2006-2055: CONTINUOUS FEED-FORWARD EVOLUTION OF A PROFESSIONAL DEVELOPMENT COURSE SEQUENCE

Gail H Keraga, Rensselaer Polytechnic Institute

Gail H. Keraga is an Educator and Staff Member of the Archer Center for Student Leadership Development at Rensselaer Polytechnic Institute.

Linda McCloskey, Rensselaer Polytechnic Institute

Linda McCloskey is the Director of the Archer Center for Student Leadership Development at Rensselaer Polytechnic Institute, Troy NY.

Richard Smith, Rensselaer Polytechnic Institute

Richard N. Smith is the Associate Dean for Academic and Student Affairs in the School of Engineering at Rensselaer Polytechnic Institute.

Tracy N Schierenbeck, Rensselaer Polytechnic Institute

Tracy N. Schierenbeck is an Educator and Staff Member of the Archer Center for Student Leadership Development at Rensselaer Polytechnic Institute, Troy NY.

Continuous Feed-Forward Evolution of a Professional Development Course Sequence

Over the past seven years, the School of Engineering at Rensselaer Polytechnic Institute has incorporated a unique educational component in Professional Development and Leadership into the Design experiences required for all undergraduates. Taught by the professional staff at the Archer Center for Student Leadership Development, the two 1-credit experiences (**Professional Development I** and **Professional Development III**, respectively) have come indispensable part of the engineering educational experience of our students.

Mission Statement for the Archer Center

> *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.*

To uphold this mission, the Archer Center staff are responsible for instructional design based on the following considerations: the targeted audience/customer(s); identified learning objectives; sequencing of instruction; selection of instructional strategies; evaluation of audience/customer(s) learning and instructional effectiveness.

Given the Archer Center's roots in Student Development, assessment has always played an integral part in the delivery of services and programs outside of the curriculum. This knowledge and experience has been applied to the credit bearing courses taught by the Archer Center for the School of Engineering. This paper will address the continuous feed-forward evolution of Professional Development I (PD-1) and Professional Development III (PD-3). The description of the assessment process and some of the impacts will follow a historical discussion of the simultaneous evolution of the Archer Center and the Engineering curriculum in leadership and a brief description of the two courses as they are currently taught.

Background

During the mid-1980's, 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 develop strong enhancement of design education, including significant opportunities for team-based activities, success in which 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. (A third course, Professional Development II is taught at Rensselaer in the School of Humanities and Social Science, and is completely independent of the Archer Center sequence. It will not be described in the present paper.)

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. Finally, 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, carefully 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 will proceed with a more detailed description of the two courses and the assessment process, which has been a key component of every activity. 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 the Vice-President for Student Life. However, 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/Lectures 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, team development and ethical decision-making. Coursework and assignments are designed for students to gain topical knowledge, analyze and apply basic concepts, and expand written and oral communication skills.

Students take and also evaluate the use of the Myers Briggs Type Indicator[1]. 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, an "A" student and a "C" student have to be able to work

effectively together; however, the "C" student must learn to refrain from negatively interfacing with the "A" student because she strives for excellence. 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 (from Appendix 1) and responses from Fall 2005 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%	23%	12%
10. The instructor encouraged students to make links between PD-1 and IED.	89%	9%	3%

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).

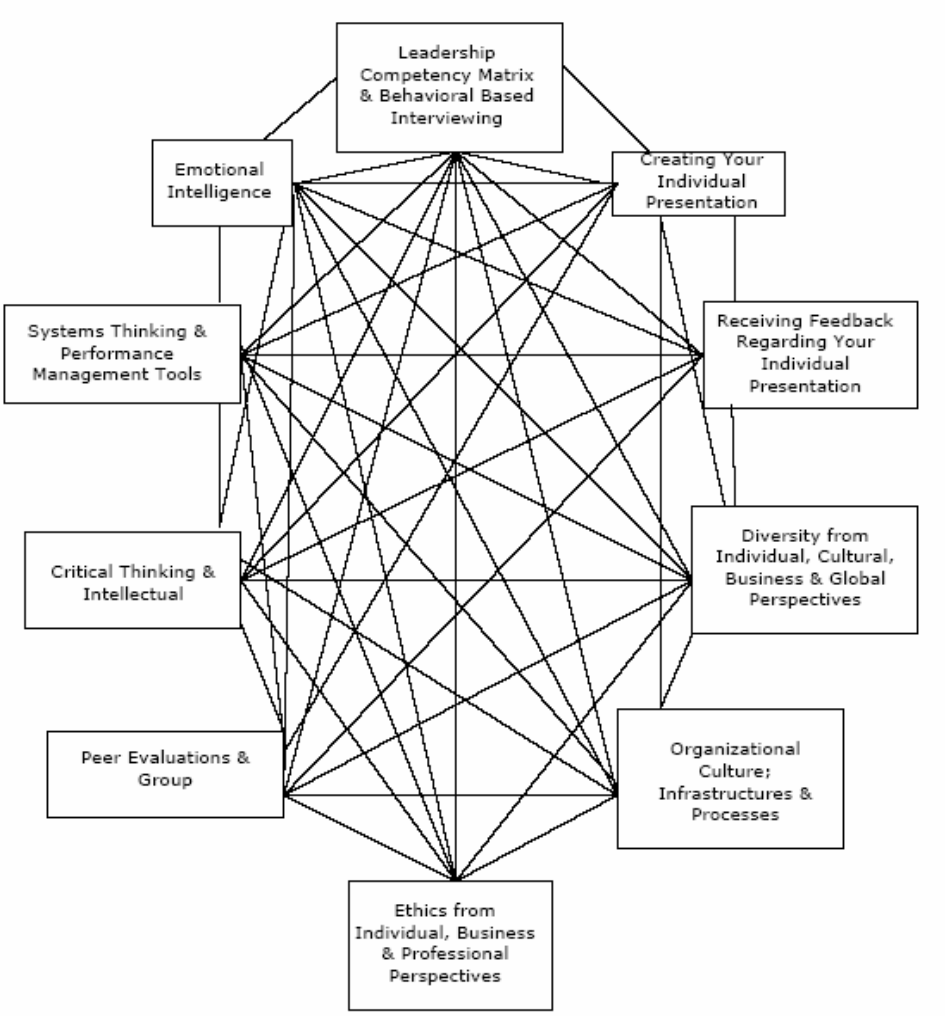

Figure 1. PD-3 Curriculum in an Interrelationship Digraph

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 (from Appendix 1) and responses from Fall, 2005 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%	4%	11%
5. The instructor encouraged students to make links and see the application of the topics discussed in PD-3 with future work experiences.	91%	7%	2%

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.

Feed-forward Assessment: Components of the Feed-Forward Evaluation Process

The evaluation process for PD-1 and PD-3 is multifaceted and continuous throughout the year. A variety of measures are used to examine the effectiveness of the instructional design. These include:

- Weekly Analysis of Curriculum
- Assessment of Student Learning
- On-going Exam Analysis
- Course Evaluation/Instructional Effectiveness
- Redesign of Course Evaluation Assessment

Weekly Analysis of Curriculum Evaluation – Each semester, approximately 8- 10 instructors teach PD-1 and PD-3 and have established both a formal and informal process for curriculum evaluation. Each week the instructors for each course (PD-1 and/or PD-3) meet to review curriculum and methods for the upcoming week, as well as review and evaluate the previous week's content/delivery. During these 1.5 to 2.5 hour meetings (per course), instructors discuss which aspects of the curriculum worked; which portions should be revised, and address any immediate changes that might be needed depending upon the feedback from the students, guest speakers, and instructors. In addition, these meetings ensure content consistency across all sections. Informally, instructors converse almost on a daily basis, if only for a few minutes, to discuss particular issues that arise that could impact the success of that particular week's curriculum.

> *Example for PD-3: During Fall 2004, a weekly analysis meeting allowed instructors to put in place a plan to ensure the maximum effectiveness of a new redesign effort from the previous summer. PD-3 courses are offered on Tuesdays and Thursdays. To assess the effectiveness of any new content, sequencing of content and/or new instructional methods, the instructors that taught Tuesday sections would return and report on the success of student comprehension of material, the effectiveness of the sequence or flow of the content, and the overall evaluation of student learning that took place. If any changes needed to take place from this new information before Thursday classes, the implementation of the changes became a priority. At the next scheduled weekly meeting the instructors that taught Thursday provided an overview of their successes and/or additional options to consider for the formal re-design process scheduled for the following semester. Even though much of this dialogue among instructors takes place outside the formal weekly analysis meeting, all changes are captured at the next weekly analysis meeting.*

Assessment of Student Learning – To assess student learning, the Archer Center continually evaluates the appropriateness of the evaluation techniques used for each course. Over the years,

a variety of techniques have been used, including essays/long-answer responses, multiple-choice exams and projects/presentations. These assessment methods are continually evaluated for appropriateness by the teaching staff based on a number of variables, including group size, facilities, time limitations, special audience characteristics such as verbal ability, special needs, or previous test experience.

> *Example from PD-1: At the inception of PD-1, students were required to provide long-answer responses to questions regarding Tuckman's Stage of Group Development. This theory describes five distinct stages groups/teams progress through as they work together. Students were asked to identify and support the stage at which their team was currently functioning. This proved to be a significantly difficult task for students, as most were unable to provide supportive documentation of the identified stage. In addition, resulted in a cumbersome grading process for instructors. A switch was made to multiple-choice exam, but great effort was made to ensure that these exams assessed beyond the knowledge (or memorization) stage by creating application based questions.*

There are six levels of learning within the cognitive domain. They are, listed from the lowest to highest level of learning:

1. Knowledge
2. Comprehension
3. Application
4. Analysis
5. Synthesis
6. Evaluation

A variety of assessment methods are developed to assess student learning at multiple levels. For instance, the highest level of the cognitive domain that can be assessed with a multiple-choice instrument is the Application level. Great care is taken in the writing and analysis of each item to ensure validity and reliability, as well as consistency with regard to learning objectives established within the curriculum.

To assess student learning at even higher levels of the cognitive domain a number of different learning assessment methods have been developed.

> *Example from PD-3: In 2004, a group project was developed which required students to analyze a film and address leadership topics in the PD-3 curriculum. During these presentations, the instructors noted that the higher levels of the cognitive domain were not reached. Therefore, a group presentation was carefully designed to target analysis, synthesis and evaluation levels of the cognitive domain. The design included case scenarios that required the students to analyze the information given and, through the use of synthesis and evaluation, prepare and present their position. During a Q&A portion of their presentations, student responses to certain questions further help instructors analyze their learning and internalization of the course content.*

On-going Exam Analysis – When a multiple-choice exam is used to assess student learning, an item analysis is performed to determine if the exam is valid and reliable. From a macro perspective this analysis helps the instructors to determine if any questions should be redesigned or deleted for the following semester. From a micro perspective this analysis allows the instructors to make immediate grading decisions based on analysis between each section, as well as throughout all sections in each course. Instructors then have a dialogue as to the different teaching strategies that might have been deployed to explain any variances, or if the curriculum suggests that another answer is also appropriate for the student to select. The item analysis is also weighted against the learning objectives for each session and an instantaneous decision can be made as to how the grading will be handled for the current semester.

Course Evaluation/Instructional Effectiveness – Both formal and informal methods are used to assess course and instructional effectiveness. Informally, instructors frequently request oral feedback from the students, either at the end of each class or at when meeting with a student. At the completion of each semester a formal course assessment is administered to all students to obtain written feedback regarding the topics addressed throughout the semester. Feedback is anonymous and cannot be viewed by the instructors until final grades have been submitted; however, the Director of the Center has immediate access to the information. The most recent version of the assessment instruments are attached as Appendices 1 and 2. The compilation of these data (both their rankings of certain components within the curriculum, as well as the common themes from student written remarks) is used to guide the Director and the instructors in the revision and/or re-design process.

> *Example for PD-1: During Summer 2005, an analysis of PD-1 course evaluations pointed to a lack of connection between the topic of Ethics taught in PD-1 and the student IED projects. The redesign of that week's content for Fall 2005 focused on developing instructional materials and methods to support this connection and help students better understand the relevancy to their projects and work as design engineers. Work is continuing in this area, with Archer Center staff and Engineering Faculty discussing ways to further enhance this connection in the classroom.*

Redesign of Course Evaluation Assessment

Considering all of the previous components of the feed-forward evolution process, it became evident that the assessment instruments utilized at the time were not sufficient in providing us with the information needed to make accurate administrative decisions regarding the development of the curriculum. Initially, the course evaluation instrument provided data from students regarding their self-perceived learning of topics presented, as well as their perceptions of the level of difficulty and practicality of the topics. Instead of using a normative based approach to assessment, we have moved more towards a criterion-based approach, which has allowed us to be more directive when requesting information from students, which, in turn allows us to be more targeted in the redesign process.

Conclusion

We have been discussing the components of the feed-forward evolution process, which occurs continually throughout the year. The results of this process are captured within the curriculum at two major times – the four week winter break and three month summer break. During these times redesign teams are assigned to work on each course. When making redesign decisions, we must consider the time and resources available, the maximum number of changes to be made within certain time constraints, and administrative support.

During these formal redesign periods, the following are also considered:

- Corporate Sponsors and Partners
- Current Global Issues – must be dominant and/or relevant to student success

Annually the Director of The Archer Center meets with the Associate Dean of Engineering to review the student evaluations and come to agreement regarding the direction of the curriculum for the following year.

References

[1] Briggs Myers, Isabel and Mary McCaulley, et al. *MBTI Manual; A Guide to the Development and Use of the Myers-Briggs Type Indicator.* (3rd Ed.) Palo Alto, California: Consulting Psychologists Press, Inc. (1998)

[2] L. McCloskey, C. Allard, J. Reel, and D. A. Kaminski, "Incorporating Leadership Training in a Sophomore Engineering Design Course," ASEE Annual Conference and Exposition, Paper 0248 (2003)

Appendix 1. Course Evaluation Instrument for PD-1

Professional Development 1 -- ENGR 2050 Fall 2005 Course Evaluation

Section _____ Name (optional) _____

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I applied the theories and concepts learned in PD1 to my IED course.	1	2	3	4	5
2. The written assignments in PD1 (Team Contract and Peer Feedback) were beneficial to my team's IED performance.	1	2	3	4	5
3. Assignments and evaluation methods were fair.	1	2	3	4	5
4. Overall, this course added value to my understanding of teamwork & leadership.	1	2	3	4	5

5. For a course that meets for 1 credit hour, I would rate the difficulty of this course as:	very difficult ○	difficult ○	reasonable ○	pretty easy ○	easy ○
6. The amount of time needed for study and completion of assignments was:	way too much ○	too much ○	reasonable ○	little ○	very little ○
7. I would rate the amount of effort I put into this course as:	too much ○	significant ○	average ○	little ○	very little ○
8. The pace of the material presented was:	very fast ○	somewhat fast ○	just right ○	somewhat slow ○	slow ○

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
9. The instructor's presentations were clear and understandable.	1	2	3	4	5
10. The instructor encouraged students to make links between PD1 and IED.	1	2	3	4	5
11. The instructor demonstrated interest in student learning.	1	2	3	4	5

Please turn over!

12. Which topic(s) did you find to be the most applicable to your IED team? (Please see list of topics on question #15.)

13. Which topic(s) did you find to be the least applicable to your IED team, if any?

14. Which topic(s) did you find the most useful to you personally?

15. Below, please indicate which topic(s) you believe PD1 should **Continue** to offer, and which topics should be **Revised**.

____	High Performance/Collaboration	____	Public Speaking Instruction
____	Public Speaking Presentations	____	Stages of Team Development
____	Team Contract	____	Ethics
____	Feedback/Johari Window	____	Peer Evaluations
____	MBTI	____	Conflict Management

16. Please provide your comments and feedback on every topic you believe should be **Revised**. Why and what would you like changed?

17. What other topics do you believe should be incorporated into the PD 1 curriculum?

18. Instruction is delivered using a combination of approaches. Please comment on what changes, if any, you would like to see in the way PD1 is taught based on the following approaches that are currently used:

	More	Less	Just Right
Theory/Lecture ○	○	○	
Class Discussion	○	○	○
Hands-on Activity	○	○	○
Instructor team consulting	○	○	○
Role play/Practice	○	○	○
Outside Reading	○	○	○

Any other comments?

Thank you for your comments!

The Archer Center for Student Leadership Development

Appendix 2. Course Evaluation Instrument for PD-3

ENGR 4010 - Section 1 Instructor:

Professional Development 3 Course Evaluation

In order to determine the effectiveness of this course we ask that you take a moment to thoroughly read and complete this questionnaire. Please be honest and feel free to make personal comments regarding any aspects of this course. Your input is a valuable tool and will help with our continuous quality improvement efforts at RPI.

Please respond to the following statements by darkening the circle below the response that most closely reflects your opinion.

	Strongly Disagree	Disagree Somewhat	No Opinion	Agree Somewhat	Strongly Agree
1. I believe that I will apply the information that I learned in PD3 in my next work/ academic environment.	_____	_____	_____	_____	_____

	Way Too Long	A Little Too Long	Just Right	A Little Too Short	Way Too Short
2. Based on the material presented in this course I believe that the time allotted was:	_____	_____	_____	_____	_____

	Way Too Hard	A Little Too Hard	Just Right	A Little Too Easy	Way Too Easy
4. For a course that meets a 1 credit hour requirement, how difficult would you rate the course?	_____	_____	_____	_____	_____

Please select the answers that you feel are most appropriate for each of the following statements by circling the number that most closely reflects your opinion.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
5. The instructor's presentations were clear and understandable.	_____	_____	_____	_____	_____
6. The instructor(s) encouraged students to make links and see the application of the topics discussed in PD3 with future work experiences.	_____	_____	_____	_____	_____
7. The instructor(s) demonstrated interest in student learning.	_____	_____	_____	_____	_____

6. Please indicate which topics you believe PD3 should **Continue** to offer, and which topics should be **Revised**. Place a check (✓) in the box which indicates your preference.

(C = Continue) (R = Revised)

	Continue	Revised
Behavioral Based Interviewing Techniques	_____	_____
Extemporaneous Speaking	_____	_____
Intellectual Diversity	_____	_____
Organizational Culture	_____	_____
Ethics/Tools for Ethical Decision Making	_____	_____
EQ & Network	_____	_____
Group Presentations	_____	_____