An Online Course for Professional Development of Chemical Engineering COOPs and Interns

Richard A. Davis, University of Minnesota Duluth

Richard Davis is a Professor of Chemical Engineering at the University of Minnesota Duluth. He has BS and PhD degrees in Chemical Engineering from Brigham Young University and the University of California Santa Barbara. His teaching and research interests include the pedagogy of engineering education, process modeling and simulation applied to mineral processing, unit operations of separations, air pollution control, and environmental management.

An Online Course for Professional Development of Chemical Engineering COOPs and Interns

Abstract

An online course was created for professional development of chemical engineering students participating in industrial cooperative education and internships. The course guides students through a series of exercises each designed to cycle through the four stages of Kolb's learning theory: experience, reflection, generalization, and experimentation. Students naturally acquire concrete professional experience while practicing in an industrial setting. Instead of a traditional approach to coop education that concludes the industry experience with a reflective report, our approach uses small reflective exercises distributed throughout the coop/internship period that focus on a set of professional competencies. Students complete Kolb's cycle using the key process steps of project management as a laboratory of generalization and experimentation with professional skills. It was concluded that students accelerated their professional development with periodic reflection and experimentation along with timely assessment and feedback from the instructor.

Introduction

An online course was designed to promote professional development for chemical engineering students during cooperative education and internships with industry. The mutual benefits of industrial cooperative education and internships for both engineering students and companies are well known. Engineering students participating in industrial cooperative education and internships have opportunities to develop their professional skills in a variety of ways that may be difficult to duplicate in an academic classroom or laboratory. Weisz and Smith[1] and Grosjean[2] documented the following benefits of industry experience for students:

- Increased confidence in their ability to perform engineering duties
- Stronger business and interpersonal communication skills
- Increased motivation to learn
- Improved practical problem solving skills from opportunities to apply theory
- Higher academic grades
- Enhanced employment opportunities upon graduation

They also listed how various university and industry stakeholders benefit from engineering internship and coop programs:

- Higher rates of student retention and graduation
- Measurable savings in recruitment costs and lower turnover rates of new employees
- New hires with industry experience exhibit better productivity and are able to assume higher levels of responsibility

Prior to the implementation of our online course for professional development, our coop course followed a more traditional approach that required a midterm survey completed by the student and a final written report and surveys of the student and employer. The surveys measured achievement of ABET student outcomes[3]. Much of the professional development that occurred was subject to the culture at the site of employment, the personality of an individual student's supervisor, and the variety of projects or processes experienced by the student. Although students and employers were generally satisfied with our students' performance, the assessment results revealed opportunities for improvement, particularly in areas of professional competencies. We also learned from our interns and retuning coop students during their capstone-design-project assessments, as well as graduate exit interviews, that the students commonly lacked confidence in their professional skills acquired during their term in industry.

We determined to take a new approach to enhance the professional development of our students while they were on location as industry coops and interns. Instead of waiting until the middle and end of the term for a survey and formal report on a student's experience, we now use a series of short reflective writing assignments distributed across their term in industry in order to accelerate the student's professional development and fortify their confidence. The new approach maintains two primary objectives to help students:

1. Gain real-world professional experience that enhances their academic training
2. Develop professional engineering skills valued by employers to propel them towards successful careers

We consulted with practicing engineers on our program's industrial advisory committee to identify professional competencies to focus our efforts for professional development of our coop and intern students. With the support of our industrial partners, we used the following three criteria to narrow our selection of professional skills targeted in the online course. Professional skills should be:

- Valued by a broad spectrum of employers[4] of our graduates
- Essential for assimilating an engineering student into an industrial environment
- Practical to be immediately effective on the job

For our circumstances, ten professional development goals were established for an engineering student to acquire during one semester-long (16 weeks) term of an industrial coop or internship:

1. Commit to personal and process safety.
2. Understand ethical and professional responsibilities (e.g., confidentiality, intellectual property, safety, punctuality, attitude, adaptability).
3. Function well on a team.
4. Develop time and project management skills.
5. Apply knowledge to problem solving.
6. Gain hands-on experience with modern engineering tools and practices.
7. Practice effective business and technical communication skills.
8. Start networking and develop professional references.
9. Explore various career paths and refine personal career goals.
10. Exceed the company's expectations through personal initiative and self-direction.

This list of professional skills is not comprehensive, and is subject to modification, both in terms of the number and types of skills. We periodically revisit the needs of our students and employers of our coops, interns and graduates as part of our process of continuous improvement.

The online course was designed with three principle phases for the students and instructors to promote student achievement of the ten professional skills:

1. Planning involving the student, instructor, and employer, to achieve the professional competencies during the industry experience
2. Brief online tutorials with short exercises for each of the ten professional skills that cycle through Kolb's experiential learning stages: Experience, Reflection, Generalization, and Experimentation[5]
3. Regular assessment activities throughout the term with guidance and timely feedback from the instructor and ultimately the employer

A significant feature of the online course draws upon various aspects of project management for the experimentation step in Kolb's experiential learning cycle. All of our coop and interns become involved in managing engineering projects during their term in industry, either directly as part of their duties, or indirectly as part of a project team. Managing projects, as well as serving under a manager, requires skills in most of the professional competencies in the 10 professional development goals. We use topics from standards of project management as the basis of student exercises designed for them to experiment and apply what they learned from their initial experiences, reflections, and generalizations around the professional development goals.

At the conclusion of a term working in industry, students, instructors, and employers see demonstrable growth in the professional skills of the students. Returning students complete the program degree requirements with increased confidence in their decision to become engineers and ability to practice engineering. Instructors find the students more engaged in their courses with improved problem solving skills. Employers likewise see increased abilities in the intern and coop students to contribute effectively to the success of their company.

Background

Employers perform commendable work providing students with industrial experiences that complement their academic training. Grosjean[2] describes the conventional coop or internship work model that has students delaying reflection and analysis of their learning until after they have completed their work experience and returned to an academic setting. However, Van Gyn[6] and Ricks[7] report that in order for students to acquire deeper learning from their industry experiences, they need additional guidance, support, and feedback from an engineering instructor. Huvard[8] also stresses the importance of planning and faculty oversight to promote increased student learning from industry experiences. In this work, we distributed the reflection and analysis parts of learning throughout the industry work term in order to move students quickly into the more advanced conceptions of learning before the end of their work experience.

We applied Kolb's theory of experiential learning and reflection[5] to the industry experience and professional development. Kolb's experiential learning cycle requires four stages, as shown in clockwise-order in Figure 1:

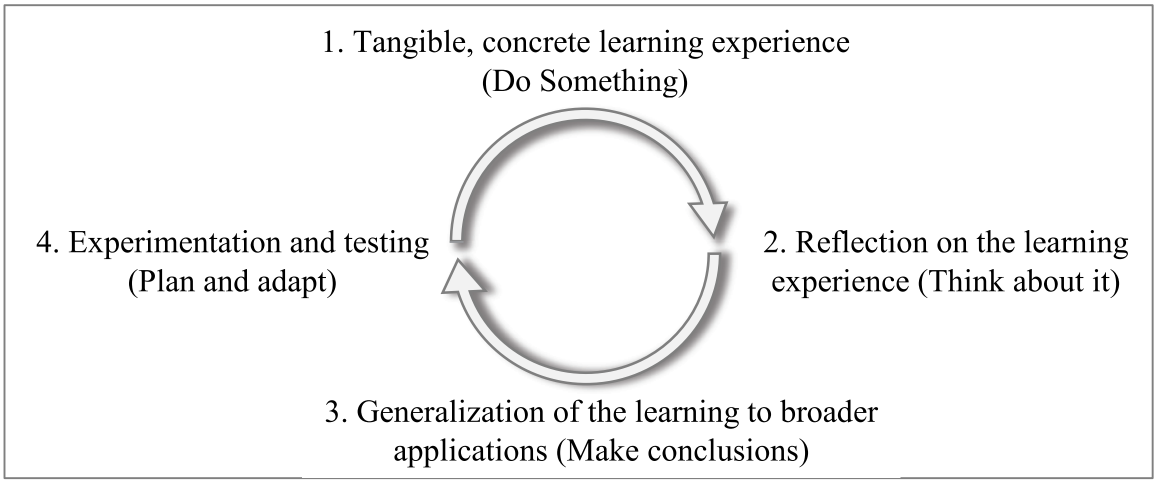

Figure 1 Four stages of Kolb's experiential learning cycle[5].

Experiential learners are actively engaged directly with their environment – the industrial engineering workplace in this case. The learner is an integral and important part of their environment – they learn from experience by turning reflection into concepts that are tested through experimentation and application[9].

Course Design and Management

The online course integrates four recommendations for course design and implementation made by the National Research Council's (NRC) committee on the developments in the science of learning[10]:

1. Learner Centered - account for student culture, background, and individual progress
2. Knowledge Centered - elevate learning towards understanding
3. Formative Assessments - address preconceptions and learning progress
4. Contextual Learning – build a sense of community to support core learning

To incorporate the NRC recommendations, the online course guides students through three key phases:

1. Planning
2. Experiential learning
3. Assessment

The planning phase helps students entering industry to recognize their own strengths and weakness and set expectations and milestones for a successful industry experience. For the experiential learning phase, an industrial setting naturally provides students with a community of engineers, technicians or operators, and managers for contextual learning. A series of brief tutorials with exercises based on Kolb's cycle[5] were created to introduce them to specific professional skills, as well as to practice using these skills in an industrial setting, and to assess their professional development. The reflection and experimentation exercises, along with instructor feedback, promote student understanding and help them gauge their individual progress.

Students engage with the online course via the electronic course management platform Moodle[11]. Moodle serves as a repository and delivery system of digital documents and web pages for the course syllabus, grades, exercises, readings, videos, as well as uploading student work. Students access the Moodle course site using their university login identification. The approach of our online course is not specific to the Moodle platform, and may be readily adapted to other online course management platforms. Students earn one semester credit for the online coop course, which represents three hours of academic work per week (including fieldwork), averaged over the term. Thus, students are expected to spend an average of one to two hours per week on the course work in addition to their time of employment. Most of the student work involves brief writing assignments. A few assignments involve recorded presentations, CAD drawings, or spreadsheet analysis.

Socrates is credited with the expression, "An unexamined life is not worth living." Borrowing from the concept of expressive writing, students tell their own story in their reflective, conclusive, and adapting writing exercises[12]. They make personal discoveries that help them make developmental corrections about their happiness, attitude, behavior, mood, and direction in their industry experience. The short, expressive writing assignments also help students gauge their successes and feel more comfortable in their coop or internship assignment.

Planning with Purpose

Students that participate in an industrial engineering coop/internship gain real-world experiences that bridge the gap between academic and professional practice. Students, in consultation with their industry supervisors, prioritize their professional development goals according to their individual levels of experience and background.

Early in the term of their industry experience, students review the list of professional development goals and meet with their immediate supervisor to set the expectations for their work. In their first assignment, students ask the following question of their employer, "What does a successful coop or intern look like?" They use Moodle[11] to submit a brief written summary of their meeting and their supervisor's response to the question. They are also asked to reflect on the experience of the meeting and establish a plan to achieve the employer's expectations, including identifying measureable milestones for achieving them. Students may complete the remaining exercises for the ten goals in any order throughout the term. The only exception is safety, which is the first goal addressed by the course, and typically the subject of the initial employer training provided to students for their job functions. Students, with input from their supervisor and instructor, identify priorities for the professional attributes they want to address earlier in their work experience, and the types of work assignments they can expect in order to develop these attributes.

The coop and intern students are also exposed to Kolb's reflective theory of experiential learning and the importance of completing all four stages of the learning cycle[5]. This is accomplished through a short reading and a set of videos that explain the stages in the cycle and why all stages are necessary for deeper learning. Individual students naturally gravitate towards either the reflective or the experimentation stages, and may have a tendency to skip over stages in the cycle. It is important that student's understand the theory behind the structure and sequence of the assignments in each learning goal so that they work through all of the stages to achieve deeper learning.

Experiential Learning Tutorials and Exercises

Each of the professional development goals is presented with a brief tutorial and a set of exercises for experience, reflection, generalization, and experimentation. The tutorials may be in the form of readings or videos. The short classic book, *The Unwritten Laws of Engineering* by W.J. King with revisions by J.G. Skakoon[13] is the primary reading material for introducing professional skills in the context of engineering practice. From the introduction to *The Unwritten Laws*, the authors King and Skakoon recognized the need for new engineers to learn accepted standards of professional practice in order to avoid "getting into much more trouble by violating the undocumented laws of professional conduct than by committing technical sins against well-documented laws of science." Additional readings and tutorial content comes from professional development articles in the periodical *Chemical Engineering Progress* published by the professional society for chemical engineers AIChE, and reference books on professional development of engineers[14, 15, 16, 17, 18, 19].

Project management concepts and tools are also included in the curriculum of the online coop course, particularly during the experimentation parts of each exercise. Readings from *Project Management Lite* by J.C. Craig are used to cover common, standard practices of project management[20]. *Project Management Lite* also comes with generic documents for professionally managing projects, such as planning, budgeting and money tracking, meeting agendas, progress status reporting, and post project reviews.

Craig has simplified the complexity of detailed project management, with its 5 areas and 42 processes, into three areas with at most ten process steps[20]. For our purpose, we have further reduced Craig's process steps into the outline from the *Unwritten Laws of Engineering* for the following five processes:

1. Define the stakeholders, purpose, goals, and deliverables of the project (answer the questions, "Why you are doing the project and what will be accomplished?)
2. Plan the project and assign roles (What are the steps that must be done to complete the project and who is responsible them?)
3. Carry out the plan to get the work done (Manage problems and changes to the plan).
4. Manage the project (Measure progress, monitor the budget, communicate updates to the team and stake holders).

5. Wrap up (Was the agreed upon work completed? Reflect on the overall implementation of the project for future improvement.)

Table 1 shows how the three components of the online course, including the initial planning phase, the ten learning goals for professional development, and final assessment phase are mapped to the five project management processes. The mapping in Table 1 depicts how the planning and assessment phases, as well as the ten professional skills targeted by the online course, are integrated broadly across project management. The integration of project management with professional development gives coop and intern students multiple opportunities to experiment with their professional skills and establish a solid understanding of how to function as an engineer and gain confidence in their abilities to manage their work effectively.

Table 1 Mapping of the course phases of planning, professional skills, and assessment to project management steps.

Project Management Steps / **Professional Development**	**Define the Project**	**Plan the Work**	**Work the Plan**	**Manage the Project**	**Wrap Up**
Plan for professional development	✓	✓			
1. Safety		✓	✓	✓	✓
2. Ethics/responsibility		✓	✓	✓	
3. Teams	✓	✓	✓	✓	✓
4. Time management		✓	✓	✓	
5. Problem solving	✓	✓	✓	✓	✓
6. Modern engineering tools		✓	✓	✓	
7. Effective communication	✓	✓	✓	✓	✓
8. Networking			✓	✓	
9. Explore career paths		✓			✓
10. Self-direction/Initiative	✓		✓	✓	
Assessment: Reflection, Presentation, Surveys					✓

Examples of Professional Development Exercises

Five examples are provided here to illustrate how the online course guides students in their learning about professional attributes, and how they may apply Kolb's learning cycle to their professional development of an attribute and experiment with the steps of project management.

All of our students receive some form of safety training during their orientation at the start of their work assignments. We augment this experience with exercises that expose them to case studies of process safety by having them find a *Process Safety Beacon* article[21] that relates to their process or product. They reflect on their safety role at the company and make conclusions about their own commitment to safety. Their safety skills are then applied to project management by conducting a risk assessment of their process or project that includes passive, active, and procedural layers to protection. They may also write about their experience managing change in the context of safety.

One of the first exercises in the planning phase provides the students with a tutorial on block flow diagraming (BFD). The students prepare a BFD of the industrial process at their work site, reflect on the nature of a simplified schematic, and generalize on how this exercise enhanced their ability to quickly learn the process and communicate effectively with their supervisor, members of their team, technicians, operators, and contractors. The students then experimental with their BFD as a project management tool in the adaptation stage of Kolb's cycle. Students have reported how a validated BFD becomes a common reference point for team discussions about the process and a tool to manage change safely by identifying individuals that have responsibilities for, or work with, the different unit operations in the process.

Email is a common and important form of communication at the university as well as in industry. To develop professional communication skills, students reflect on email usage at their site. They make conclusions about how to improve the effectiveness of their own email communications. Students learn from the *Unwritten Laws of Engineering* about audience analysis and the inverted pyramid structure of communication that was adapted from journalism to technical and business communications[13]. With the inverted pyramid structure shown in Figure 2, all forms of communication start with the critical information required by their audience, followed by additional helpful, but not critical, details, and end only with any supporting background information that may be interesting to their audience. They experiment with the inverted pyramid structure on their project progress reports, communications during meetings with team members, and communications with personal critical to the success of their project.

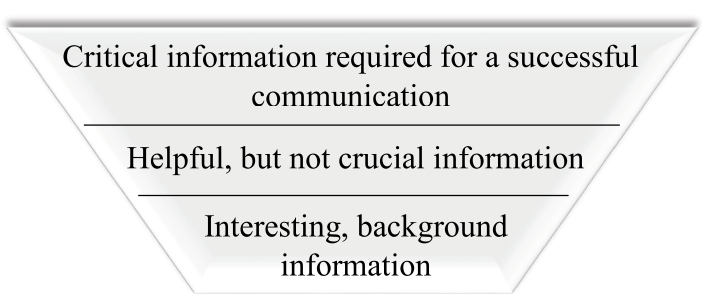

Figure 2 Inverted pyramid metaphor for the recommended structure of technical communications that puts the critical information at the top.

In another set of exercises, students learn skills for efficient time management. Fricke[22] observed, "Real world engineering is not structured for students like the academic environment." One of Fricke's strategies for workplace success is to document everything using a daily planner. By planning their time on a daily basis, students "learn to create order from the chaos." Students reflect on their experience with Koomey's time management tips[23]:

1. Analyze your time usage and make adjustments if necessary.
2. Work on the most important tasks during your most productive time.
3. Carry a bound paper note pad or notebook with you to:
   - Keep your daily plan.
   - Jot down spontaneous notes and ideas.
   - Do your thinking on paper.
   - Listen carefully and take good notes.
4. Everything should have its place – avoid wasting time searching for routine information.
5. Automate routine tasks using standard forms or software applications.

Students keep a log of their activities for two weeks with notes of how they spent their time in 30-minute increments. They reflect on their time usage and make general conclusions about their own habits that need reinforcement or change. They then experiment with how they apply their conclusions to managing projects in terms of meeting agendas, reporting forms, archiving information, and daily planning.

Experience with teamwork comes directly from industry work assignments, either directly as a member of a team, or indirectly through observing team functions. To learn about how to function and contribute to their teams, students study two articles on personal problem solving styles[24] and emotional intelligence[25]. They reflect on their experiences with how individuals on their team approach problem solving and deal with team dynamics in ways that enhance or detract from the team's effectiveness. Students also take an interpersonal style survey to help them discover their own distinctive approaches to interpersonal communication, creative problem solving, and team dynamics[26]. Students reflect on how they work in a team using the style survey as the starting point to identify their individual strengths and weaknesses. They generalize by describing their engineering team and surveying the various titles, roles, and backgrounds (education, degrees, and training) of each member, including their own role on the team. For the experimentation step in Kolb's cycle[5] for this example, students adapted their conclusions about what works well in a team-based work environment to their own role and responsibilities for managing projects and people involved in their projects. For example, a student may identify the subject matter experts in the company for their process or product and use their new interpersonal communication skills to develop productive working relationships them.

Assessment

The final component of the course involves five assessment tools:

1. Student reflection on their industry experience in the form of a letter to their successors
2. Student final presentation on their industry experience
3. Communication with the student's academic adviser

4. Student survey on their achievement of aspects of professional development
5. Employer survey on the student's level of professional development

At the close of the industry coop or internship, students compose a hypothetical letter to future students coming after them into their position at the company. This exercise is adapted from Brookfield's classroom exercise[27] that helps instructors discover their students' perceptions about how a course performed. The seasoned coop/intern student is invited to share any advice and insights about how to survive and thrive in the industry experience. The coop/intern student's letter is requested to be as specific as possible about what they think future coop students and interns need to know and do to succeed. To get the student thinking about the contents of their successor letter, they ask themselves the question: "Have you ever said to yourself, 'I wish I knew that before I started!'?" The contents of the letter may address a series of questions adapted from Brookfield[27]:

- Did you achieve your professional development goals? How did you do it? If not, why?
- What do you wish someone had told you before you started your coop/internship?
- What advice do you have for an engineering student about to start their industry internship/coop?
- What is the most important thing new interns/coops should do to be successful?
- What are the most common (and avoidable) mistakes that coop/interns make?
- Are there any other insights you care to share?

In the online coop course, we replaced the requirement of a final written report with a recorded presentation. Students use voice-over-PowerPoint to document their industry engineering experience, both in terms of technical and professional skill development. The majority of the companies that hire students for coops or internships require a formal presentation as part of a student's exit process. Fewer companies require a written report of their experience. The recorded presentation is intended to give students' practice making a final presentation in terms of timing, organization, voice level, diction, and other aspects of making an informative and engaging presentation. They find this exercise helpful for preparing talks that leave their best final impression with the employer. The instructor uses the presentation to assess the student's communication skills and other aspects of professional development.

Before the end of the industry work period, students communicate with their academic advisor for guidance on registration and courses. Advisors work with the students to identify a course of study for timely completion of the degree that compliments their work experience. Returning students frequently adjust their academic goals based on their industry experience. With their new goals, they may seek advice about courses offered through the programs in business, computer science, specific technical courses in science or engineering, or other courses on various topics such as interpersonal communication, psychology, and management.

The last pieces of the assessment involve two surveys: one completed by the student and the other by their direct supervisor. The surveys are simple rubrics that score the students achievement of the 2015 ABET student outcomes[3] (d) through (g), (i), and (k).

Results

Consistent assessment tools have been used to evaluate the performance of our students registering for cooperative education and internship credits over the last two decades. Using the traditional approach, students submitted a final written report and delivered in person a final presentation on their industry experience. The department also conducted surveys of the students and employers. The employer survey included a question to rank the perceived importance of the outcomes. The rubrics for each outcome have four levels of scoring (zero to four) with Level 1 = Unsatisfactory and Level 3 = Satisfactory. The graded reports, presentations and surveys indicated the student's level of achievement in selected student outcomes defined by ABET[3]. The employer surveys indicated statistically significant improvements for student outcomes (d), (f), and (g). We interpreted these results in the context of the student work related to these professional competencies. Table 2 shows the average results from the employer surveys starting three years prior to the change through the three years with the new online course. The sample sizes for the three-year periods before and after the implementation of the online course were 28 and 34, respectively. The employer surveys indicated statistically significant improvements for student outcomes (d), (f), and (g). We interpreted these results in the context of the student work related to these professional competencies.

Table 2 Aggregated results of employer assessment of ABET student outcomes[3] before and after implementing the online course for professional development. Four-level Scale: 1 = unsatisfactory, 3 = satisfactory. Scores include a 95% confidence interval.

ABET Student Outcomes	**Before**	**After**	**% Change**
(g) Ability to communicate effectively	2.4 ± 0.4	3.1 ± 0.3	+29
(f) Understanding of professional and ethical responsibility	2.4 ± 0.3	3.0 ± 0.2	+25
(d) Ability to function on multidisciplinary teams	2.6 ± 0.3	3.1 ± 0.2	+19
(e) Ability to identify, formulate, and solve engineering problems	3.0 ± 0.2	3.2 ± 0.1	+6.7
(i) Recognition of the need for, and an ability to engage in life-long learning	3.0 ± 0.2	3.1 ± 0.1	+3.3
(k) Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	3.2 ± 0.4	3.1 ± 0.3	-3.1

Outcome (g) for communication skills showed the largest improvement. Students learned about the variety and types of communication, ranging from interpersonal forms in emails and informal settings with coworkers, to formal settings such as team meetings and presentations. Student responses to the exercises showed how they learned to recognize appropriate communication styles for different audiences and adapt their own communication skills to fall in line with the standard practices at their work sites. Communication skills are also important for effective project management. Students were able to hone their various skills through their experimentation with applying their communication skills as part of the steps in project management.

The next largest jump in improvement was for student outcome (f): an understanding of professional and ethical responsibility. The exercises related to this outcome covered topics that include safety, personal initiative, work ethics, and time-management. Student responses during reflective exercises showed how they increased their understanding of, and commitment to, personal and chemical process safety. Students also reflected on their use of time and made plans to become better organized to use their time more efficiently during a work day. Reflective responses also revealed that students had a better grasp of ethical responsibilities in terms of when to use company resources, guarding proprietary information and privacy, and how to represent the company to the outside.

The third significant positive change was for student outcome (d): the ability to function on multidisciplinary teams. The exercises related to this outcome included understanding roles on teams, team building, emotional intelligence, and interpersonal styles

Where no significant improvements were observed, student responses indicated that these outcomes are more in line with academic training for problem solving, learning new skills, and computing tools. Prior to the online coop course, students already possessed these skills formed through their coursework.

An important aspect of the online course is the ability to use the information gathered from student assessments to refine and adapt the tutorials and exercises around professional development. The nature of the course continually evolves as students participate and share some of their best practices. From the self-assessment reports, we have seen an increased level of student confidence in their professional skills. More students report that they are happy with their decision to study chemical engineering and pursue related careers.

Conclusions

An online course was created to enhance professional development of chemical engineering students while working as industrial coops or interns. The course was designed to help students plan for a successful industry experience and employ Kolb's reflection theory of experiential learning with tutorials and exercises that help them acquire higher levels of professional competencies during their industry work experience. The exercises reinforce students' professional development through experimentation with topics, practices, and principles from standard project management steps. Assessments of student development using the new course structure show significant improvements in professional competencies of effective communication, an understanding of professional and ethical responsibilities, and the ability to function on multidisciplinary teams. In addition, students learn about the formal steps of project management and see increased levels of confidence in their professional skills that enhance their ability to perform engineering job functions.

Bibliography

1. M. Weisz and S. Smith, "Critical Changes for Successful Cooperative Education," in Proceedings of the 28th HERDSA Annual Conference, Sydney, 2005.

2. G. Grosjean, "Alternating Education and Training: Student's Conceptions of Learning in Co-op," in Integrating School and Workplace Learning in Canada, H. Schuetze and R. Sweet, Eds., Montreal, McGill-Queen's University Press, 2003, pp. 175-196.

3. ABET, Criteria for Accrediting Engineering Programs, Baltimore: ABET, 2014, p. 3.

4. Johri and B. Olds, Eds., Cambridge Handbook of Engineering Education Research, Cambridge: Cambridge, 2014, p. 736.

5. D. Kolb, Experiential Learning: Experience as the Source of Learning and Development, Upper Saddle River: Prentice Hall, 1994.

6. V. Gyn, "The Educational Orientation of Cooperative Education: A Critical Variable in Effectiveness," Journal of Cooperative Education, vol. XXX, no. 1, pp. 17-25, 1994.

7. F. Ricks, "Principles for Structuring Cooperative Education Programs," Journal of Cooperative Education, vol. XXX1, no. 2-3, pp. 8-22, 1996.

8. G. Huvard, "Make Summer Internship a Learning Experience," Chemical Engineering Education, vol. 32, no. 1, 1998.

9. P. Eakins, The Theory and Practice of Cooperative Education, Victoria University of Technology, 1997.

10. National Research Council, "How People Learn: Brain, Mind, Experience, and School, Expanded Edition (2000)," 22 January 2016. [Online]. Available: http://www.nap.edu/catalog/9853/how-people-learn-brain-mind-experience-and-school-expanded-edition.

11. "Moodle," The Moodle Project, [Online]. Available: https://moodle.org/. [Accessed 22 January 2016].

12. J. Pennebaker and M. Francis, "Cognitive, emotional, and language processes in disclosure," Cognition and Emotion, pp. 601-626, 1996.

13. J. Skakoon, The Unwritten Laws of Engineering, New York: ASME Press, 2001.

14. T. Yuzurtha, How to Succeed as an Engineer: A Practical Guide to Enhance Your Career, Vancouver: J & K Publishing, 1998.

15. D. Goldberg, The Entrepreneurial Engineer, Hoboken: Wiley, 2006.

16. H. Fogler and S. LeBlanc, Strategies for Creative Problem Solving, Upper Saddle River: Prentice-Hall, 1995.

17. K. Smith, Teamwork and Project Management, 3rd ed., New York: McGraw-Hill, 2007.

18. J.G. Miller, QBQ! The Question Behind the Question: Practicing Personal Accountability at Work and in Life, New York: G.P. Putnam's Sons, 2004

19. J.G. Miller, Flipping the Switch, , New York: G.P. Putnam's Sons, 2006

20. J. Craig, Project Management Lite, North Charleston: CreateSpace, 2012.

21. SACHE, "Process Safety Messages for Manufacturing Personnel," AIChE, [Online]. Available: http://sache.org/beacon/products.asp. [Accessed 27 January 2016].

22. Fricke, "From the Classroom to the Workplace: Motivating Students to Learn in Industry," Chemical Engineering Education, vol. 33, no. 1, 1999.

23. J. Koomey, Turning Numbers into Knowledge, 2nd Edition ed., Analytics Press, 2008.

24. J. Hipple, "What's Your Problem Solving Style," Chemical Engineering Progress, pp. 53-57, August 2004.

25. C. Marshall, "Make the Most of Your Emotional Intelligence," Chemical Engineering Progress, pp. 92-95, February 2001.

26. P. Dominick, W. Lawbaugh, R. Freuler, G. Kinzel and E. Fromm, Tools and Tactics of Design, New York: Wiley, 2001.

27. S. Brookfield, Becoming a Critically Reflective Teacher, San Francisco: Jossey-Bass, 1995.