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On the Job Training: A Case Study on Using Consulting Experiences to Enhance Students' Employability

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ABSTRACT

One university program piloted and implemented a novel approach to addressing ABET's requirement that students are prepared and meet the engineering community's needs. Graduate students participate in a required, immersive, three-week, team consulting engagement with various non-profit and for-profit organizations. This 1.5-credit course attempts to marry students' development of technical management skills with practical application of non-technical or soft skills, including communication, ethics, strategic analysis, and teamwork, to better positioning them for the work environment's broad and diverse needs. This paper describes the approach, methodology and implementation of the program, as well as data on its success, so other schools can explore implementation.

KEYWORDS: Non-Technical Skills, ABET, Consulting, Management, Curriculum

INTRODUCTION

Employers expect new employees to have not just technical expertise, but also increased dexterity in the non-technical skills that contribute to their ability to provide value on projects. These non-technical skills include communication abilities, ethical understanding and reasoning abilities, analytical skills, leadership and teamwork, along with others. Programs in the U.S. and other countries have attempted a number of approaches toward achieving these goals, with most focused on classroom instruction or discovery, and/or internships. Yet, these attempts often fall short because of their inherent constraints.

A growing chorus of engineering organizations are echoing what they hear from employers, who want graduates who can apply technical and non-technical skills (also referred to as soft skills or behavioral skills) in the work world with equal adeptness. ABET, the American Society of Engineering Education (ASEE), the American Society of Mechanical Engineers (ASME) and the American the National Academy of Engineering

(NAE) are echoing what they hear from employers (Dukhan & Hassif, 2014)."There is nothing soft about cultivating or acquiring these skills, and how critical for success they are for engineers in today's economy" (Palmer et. Al, 2011).

ABET mandates that all engineering programs ensure their students have "an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability." Students, according to ABET, require "the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context" and that graduates have "knowledge of contemporary issues" (ABET, 2015). Similarly, the American Society of Engineering Educators sees the need for graduating engineers to be better communicators (ASEE, 2014), while the National Society of Professional Engineers advocates for "prowess" among engineers in both technical and non-technical skills (Golden, 2016). But those programs that attempt to integrate non-technical skills into the classroom are not always successful. "Despite the fact that these skills affect personal and organizational outcomes and that universities value curriculum emphasizing interpersonal skills, students often fail to see the benefit" (Halfhill & Nielson, 2007).

To stand out to employers, graduates need a broader mix of technical and non-technical skills. The former are the skills required within a discipline, including specific processes, tools, and techniques (Sukhoo, 2005). Non-technical skills are broadly defined as the competencies necessary to manage one-on-one and one-to-group interactions. Non-technical skills most frequently identified through research (Halfhill, 2007; Law, 2004; Muzio et al, 2007; Pant & Baroudi, 2008; Petter & Randolph, 2009; Stevenson & Starkweather, 2010) include:

- Teamwork
- Leadership
- Decision-making
- Verbal and written skills
- Communication
- Conflict management
- Dealing with ambiguity and change
- Problem-solving
- Giving and receiving constructive feedback

For a finance student, for instance, technical skills might include knowledge and competence in calculating net present value, asset turnover, and assessing the risk of an investment portfolio. Non-technical skills that student might use include presenting the risk in an investment portfolio to senior management and working with colleagues to mitigate risk in that portfolio. Neither of

these areas of skills can operate in isolation, a reality that employers are noting in their desire to engage graduates who can perform both well (Porterfield et al, 2015).

(The authors choose to refer to these skills, including communication, project management, leadership, and adapting to change, as non-technical to clearly delineate how they contrast with the technical skills, knowledge and abilities traditionally taught in academic institutions.)

Students, faced with growing costs for their postsecondary education, sense the problem, too. McKinsey, surveying students in nine countries, including the U.S., determined that half of those students are unsure whether their postsecondary education improves the odds of them finding a job. Meanwhile, almost 40 percent of employers asked in the same survey, say they have vacancies in entry-level positions because applicants lack necessary skills for the position (McKinsey, 2012). Ryan Smith, founder and CEO of Qualtrics, wrote in *Fortune*:

> The number one problem I see in academia today is that students are coming out unprepared for the workplace. In other words, they lack on the job training. Universities teach students how to think, but they don't provide real world experience, so people leave school unprepared for the workplace. It's the equivalent of having a pilot graduate from flight school without ever having flown a plane. That's why I believe everyone should graduate from school with the equivalent of 3,000 flight hours so they know how to tackle challenging projects (Smith, 2015).

McKinsey put it more succinctly. "Clearly, employers need to work with education providers so that students learn the skills they need to succeed at work." (McKinsey, 2012).

Engineering programs in the U.S. and other countries have attempted to satisfy this dearth of professional experience by inviting business leaders to lecture, creating simulations and other classroom activities, and supporting real-world extracurricular programs and internships (Galloway, 2007). But these attempts often fail to provide students with realistic situations in which they can identify, engage and improve these non-technical skills in concert with their technical skills. The safety net of the classroom or the inherent role of the mentor in ensuring students stay on track at an internship can greatly erode the students' potential for discovery and learning in these settings. Moreover, while internships may potentially provide vital professional experience, not all students have the opportunity to secure a meaningful internship, and many who do are too often consigned to low-level work.

LITERATURE REVIEW

The most prepared and successful graduates are those who have both technical expertise and non-technical skills. Before focusing on non-technical skills, research first explored the broader concept of competence. To be a successful project manager, several researchers found the needs for greater training and education in non-technical skills (Wateridge, 1997; Wirth, 1992; Pant & Baroudi, 2008). Boyatzis found that competent managers need "an underlying characteristic of a person...including motives,

traits, skills, aspects of one's self-image and social role, or body of knowledge which he or she uses" (Boyatzis, 1992). This list of qualities can easily be extrapolated to other fields such as engineering.

Competence has been described as the combination of both job performance and behaviors top performers exhibit. That combination is further enhanced by workers who consider the organization's culture and needs (Cheng et al, 2005). A behavioral competency model for project managers encompassed 12 qualities (Cheng et al, 2005):

- Achievement orientation
- Initiative
- Information seeking
- Focus on client's needs
- Impact and influence
- Directive mess
- Teamwork and cooperation
- Team leadership
- Analytical thinking
- Conceptual thinking
- Self-control
- Flexibility

Subsequent research explored how managers' observations of their technical engineering project management professionals compared to test results for "soft skills quantification" (SSQ) in six areas -- results orientation, interpersonal skills, personal accountability, flexibility, problem-solving, and planning and organization -- resulting in another definition of these non-technical skills (Muzio et al, 2007). Two surveys of more than 200 members of the National Association of Colleges and Employers found that non-technical skills are in greatest demand. "Leadership" and "the ability to work in a team structure," followed by "communication skills" and "problem-solving skills" were the most sought after qualities in new hires (NACE, 2014, 2016). Analyzing the growing library of research on this area, Stevenson determined that "the significance of behavioral competencies in highly technical environments has been amply demonstrated" (Stevenson & Starkweather, 2010).

Employers recognize the need for a mix of technical and non-technical skills. "Often (projects) fail because of a project manager's inability to communicate effectively, work within an organization's culture, motivate the project team, manage stakeholder expectations, understand the business objectives, solve problems effectively, and make

clear and knowledgeable decisions" (Belzer, 2001). Employers continue to see employees who cannot accomplish the non-technical aspects of the job. For instance, communication was found to cause 43% of surgical errors (Gawande et al, 2003). Noting that 27% of claims against a health care organization resulted from cognitive and diagnostic errors in the operating room (Wilson, 1999), authors of one study argued, "These findings support the argument that technical skills are necessary, but not sufficient to maintain high levels of performance over time." They further suggest that achieving and maintaining the level of success needed for surgery, "attention needs to be paid to non-technical skills such as team working, leadership, situation awareness, decision making, task management, and communication (Yule et al, 2006). The concern is especially acute in newly hired workers. "Entry level employees might bring knowledge, skills and abilities to the job, but competencies are the result of experience; they are built up over time" (Gokhale, 2005). In 2008, researchers suggested a need to develop training grounds that merge the knowledge of practitioners, seasoned with non-technical skills, with the technical areas best developed in the academia (Berggren & Soderlund, 2008). Put another way, classroom settings are ill-equipped to offer students both the instruction and "seasoning" they need in all of these areas, thus establishing the need for new approaches.

PROGRAM FRAMEWORK

To provide realistic professional seasoning, in 2015 the subject university launched a 1.5 credit required course, entitled The Practice of Consulting. The three-week, immersive course is held during the intersession between spring and fall semesters, after the students have studied business strategy, accounting and finance and professional communications. The objective is to give the entire cohort of graduate engineering students the opportunity to form teams and focus exclusively on the needs of real clients. The school performed a pilot in January 2015, with 27 students participating in team consulting opportunities in Panama, Israel and Baltimore, Maryland. In January 2016, the program was expanded and more formalized, providing 28 students with opportunities to conduct team consulting work with clients in Israel, Honduras, Portugal and Baltimore.

Only students who had successfully completed their first semester in the Master of Science in Engineering Management program, where coursework focused on accounting and finance, innovation and growth strategies and presentation, qualified to participate in this "immersion experience." The course was graded Pass/Fail.

Planning Timeline

Planning for the course begins each year approximately 6–12 months before the students start their work. Course leaders identify potential target employers, including for-profit and not-for-profit organizations, seeking projects, largely related to entrepreneurship and market entry, that can be completed in the necessary time frame and which build on students' fall studies. International projects often require the help of the university's study abroad director to identify and build, since, in addition to the project itself, these "immersions" also seek to provide a strong sense of the host country's business environment and culture.

Working closely with course instructors, organizations chosen to participate in the program develop a one- to two-page explanation of their projects and how they might engage students in the consulting endeavor. In several cases, the consulting engagement involved an existing program that students would refine, extend or support. Early in the MSEM first semester, students receive copies of each summary so they can identify suitable projects.

Program Evolution

In the first year, students simply told program administrators of their interest in a specific opportunity. In year two, students prepared a one-page memorandum in support of the program of their choice, building on a classroom lesson on memo writing. Students submitted these memoranda in late September 2015 for the January 2016 course. Instructors then determined the best mix of students for each project, coordinating students' interests and desires with program logistics. These logistics included the number of students a project could support, travel costs and success in prior courses. Students who undertook overseas opportunities in year two were required to pay a small portion of their travel expense as a means of defraying costs and encouraging a greater commitment to the course. Scholarship funds were available for students needing financial aid to meet this requirement.

Students started their engagement in the first week of January with an overview of the organization, structure, products and services, and goals. The organization and students then discussed goals for the project. These discussions tended to be broader and less defined than the traditional problem/solution approach that these engineering students typically appreciate and favor. Students were forced to identify several important aspects of their project from the onset, including an appropriate team, methods of researching their problem, identification of best solutions, and teamwork within their teams and with their client. In some cases, students attempted to research the solution via secondary sources, rather than explore the range of possibilities that could not be researched in traditional or academic ways. When clients objected to the "academic" solutions, the students realized that they needed to better communicate with their clients and, in the process, practice the very skills that employers seek.

In the first year, the work product – a report, a presentation, accomplishment of a jointly agreed upon goal goal, and/or an reflection on their work – was due during the Spring semester. But for year two, the projects were self-contained within the three-week course period, forcing students to invest heavily in achieving the outcome and overcoming any obstacles in an efficient manner, once again replicating the realities of a work situation.

Unlike nearly every prior academic and work experience, students had to find their way. The traditional problem/solution approach was rarely available because even if a problem was articulated through discussions with the client, students had to determine if the problem the client identified was, in fact, the true problem or if something else actually was the issue. For instance, one group in January 2016 was asked to explore how to expand the effectiveness of endoscopes and were given a possible solution. Their research suggested that the clients' solution would not work as articulated, sending the students out to identify alternative avenues for a solution and communicate this surprising news to the client. This frustrating analytical process is difficult to teach in the classroom, but the immersive consulting project forces students to confront the common workplace reality that the client often cannot recognize the limitations of his or her ideas.

In every case, students working in teams achieved goals providing value to their client. While the effectiveness of these results varied among projects, no organizations expressed dissatisfaction or frustration with the experience, and in most cases, they asked to be considered again for future Practice of Consulting experiences. Two of the organizations that participated in year one participated again in year two.

ASSESSMENT

To assess the success of the program for students, the university conducted a 19-question survey in February 2016. The program attempted to send 27 student participants from 2015 and 28 student participants in 2016 an online survey. (Because some students graduated prior to the issuance of the survey, the appropriate email to reach the students to conduct the online survey was not available.) Exactly 18 students completed the survey. The breakdown of participants includes five students who graduated in Spring 2015, three students who graduated in Fall 2015, four students expected to graduate in Spring 2016 and six students expected to graduate in Fall 2016. Four of the respondents performed their course in the U.S., while the remaining 14 went overseas.

Survey respondents' concentrations within the university's MSEM program included chemical and biomolecular science (2 students), civil (1), computer science (2), communication science (1), environmental systems (1), material sciences (1), mechanical engineering (3), nano/biotech (1), operations research (3), probability and statistics (1) and smart product and device design (2).

Students were asked to evaluate specific aspects of the Practice of Consulting course (Table 1).

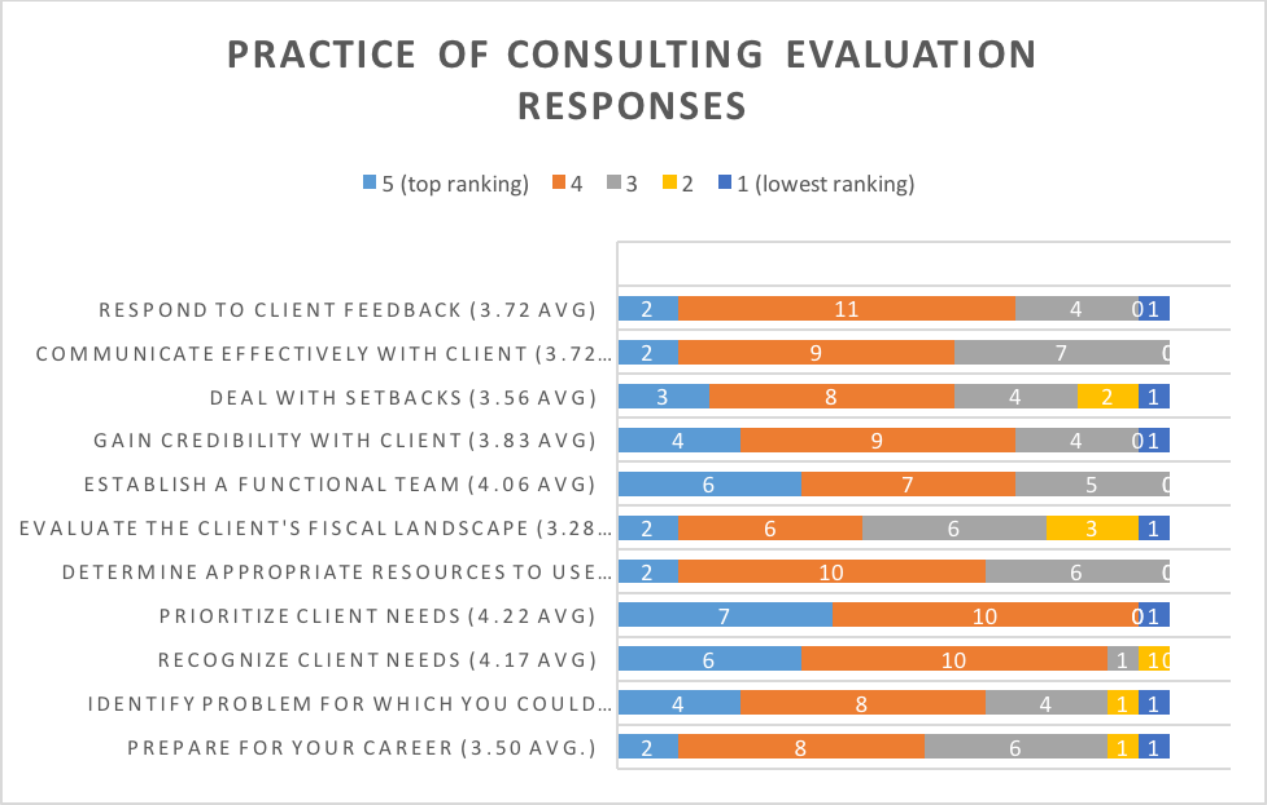

Table 1: Student Reponses to Evaluation

Students also were asked to assess the effectiveness of the course instruction in their first three classes in preparing them for the Art of Consulting course (Table 2).

Given a selection of choices for the prompt, "How would you describe the impact of The Practice of Consulting course? The experience prompted me to:" students responded (when able to select one or more answer):

- Acquire or strengthen a specific skill (6 responses)
- Pursue a field I had not considered before (5 responses)
- Seek a consulting job (2 responses)
- Realize that you preferred more technical engineering (2 responses)
- Another experience to build my story (1 response, written in)

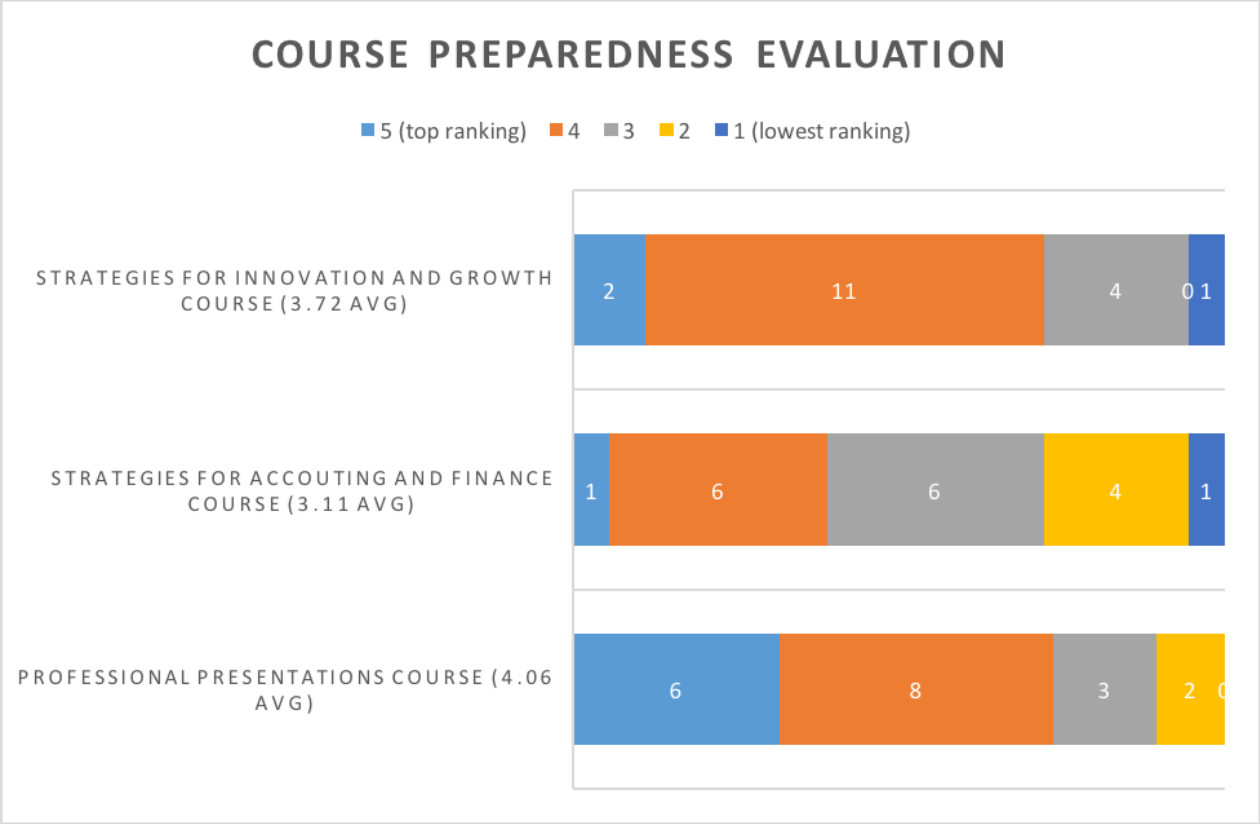

Table 2: Course Preparedness for Practice of Consulting Results

DISCUSSION

The overall results appear favorable. To imitate the real-world nature of the course, students had no clear objectives identified at the beginning of the course, except to accomplish whatever task the client put before them. This vague nature – one engineering students especially find challenging – may contribute to the results shown.

The results suggest several important considerations for this course and others. First, the results may indicate that students may not be aware or able to make a direct connection between what they are learning in the classroom and the non-technical skills employers seek. Given that the subjects of this analysis are engineering students, their recognition of the non-technical skills themselves could vary, as could their ability to assess which ones, if any, were being engaged in specific tasks.

Students provided the best responses to two questions addressing client needs ("recognizing and prioritizing" and "establishing functional teams"). These areas are the easiest to recognize because they are the most concrete. That students found these areas beneficial should come as no surprise. These two areas alone would justify continuing the course, as shifting from the

technical aspects of engineering (problem/solution) to the less exact science of determining how to go about a task to meet the needs of a client or employer and to work effectively in teams is of paramount concern and importance in any workplace. Similarly, students' responses to the benefits of a Professional Presentations class on their work bolsters this argument; each team had to deliver a presentation to their client as part of the Practice of Consulting requirements, thus forcing them to apply directly the skills they acquired in the class.

Other results, while still positive, suggest the possibility that the language of the survey instrument or the language used in the classroom is not translating effectively into the workplace situations students face. Additional research on this possibility is warranted.

Surveying students also may be premature, for students may not yet recognize the value of the experience. Being able to provide details about this real-world experience in job interviews could serve to differentiate these students from other graduates. These students would not know or understand this benefit yet, nor would they recognize how using these non-technical skills in the workplace would improve their ability to achieve workplace goals.

CONCLUSION

After two years, this program demonstrates progress toward achieving the goal of greater engagement of students prior to graduation in workplace situations where they can employ both technical and non-technical skills. Using a three-week, immersive approach forces students to act and react to situations at a pace more consistent with what they will face upon graduation. That students often fail to recognize how their instruction has fostered their ability to engage in these real-world situations is worth additional study to determine if students lack an understanding of the specific skills they must employ or if they really do not feel as if their non-technical instruction plays an important role in their preparedness for real workplace situations.

The effectiveness of this Practice of Consulting course in the curriculum of the graduate MSEM program shows promise, as universities continue to seek creative methods for better preparing their students with both technical and non-technical skills employers covet.

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