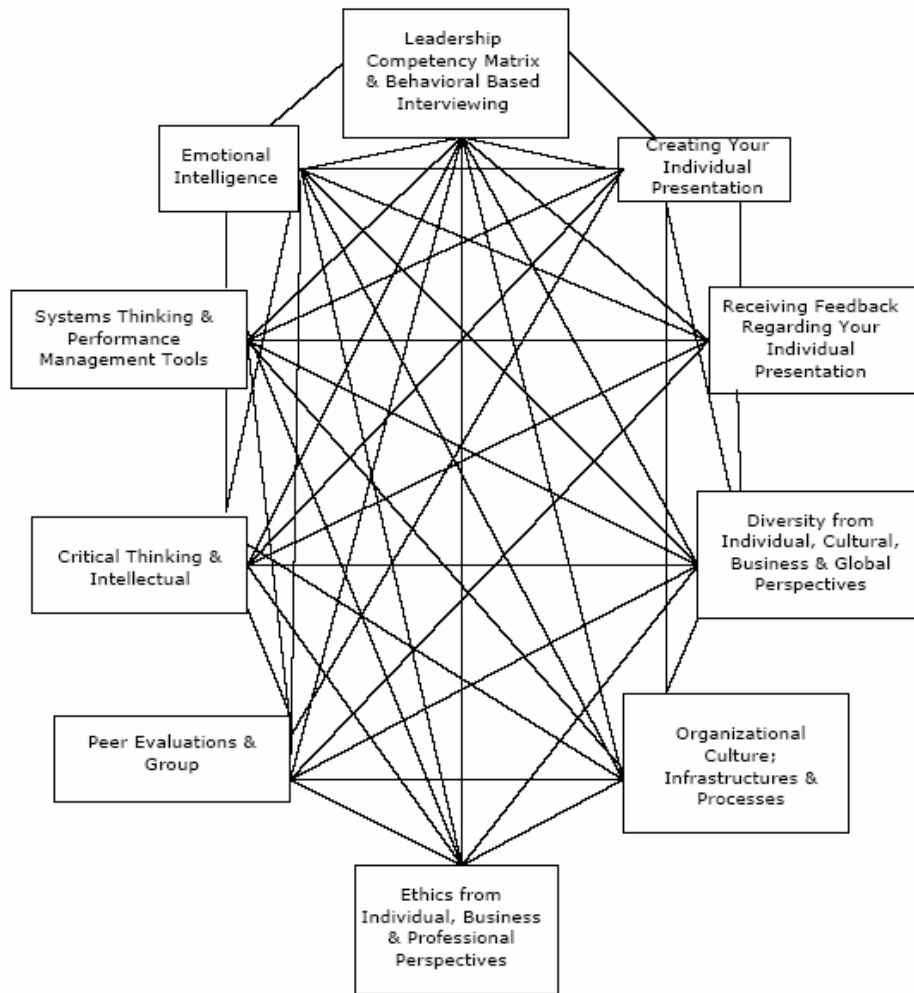


Figure 1. PD-3 Curriculum in an Interrelationship Digraph

An important indication of the acceptance of these instructional components by students is provided by specific responses students have provided in the end-of-semester course evaluations. For **PD-3**, key questions and responses from the 06-07 academic year are as follows:

Question	Strongly Agree or Agree	Neutral	Disagree or Strongly Disagree
1. I believe that I will apply the information that I learned in PD-3 in my next work/academic environment.	84% (F05) 80% (S06)	4% (F05) 7% (S06)	11% (F05) 13% (S06)
5. The instructor encouraged students to make links and see the application of the topics discussed in PD-3 with future work experiences.	91% (F05) 92% (S06)	7% (F05) 7% (S06)	2% (F05) 1% (S06)

Summary Evaluation of PD-1 and PD-3. PD-1 and PD-3 utilize 2 credits of the entire Bachelor of Science requirement at Rensselaer. Prior to their inception, 24 credits of Humanities and Social Science credits were required, and the reduction to 22 credits to permit these valuable experiences to be offered to our students has been regarded by students, alumni, corporate partners, and recruiters as an important and affirmative decision. The courses were cited repeatedly by ABET evaluators as important components of the Professional Development Outcome (ABET Criterion 3(e, f, g, h, k)). Our corporate partners go beyond verbal support, and take an active role in supporting our efforts because they know that if our graduates are introduced to the concepts and competencies while at RPI, the cost of their training lowers when hiring an RPI graduate.

Examples of support from corporate partners for **PD-1** included guests from ExxonMobil joining the Archer Center instructors during the session on public presentations to assist in providing feedback to students when presenting on their project design, and/or final project outcome(s). Another example is when representatives from Knoll Atomic Power Laboratory (KAPL) assist with the interpretation of the Myers Briggs Type Indicator (MBTI) assessment that is done with the students.

Examples of support from corporate partners for **PD-3** include representatives from General Electric (GE) working in concert with the **PD-3** instructors to provide the students feedback regarding their initial impression when speaking extemporaneously on a topic that they will likely address further in their careers. Also, other entities such as General Dynamics and BAE Systems have come into the classroom to support the sessions which address how one is to navigate within organizational structures and cultures effectively, as well as engineering ethics.

Professional Development II (PD-2). The middle segment of the Professional Development sequence is actually taught as an independent course from the two described in the paragraphs above. The experience is designed to provide an academic context for understanding leadership and professional organizations. There are actually two separate courses that are available for third-year students, and both are taught by faculty in the School of Humanities and Social Sciences. Students must choose one of these two courses, which are taught from the Departments of Psychology (PSYC) and Science and Technology Studies (STSS), respectively..

PSYC-4170 “Leadership Theories” exposes students to a variety of leadership theories, especially those that focus on traits, behaviors, influence processes, power, and charisma. Of special interest is the comprehensive theory of transformational leadership, which actually encompasses many aspects of other theories⁴. The goal is for students to understand what makes an effective leader. After they leave college, graduates will meet leaders and managers and be able to recognize their effective leadership traits, behaviors, and skills. They will appreciate how to deal with leaders with different abilities and skills and what it takes to be an effective leader, so that they may improve their leadership and managerial skills.

The second course, STSS-4840 “Professional Development II” leads students through issues of leadership within professional organizations. They are exposed to academic research literature in organization studies, social psychology, marketing and political science that are relevant to human behavior in work organizations⁵. They also receive insights from practitioners, class presentations, and from reading assignments from popular media.

Each of these two courses is offered every term to accommodate the 700 students who are pursuing engineering degrees at Rensselaer, and they, along with **PD-1** and **PD-3**, are an essential component of our attainment of several ABET outcomes. Unfortunately, the two H&SS courses have not been as well received over the years by students as **PD-1** and **PD-3**. There are several reasons for this student dissatisfaction, all of which are being reviewed and addressed by the School of Engineering and the School of Humanities and Social Sciences. One critical difference is that the H&SS courses are taught in larger sections and by faculty who have other academic responsibilities, making it difficult to evolve course content and pedagogies to make them more effective. On the other hand, the Archer Center staff are professional educators whose sole responsibility is the coordination of professional development and student leadership activities throughout the Institute. All the instructional staff coordinate continuously with one another and with engineering faculty to improve the courses and to ensure their relevance. Detailed examples of this continuous quality improvement process were cited in [1].

Overall, the model provided for the large annual cohort of students in the professional development area is unusual compared with many that we have reviewed, in which engineering faculty themselves attempt to incorporate these issues into capstone design courses or in other engineering courses, often with limited success.

References

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