Using Engineering Competency Feedback to Assess Agricultural Engineering Curriculum

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Abstract

In order to adequately address ABET Outcomes, Iowa State University's (ISU) College of Engineering (COE) is using a competency-based assessment program that provides semester-to-semester feedback from students and employers engaged in cooperative education. The ISU Engineering Career Services (ECS) office collects these data for the fall, spring, and summer school terms. The average data by department is available for use by departmental committees to assess students' competency levels and program outcomes. The Agricultural Engineering (AE) program at ISU is using this data, along with cooperative education student focus group feedback, to assess our curriculum. This process is ongoing and is very valuable in meeting ABET expectations for continuous improvement based on constituent feedback. This paper will describe the competency-based assessment program in the COE at ISU, present the data provided by the ECS office and the AE student focus groups, and show how this feedback is being used in our continuous improvement initiative.

Background

The College of Engineering (COE) at Iowa State University (ISU) has undertaken a new initiative to help address the ABET 2000 Outcomes. In order to accomplish this, it has partnered with Developmental Dimensions International, Inc. (DDI)[1] to develop an online assessment tool for quantifying engineering competencies in the workplace for students taking experiential education courses within each engineering department. With the help of our constituents, the COE and DDI developed and validated a matrix that has linked fourteen-workplace competencies to each of the a-k outcomes.[2,3] Using an online assessment tool, co-op/intern students assess these competencies at the end of each co-op/intern work period. The supervisors also assess the students on these same competencies. The average results for the students and supervisors, in each engineering department, are made available to the department curriculum committees after each work period for evaluation. The Agricultural Engineering Curriculum Committee at ISU has used this feedback to develop curriculum plans and changes. Feedback from co-op/intern student focus groups has been used to clarify the competency data received from the Engineering Career Services office. This feedback, along with other sources of feedback, has been very helpful to the curriculum committee in assessing our current program.

Mentkowski et al. (2000)[4] addresses this type of initiative for a curriculum group. *" For curriculum designers – any faculty or staff group who designs learning for students – the essential question is, "What elements of a curriculum could make a difference in our own* *situation, for our own students?" A broad range of educators need to struggle with such questions in order to advance an effective critique and continuing development of what to teach and how. As faculty and staff take professional responsibility for student learning, they also take responsibility for curriculum. In a curriculum that focuses on student learning outcomes, thinking through the curriculum is a continuing, essential activity, where educators question what ought to happen and how to make it happen in practice*."”

They go on to say that: *"Work situations often seemed to test and validate the curriculum's ability work models, as well as the student's capacity to use them. The most common outcome of internships, field experiences, or concurrent employment was confirmation of both models and the skills. As a result, students developed confidence in their own ability to make judgments and take action in a work setting.*[5]

Hanneman et al. (2002)[6] talks about the value of using workplace competencies to address ABET outcomes. *"The unique approach of addressing ABET Engineering Criterion 3 Outcomes (a-k) as workplace competencies assumes that the experiential education workplace provides a valuable opportunity to assess student development and demonstration of these Outcomes. The authors invited more that two hundred constituents, representing alumni, employers, co-op/intern students, parents, ISU faculty and partnering international faculty to contribute to the design, creation, validation and implementation of the ISU competency-based, accreditation-aligned assessment tools'.* The COE at ISU and DDI developed fourteen workplace competencies that were determined to be necessary and sufficient to address the a-k outcomes. These competencies are listed in Table 1.

Table 1. ISU Competencies

• Engineering Knowledge	• General Knowledge
• Continuous Learning	• Quality Orientation
• Initiative	• Innovation
• Cultural Adaptability	• Analysis & Judgment
• Planning	• Communication
• Teamwork	• Integrity
• Professional Impact	• Customer Focus

Definitions for each of these ISU Competencies, specific to Iowa State University's and the College of Engineering's vision and missions, were created. Each definition was designed to be clear, concise and independent of all others (Table 2). Specific to each definition is a set of observable and measurable key actions that a student may take that demonstrates their development of that ISU Competency. These key actions are the basis of our assessment tools. Also associated with each ISU Competency is a set of representative career activities, which represent the workplace settings, used to describe a "Critical Incident". Using the key actions and representative career activities described in the critical incidents, the fourteen ISU Competencies have been mapped to the Criterion 3 (a-k) outcomes in matrix form (Figure 1).

Table 2. ISU Communication Competency Definition and Key Actions

Communication:

Clearly conveying information and ideas through a variety of media to individuals or groups in a manner that engages the audience and helps them understand and retain the message.

Key Actions

- Organizes the communication—Clarifies purpose and importance; stresses major points; follows a logical sequence.
- Maintains audience attention—Keeps the audience engaged through use of techniques such as analogies, illustrations, body language, and voice inflection.
- Adjusts to the audience—Frames message in line with audience experience, background, and expectations; uses terms, examples, and analogies that are meaningful to the audience.
- Ensures understanding—Seeks input from audience; checks understanding; presents message in different ways to enhance understanding.
- Adheres to accepted conventions—Uses syntax, pace, volume, diction, and mechanics appropriate to the media being used.
- Comprehends communication from others---Attends to messages from others; correctly interprets messages and responds appropriately.

ABET OUTCOMES VERSUS ISU COMPETENCY MATRIX

Engineering Criteria 2000 Criterion 3 Program Outcomes and Assessment		ISU Competency: Engineering Knowledge	General Knowledge	Continuous Learning	Quality Orientation	Initiative	Innovation	Cultural Adaptability	Analysis and Judgment	Planning	Communication	Teamwork	Integrity	Professional Impact	Customer Focus
(a)	an ability to apply knowledge of mathematics, science, and engineering	✘		✘		✘			✘						
(b)	an ability to design and conduct experiments, as well as to analyze and interpret data	✘		✘	✘	✘	✘		✘	✘		✘			✘
(c)	an ability to design a system, component, or process to meet desired needs	✘		✘	✘	✘	✘	✘	✘	✘	✘	✘			✘
(d)	an ability to function on multidisciplinary 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 societal context	✘	✘	✘				✘	✘						
(i)	a recognition of the need for, and ability to engage in, life-long learning			✘		✘									
(j)	a knowledge of contemporary issues		✘	✘				✘	✘						
(k)	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	✘		✘	✘	✘		✘	✘						

Figure 1. ABET Outcomes versus ISU Competency Matrix

The Assessment Tool

In the Fall Semester of 2001, the COE piloted its new constituent-created, competency-based, ABET-aligned assessment tools for the engineering experiential education workplace, using Online Performance and Learning (OPAL™)[7]. OPAL™ is DDI's online competency development and performance management software that provides assessment, development, coaching and learning tools. Following customization of OPAL™ to present the ISU Competencies, Key Actions, and assessment surveys, the system was introduced to over two hundred cooperative education and internship (semester long only) students and their two hundred supervisors in eighty-five different companies. To receive academic credit for the work term each student was required to complete the standard self-assessment and to ensure that the supervisor completed the same assessment of the student.

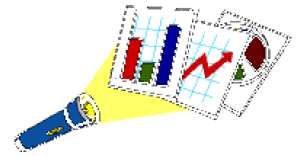
The standard assessment survey consists of the sixty-one Key Actions associated with the fourteen ISU Competencies. Each student and each supervisor provided an assessment of the student's demonstration of each Key Action. For each accredited program the average value of each Key Action is computed from the student's self assessment and separately from the supervisor's assessment. A value for student development and demonstration of each ISU Competency is computed as the average of the averages of the associated Key Actions (Figure 2).

The Fall 2001 data were collected during the final two weeks of the semester, tabulated, statistically reduced, and reported by program and college. A 97% sample collection, consisting of over 25,000 individual measurements, was achieved. All ten accredited programs were well represented in this sample. These data were communicated to the curriculum and academic quality management committees in each of the accredited programs and the college. Additionally, the data were provided to the dean's Task Group and the Employer Advisor Boards for Cooperative Education, Internship, and Summer Programs.

This process has been moved from pilot to production, repeated during Spring Semester 2002 and the Fall Semester 2002 and defined to be standard operating procedure of the Engineering Experiential Education Program. The OPAL™ Competency Survey uses a five point scale (1=Much less than acceptable – Significantly below criteria required for successful performance, 5=much more than acceptable – Significantly above criteria required for successful performance). The data provided from the Engineering Career Services staff includes student and supervisor mean score values, and also includes the ranking of the fourteen competencies (1 = highest mean score value, 14 = lowest mean score value). DDI recommends that departments look more carefully at patterns than a mean value; therefore the rankings of the competencies are shown in Table 3. The ranking are shown for the first three work terms that OPAL™ has been in place for assessing the co-op/inter experiences. The Spring/Summer data only represents four students, and should be considered with caution. The AE curriculum had 10 students out on co-op in the Fall of 2001 and 9 students out in the Fall of 2002.

Report: Detailed

To view the definitions for the standard survey competencies and Key Actions, select Definitions.



Standard Survey Name	Organization	Group/Department
Experiential Ed ABET Survey Spr/Sum 2002	Students	Ag & Biosystems Engineering
Standard Survey Description: Experiential Education ABET Aligned Standard Survey for Spring 2002.		

Report Based on 5 Respondents of 4 Surveys

Key:	1	2	3	4	5
	Never or Almost Never	Seldom	Sometimes	Often	Always or Almost Always

Competencies/Key Actions
(Competencies and their Key Actions are rank ordered by the average rating. Others = the Respondents. Self = the Group/Department who sent the survey)

Competencies/Key Actions		Average Frequency
Integrity (ISU Accreditation Aligned)	Others	5.00
	Self	4.33

Figure 2. OPAL™ Report for AE Co-op/Intern Student for Spring & Summer Sessions.

Table 3. Ranking of ISU Accreditation Aligned Competencies for AE Co-op/Intern Student (Fall 2001, n = 10; Spring 2002, n=4 ; Fall 2001, n=9)

ISU Accreditation Aligned Competencies	Self Assessment Average Scores/Ranking			Employer Assessment Average Scores/Ranking		
	F01	S02*	F02	F01	S02*	F02
Analysis & Judgment	8	11	13	6	4	7
Communication	11	9	12	14	9	13
Continuous Learning	10	10	6	5	5	11
Cultural Adaptability	2	7	8	8	14	12
Customer Focus	7	13	5	9	12	8
Engineering Knowledge	12	14	4	13	13	2
General Knowledge	3	4	11	11	8	6
Initiative	13	5	9	2	3	9
Innovation	14	8	14	12	11	14
Integrity	1	6	1	1	1	1
Planning	5	12	2	7	6	3
Professional Impact	9	2	7	4	2	5
Quality Orientation	6	1	3	3	7	4
Teamwork	4	3	10	10	10	10

*includes students out for spring and summer sessions

The Fall 2001 data was distributed to the AE curriculum committee early Spring Semester 2002. The initial reaction was that our curriculum was failing our students in regards to providing adequate learning in the area of engineering knowledge. It is interesting to compare the student's self-assessment ranking with those of their supervisors. In many cases there are major discrepancies. For example, for the teamwork competency, the student assessment ranked 4th compared to 10th for the supervisor. Students may be confusing teamwork activities with teamwork effectiveness. The initiative competency is also very interesting. The students' ranking was 13, compared to 2 for the supervisor. The AE curriculum committee was most intrigued by the supervisors' assessment of the engineering knowledge and communication competencies. These two ranked 13th and 14th respectively for the supervisors' assessment. To quote one professor, "This is what our job is all about as engineering educators, and it looks as though we are failing." There was also major concern for the students' communication competency. This competency ranked 11th for the students. The students seemed to be more confident in their communication competency than did the employers. Innovation also ranked low for both assessment groups. This was not as disturbing, since the lowest key action addressed "challenging paradigms" in the workplace, which we would not expect undergraduate students to do in a co-op or internship setting.

On a positive note, the supervisors ranked Integrity as their top the top competency for all three work periods. Professional Impact and Quality Orientation also ranked in the top five for each work period.

Focus Group Assessment

To help clarify the data provided by ECS, the ABE faculty conducted a student focus group with the co-op/intern students in the Spring of 2002, to help understand why the engineering knowledge and communication competency scores ranked to low for our AE students. This same process was followed in for the Fall 2002 co-op/intern students. The results of these focus groups helped to shine some light on the faculty's concerns.

Focus Group – Engineering Knowledge Competency

The first half of the focus groups was addressed the engineering knowledge competency. Faculty were concerned that our students were not being prepared as well as other majors within the COE. It ended up that 6 or the 9 focus group participants were sophomores, and had not taken any or very many engineering course yet. The definition and key actions for the engineering competency are shown in Table 4. ?When studying the supervisors assessment, the knowledge of experimental design and analysis key action scored the lowest at 3.78 out of 5.00. The other key actions scored close to a 4.00 out of 5.00.

Table 4. ISU Engineering Knowledge Competency Definition and Key Actions

Engineering Knowledge:
Having achieved a satisfactory level of knowledge in the relevant specialty areas of mathematics, science and engineering.

Key Actions

- Knowledge of mathematics – Demonstrates a knowledge of mathematical principles required to practice engineering in one's specialty area.
- Knowledge of science – Demonstrates a knowledge of the scientific principles required to practice in one's specialty area.
- Knowledge of experimental design and analysis – Demonstrates a knowledge of the principles of experimental design and data analysis in one's specialty area.
- Knowledge of current engineering tools – Demonstrates a knowledge of the use of contemporary tools needed to practice engineering in an effective manner.
- Knowledge of engineering – Demonstrates a knowledge of engineering principles required to practice in one's specialty area.

The first question for the focus group addressed the students' opportunity to demonstrate engineering knowledge in the workplace. Some selected responses follow. Each student was given a number to protect their identity. Students had the most opportunities to demonstrate engineering knowledge in the areas of drafting, electronics, testing, and mechanics and materials. Several students addressed the engineering analytical approach needed for success in the engineering workplace. Even though all the students in this group had had some engineering graphics, calculus, and physics, few had taken any electronic, testing or engineering mechancs courses.

Question: ***What opportunities did you have at your internship or coop where you were able to demonstrate engineering knowledge?***

Student 6: *I think a big part of it was a lot of the drafting principles that I took in high school and also in 170 (engineering graphics and design course. We did a lot of that and I carried a lot of that into that job which helped out a lot. There's a lot of design work involved in my job.*

Student 7: *I would add to that. I'd say as well as drafting, I also did quite a bit with testing (testing of valves). Just had to have different knowledge as far as electronics a little bit and in just converting different numbers and stuff such as that.*

Student 8: *I did a lot of design work and used Pro E a great deal… Also, I did a lot of testing too…general proper testing procedures and things like that… ways to think about the test and how to set it correctly…and general testing knowledge I guess.*

Student 2: *....guess part of my job was right away I was doing an audit of our designs with (the company I worked) to make sure our valves had certain wall thicknesses according to a pressure vessel code. So being able to just look up ASME V16 34 and being able to understand the terminology to see if our product met design codes.*

Student 1: *I was working a lot with test and evaluation and we did a lot with fluid mechanics and fluid properties and stuff like tha,t so I could use a lot of the stuff I learned.*

Student 3: *I think the whole analytical approach that you learn with engineering helps everyday on the job and that you do at work .....*

Student 5: *I did such a broad range of things… there's nothing I can narrow down, just that the whole analytical approach that they talked about… (I) designed a lot of structures so the engineering mechanics course actually paid for me.*

Student 9: (I had a) **u***nique opportunity to follow and bring a product into production. So you are following design changes from within the design you have to make those changes. You've got to approach those changes analytically so you know where you've got to start. So you just don't let things fall apart on you...*

The second question asked the students was related to having appropriate engineering knowledge for the job assignment. The students realized that they did not have all the engineering knowledge they needed and were willing to learn on the job. It appeared that the supervisors knew in advance that the student did not have all or any of the necessary engineering knowledge required for the assigned tasks. The need for a better electronics background showed up for the majority of the students. Some also specified needing some experience with fluid hydraulics, which isn't taught until the senior year in our curriculum. Our electronics and controls class is offered during the junior year of our curriculum.

Question: ***Did you feel that the engineering knowledge that you had going into the workplace was adequate to the assigned position that you were given?***

Student 7: *Yes and no… I think it was definitely a good start. With any job you are going to pick up specific tools you are going to need to complete that actual job. Yeah, I had what they asked upon me to start off with, but I learned a lot too, as far as specifics towards hydraulics.*

Student 2: *A good example of what (Student 7) said, yes and no. I hadn't taken mechanics and materials yet, but I learned a lot about that on the job. We attached a lot of strain gauges – comparing stresses and strains. Had I taken that class, I would have known that kind of stuff. But I learned a lot from the job site.*

We also wanted to know if the co-op/intern employer were clear on the engineering knowledge that what the students needed for the job. Were their expectations clear during the interview process? The students didn't feel that they were misleading in this respect.

Question: ***Did they ask you to have that background coming in?***

Student 2: *If I had been a design coop in our department that would have been a requirement. But I was under product support, so I did a lot more product testing and improvement of products instead of designing. The coop in my department already had mechanics and other things so it wasn't a requirement for my job specification.*

Student 1: *My first project was an electric actuator – It would have been a lot more helpful if I would have had an actual course in electronics or electrical engineering or something like that. I learned a lot as I went.*

Student 6: *Sitting there listening to my supervisor tell me all the material properties—saying Young's modulus, some thing ratio and all that stuff. I really had no idea what that was. I had three semesters going into that internship. I had on Eng. course and when I came back I took mechanics and materials. A lot of that stuff I gained on the job as far as mechanics material and products that helped out in that class a lot. As long as you have people you are working with that will take the time to explain to you, and I really did. It works both ways it's not just engineering knowledge that you took into the job you also have to concentrate on engineering knowledge that you took out of the job. If you sit there and study something in class and apply it at your job and see how this actually matters and how it's going to take you somewhere, then you can actually use it. I think that's one of the duties of an internship that I experienced.*

Our students found the expectations of their supervisors to be high. They did, however, find the supervisors and co-workers to be very helpful in teaching them what they need to know to get the job done. Initiative and the willingness to continually learn new things helped the students through tough assignments. The supervisors ranked both the initiative and continuous learning competencies high for our students (Table 3). One student found that cultural adaptability is also important a good working environment with their supervisor.

Question: ***Was the expectation of your supervisor's relationship to the assignment that you had, was it above the capabilities of what you were coming in with, or above and beyond what you should be doing at this point and time in your career?***

Student 4: *For me, I thought that it was about adequate.*

Student 9: *Usually, seemed like most of the coops that I worked with myself exceeded their expectations because they only teach you what they want you to do.*

Student 2: *If you go at it with the mentality that the opportunity that you are receiving is not just a job and that if you don't perform and don't work our tail off then there's no other reason for them to spend time with you. That's the kind of mentality that I had. Being in Milwaukee and not knowing anybody --- you really don't have anything else to do but work.*

Student 2: *So I would say the expectations are more than not. If you have the work ethic and the will to do what you need to do. I haven't talked to a lot of people that they didn't say they didn't do what they were expected to do nor had a bad experience so.*

Student 8: *I guess for me they really had really high expectations of me coming in and I think I met those expectations coming in. Some parts that were difficult for me was I was working in France and my supervisor was German and it was very hard to adapt to his style and his personality. Because it was really different from the supervisor I had in the United States. His attitude towards the way I should go about things and the way I should learn were different. So it took me quite a while to get comfortable with our relationship and figure out how to ask him questions. It was very interesting he would not offer any information – it always seemed like he wanted me to figure out the right questions to ask. He seemed offended if I didn't ask the right questions or if I asked a dumb question. I not saying anything bad about him—but just adjusting to that difference was difficult.*

The concern our faculty had about failing our students when is came to engineering knowledge, faded away after we learned that a majority of the AE co-op/intern students were sophomores or first semester juniors. It was important to find if these sophomores felt comfortable in the engineering workplace this early in their academic careers. Or should they have waited another year? The results showed that they all felt the experience was important at this time in their program, and that they are glad they didn't wait. The co-op/intern students in the Fall 2002 semester were mainly junior and seniors, and the supervisor scores place the engineering knowledge competency in fourth place.

Question: ***For those of you that are sophomores going out – do you feel it was a good time for you to go out or wait another semester?***

Student 2: *I think it was a good time. It makes school a lot easier. It makes you realize that you are important and you can apply something out in the real world.*

Student 7*: (It) puts school a lot more in perspective in terms of what classes and what it is going to do for you.*

Student 2*: One big thing is that it helped me realize what I really wanted to go into being an engineer. Like what I'm studying for now isn't going to be when I graduate. Exactly, it gave me a taste of that too. I ended up switching majors because of my internship experience. I definitely had a change for me. So I think it was good timing had it gone another year, I would not of had a lot of the classes that would applied to the major that I wanted.*

Focus Group – Communication Competency

The second half of the focus group was spent addressing communication within the engineering workplace. The communication competency definition and key actions are shown in Table 2. The key action that fell short was "organizes the communication". The students and supervisors both scored this at 3.89 out of 5.00. The other key action scored at a 4.00 or slightly higher. The students in the focus groups first answered a question related the kind of writing they did in the workplace. Most of them mentioned technical reports related to operations, testing, and data summaries. The other forms of communication used frequently were email and phone conversation. The need for curricular content related to organizing communication become very evident as you read their comments.

Question: *What kind of writing did you do in the workplace, if any?*

Student 1: *I had to write-up a technical operations manual and hydraulic test and fuel stand up. Because when we had to ship these units out they had to be fill of hydraulic oil and tested for certain operation functions and cycle times. And separate functions like that. I had to write a manual on how to trouble shoot and it was pretty involved program that had an operators interface so that we had to make really simple for the assemblers to learn fairly easy. It was a complex manual that I had to write for other engineers who came in and took over after I left. Where to trouble shoot if something went wrong, or if you had a valve fail where would you check for it that went bad or was it the valve. So it was a very complex tech manual.*

Student 2: *I did a lot of writing up test reports but it was fairly simple. I just had to follow their format and that was it. They already had a program all set up. I just had to enter the data and you were done.*

Student 3: *I guess for me I had to write- up a test report after I had my design done. We had to go out and test our prototype. Each assignment was set up to be testing individually so I had to* *write up my own report on my prototype. I had to incorporate the pictures into the report.*

Student 4: *I didn't do a lot of technical writing. A lot of reports I gave the value on the tables and shortly describe what were in the tables. What the critical values are you had to pay attention to. As far as technical reports, I didn't have to do that.*

Student 5: *I worked some with operations manuals. I worked in department where we built a lot of machines – so we did a lot with operations manual for safe operating machinery and stuff like that. So I got involved with a lot of things like that. Technical reports I didn't use.*

Student 6: *Mostly of the things I did had somewhat of an outline. A lot of the things I did were like testing the competitor's products. I would just take the product a part and look at it. Taking measurements and just analyzing it. The report you had a basic outline of it but then from there you would have an outline for each section of what you wanted to talk about. But it was definitely good experience. As far as feedback, the outline would go around to three people and they would proofread it and it would be put in a file. It definitely helped from having the courses that we had.*

Student 7: *The first couple of days on the job I build 12 prototype motor valves for John Deere. They did all the testing battery on them. Basically, the same testing they used on the competitors valve. I don't know if that was the report you wrote but I was suppose to test report for it but it got shuffled under a lot of other things. It was not really a hot project at this point. As far as a lot of technical writing I never had to do it. Most of the stuff I did was on ProE and I did the reporting to my boss. If he was in Waterloo or Europe, I would just send him an email talking about what the design issues are and that's what I was talking about as far as conveying your ideas on paper. It's a lot easier as far as doing your test report.*

Student 8: *I had a lot of like business communication and stuff like that emails and phone calls with just information in them using the right format.*

Student 9: *Sometimes that is overlooked a lot of times.*

Student 8: *The real important part of my job was to enter office emails and make phone calls leave detailed message.*

The focus group was asked to address other forms of communication they used in the workplace. Several mention oral communication skills needed for effective communication on the phone. Oral presentations using PowerPoint were also common place for a majority of the students. They realized the importance of others time and the need for timely, effective oral presentations. The need for time management related to presentation was discussed as a curricular issue.

Question: ***What other forms of communication did you have to do?***

Student 9: *With my responsibilities I had to conduct several meetings a week. How we are doing on the prototype, how we are doing on the robotics system. I had to be involved in a lot of meetings and had to facilitate a lot of the meetings too. You learn really fast how to have a meeting because people will get up fast and leave if can't get it done in less than ten minutes. So you get to the point really fast. It just like really helps you in terms of your engineer skills.*

Student 6: *Time management is big it's huge. The people that you are working for it are protective of their time – and you don't know how much they do until you see what all they have to do. As far as holding meeting in an efficient way, to make sure all the people who need to be there are there so you do not have to hold another meeting. You pretty much know how to deal with it. You really can't do this in a classroom it's just little stuff that you pick up.*

Student 3: *I had to do quite a bit of presentations and way pretty involved. We had to sit in front of a lot of people on Friday morning and tell them what happened. It would be pretty much from salespeople in the company to the president. Had to make sure you get it done the first time so you don't have to have another meeting. One thing is to know how to adapt it is to make it meaningful meeting for everybody.*

Student 8: *PowerPoint is used in almost every meeting that I've been at. To put a good presentation together and levitate a lot of the other junk (is important). Make sure that everything is in order…, so that everyone can follow it.*

Student 4: *One thing a lot of people do not know how to do is to hook up a computer to a projector.*

Student 7: *Waste of time, I've gone to meeting and sat for ten minutes where someone has spent that time trying to hook up the technical stuff for their presentation. You just waste a lot of time just sitting there. Maybe that needs to be in the 160 or 170 classes. No, in 101!*

Student 2: *I'd say that for the position that I was put in for the coop… we had to give a lot of presentations to a large group of people that were like a part of the design team. Two of us on the team had both taken English 314 (technical writing) in the fall and he said after that class he wish he'd had that class before he'd given these types of presentations, because that helps you communicate technically to these type of people that may not understand it. But I guess it was different because it was the design team and they were all engineers. He had to communicate to a lot of people that were from the business side of things the marketing and so that 314 would of helped him a lot going into that internship. I had taken that class too so I realize that is true too.*

OPALä Effectiveness

To better understand the effectiveness of the OPAL™ assessment from the student's perspective, we asked them at the end of the focus group to discuss their impression of OPAL™ and its use. The reviews were mixed, but mainly positive. A couple of the students spent significant time going over their assessment results with their supervisor.

Question: ***We dropped OPAL on you cold turkey. What conversation did you have with your supervisors?***

Student 3: *I hated it—personally.*

Student 7: *I had a very good experience with it. I actually really like it. It took my supervisors a while to fill it out. I sat down with one of my supervisions and we sat down right before I left. It left me with a really good feeling. Let me know where my future would be with the company and so I think if you are doing a good job it leaves you with a good feeling when you do leave because you can go and look at it too. I guess if you had a bad experience it might be the other way round. You are going to know what you did wrong and right.*

Student 8: *Actually I had a really good experience with it too. I had filled mine out and my supervisor filled his out and we sat in his office for 2 hours or more and compared the two. It helped me identify my strong points as well as my weak points and areas that I need to improve on and one I did well in. He provided specific examples asked that I provide him with examples too.*

Student 3: *I guess one of my biggest complaints is—I don't' know about you guys, but already within our company we already have a lot of assessments within our company and I've already gone through four of them. Then we dropped two of them, but I thought they were both pretty repetitive. I don't' know if all companies do that but.*

Student 8: *We had one right when we got there and one after three months. (The company) has one but it was actually the engineering management that filled it out for me. He was so distance from me it was not good but the* ***OPAL*** *one was good because it was my direct supervisor that filled it out. We had good conservation about it.*

Conclusion

The College of Engineering at Iowa State University has successfully implemented a competency-based assessment program for our co-op/intern program, that provides a more meaningful way of assessing of ABET Criterion 3 (a-k) Outcomes. With the help of Development Dimensions International, Inc., the COE is receiving student and supervisor feedback from an online competency assessment tool (OPAL™).

The Department of Agricultural and Biosystems Engineering is using data on Ag Engineering students from OPAL™, along with the transcription data from focus groups, to help identify current strengths and weaknesses of our curriculum. With these data and the transcription data from focus groups, we have a much clearer picture of the current strengths and weaknesses of our curriculum. We learned that the scores and rankings received from the OPAL™ should be carefully analyzed, and validated with additional assessment data, like that available through focus groups. Academic progress should be correlated to the OPAL™ score so as to not make unneeded changes in the curriculum. For example, one would not expect sophomores to score high in engineering knowledge, yet juniors and seniors should.

The results from OPAL™ and the focus groups verify that our current curriculum is helping students to be successful in the engineering workplace. Some efforts need to be made in the areas of "knowledge of experiment design and analysis" (a Key Action of the Engineering Knowledge Competency) and "organization of communication" (a Key Action of the Communication Competency). Earlier exposure to electronics would also benefit our students. The AE curriculum committee will be spending significant time addressing these issues. Since we will continue to receive semester competency reports, we should be able to observed more real time improvements in our areas of concern.

Finally, students can gain great insight into competencies they need to improve on. The key will be to have meaningful evaluations with their supervisors and/or academic advisor to establish a plan for improvement. The OPAL™ assessment results can help students to improve professionally, and help faculty to improve curriculum to help ensure student success in the engineering workplace.

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