"Rounding-up the industrial engineering educational profile with adaptive soft skills framed by a cultural competency approach in an industry-university partnership."

Dr. Imelda Olague-Caballero, New Mexico State University

Dr. Imelda Olague studied Civil Engineering at the University Autonomous of Chihuahua (UACH) and Ph.D. in Civil Engineering at New Mexico State University (NMSU). Currently, Dr. Olague is pursuing a second Ph.D. in Industrial Engineering at NMSU. She is the institutional liaison between UACH and NMSU supporting academic partnerships and research collaborations. Her research area is in geotextiles composites from plastics and natural fibers. In addition she studies the manufacturing of eco-friendly construction materials. Currently, she is collaborating with the NMSU Department of Industrial Engineering to develop industry-university partnerships and to study the effects of experiential learning on the employability of engineering students.

Dr. Delia J Valles-Rosales, New Mexico State University

Dr. Delia Valles-Rosales is Associate Professor in the Department of Industrial Engineering at New Mexico State University. Delia is originally from Mexico. She received her B.S. from the Instituto Tecnológico de Durango and Ph.D. from New Mexico State University. Her research uses nature to inspire the development of innovative manufacturing processes, new processes of biomass utilization in the plastic industry, and models and algorithms for system optimization in agriculture, industry, and service areas.
“Rounding-up the Industrial Engineering Educational Profile in a Industry-University Partnership.”

ABSTRACT
This paper details the creation and implementation of a pioneering industry-university partnership that recognizes the pedagogical value of learning experiences beyond a formal curriculum. The goal is to complement the traditional engineering education approach of producing engineers with hard technical skills incorporating educational experiences in industry. It is expected that the new industrial engineering graduate will be ready to enter into professional life with a strong technical background and being sensitive to the challenges posed by diversity and cultural differences. This partnership attempts to foster global and cultural competency by creating educational environments that favors a new type of global engineer, with a broad range of skills and knowledge, above and beyond a typical industrial engineering (IE) curriculum. The proposed educational model was founded in the sophomore and senior curriculum series of IE 316 Methods Engineering & IE 478 Facilities Planning. IE 316 introduces participants to methods engineering and work measurement fostering the development of critical thinking, self-assessment, and team work; IE 478 trains the students in the art and science of facility design and planning. Rounding-up the curriculum of these classes, this educational experience complements the student’s professional profile by adding the necessary cultural competency required to produce a global engineer. The model consists of five components: identification and selection of industry partners and potential projects; attendance to in-class mini-lectures & assignment of pertinent readings supporting the selected project; student’s training previous to their incorporation to the project; monitoring students’ progress by supervision of peer & industry mentors and class instructor; continuous evaluation and assessment of the learning experience through weekly reports and a final project presentation to the company’s CEO. Completing the educational cycle, cultural competencies are developed throughout the model components by exposing the students to interactions with industry personnel at several levels including staff engineers, technicians, and blue-collar operators with different cultural and ethnical backgrounds. The whole experience ensures the development of the students’ ability to value diversity and to work effectively across cultures, while learning and practicing fundamental concepts of industrial engineering such as lean manufacturing, time studies, line balancing, quality control, and safety engineering in a real world scenario. The literature reports similar successful experiences where academic institutions are getting prepared to face challenges of globalization by partnering with industry. It is expected that this partnership will help to enhance self-efficacy beliefs in the participants. So far this collaboration has been in place for two academic years resulting in eight students benefited from this partnership; currently three of them are permanent members of the engineering staff in one the industry partners. There is an increasing interest among IE students to be part of this program; currently twenty-four students are enrolled in the current cohort. This paper provides evidence of the main findings of this educational experience and it is expected that this model will be soon institutionalized as an apprenticeship program.
**Introduction**

Currently there is a worldwide trend to produce highly skilled and culturally competent engineers able to be employable upon graduation. This trend is a consequence of globalization and the unstoppable economic phenomena related to the expansion of a global free market (Sanchez-Goni, 2009) and the need to align higher education credentials and labor market demands. The challenge is to create appropriate educational environments and instructional strategies that foster a comprehensive engineering education while facilitating the development of employability skills, defined as the “set of achievements-skills understandings and personal attributes-that makes graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community, and the economy” (Yorke, 2004). However, the literature steadily repeats that engineering graduates are being poorly equipped with the skills and abilities required to close the gap between graduates’ attributes and job market and employers’ expectations (Andreu-Andres & Garcia-Casas, 2011; Nair, Patil, & Mertova, 2009; Sanchez-Goni, 2009; Andrews, 2008; Andrews & Higson, 2008) because there is a mismatch of engineering programs and the demands of current professional engineering practice (Sheppard, Macatangay, Colby, & Sullivan, 2008).

Serious concerns are being raised about Institutions of Higher education’s efficacy to prepare students to integrate their technical knowledge with real world problems. Institutions of Higher education (IHE) need to reflect on their responsibility to offer quality education learning experiences that link the knowledge learned in the classroom and the competencies required for the workplace. For instance, Andrews and Higson (2004) pointed that most universities around the world are being questioned about their ability to graduate engineers able to meet the needs of employers related to social ethics skills and the ability to work with people of different backgrounds. Nair et al. (2009) reported that the results of the 2007 Monash University Employer Survey concluded that there is a need to have a clearer understanding of essential generic and professional attributes of engineering graduates to ensure quality in higher education, and that colleges and universities need to collaborate more closely with industry to re-design or re-align its educational programs with the competencies required by the employers.

On the other hand, in 2006, the results of a survey conducted by the Association of American Colleges and Universities (AAC&U) among employers, indicated general agreement that colleges and universities should place more emphasis in the areas of integrative learning or the ability to apply knowledge and skills to real world settings through internships or other hands-on experiences in order to produce graduates sensitive to cultural values of other countries and to global issues and knowledge of human cultures (AAC&U, 2007). Moreover, according to Hernandez-March, Martin del Peso, & Leguey (2009) there is a lack of uniform efforts among the states to survey employers about graduates’ competencies and the resources of higher education institutions to facilitate their transition into the labor market (Hernandez-March, Martin del Peso, & Leguey, 2009).

Although it is important that IHE develop innovative ways to adapt or improve their engineering curriculum to increase the employability, work readiness and mobility of their graduates (Treuer, Sturre, Keele, & McLeod, 2010), several authors support the idea that employability is better and more effectively learned outside the formal curriculum (Andrews & Higson, 2008) specifically on the experiential environment of real world engineering practice. This idea is in alignment with the Accreditation Board for Engineering and Technology (ABET) criteria that requires
higher education to provide students with hands-on practice and opportunities such as solving real problems, understanding societal issues, and working in multidisciplinary teams (ABET, 2007). The challenge for IHE is to develop innovative experiential learning programs that promotes the integration of students’ technical knowledge with “and understanding of engineering practice in different real world environments.

Various authors have provided useful models to explain the process of learning from experience. For instance, John Dewey (1859-1952), popularized the concept of Experiential Education which focuses on problem solving and critical thinking rather than memorization; Carl Rogers (1902-1987), distinguished two types of learning: cognitive (meaningless) and experiential (significant) and lists the qualities of experiential learning as: personal involvement, self-initiated, evaluated by learner, and pervasive effects on learner. To Rogers, experiential learning is equivalent to personal change and growth and affirms that learning is facilitated when: (1) the student participates completely in the learning process and has control over its nature and direction, (2) it is primarily based upon direct confrontation with practical, social, personal or research problems, and (3) self-evaluation is the principal method of assessing progress or success. David Kolb (1939) described experiential learning as an integrative process of concrete experience, reflective observation, abstract conceptualization, and active experimentation. In summary, Experiential learning theory defines learning as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984).

According to the Association for Experiential Education, “Experiential learning is a philosophy and methodology in which educators purposefully engage with students in direct experience and focused reflection in order to increase knowledge, develop skills, and clarify values” 2. The Faculty Development and Instructional Design Center of the Northern Illinois University stated that experiential learning experiences help to complete students’ preparation for their chosen careers inform real world practice with theory learned in the classroom. Through these experiences students develop communication skills and self-confidence and gain and strengthen decision-making skills by responding to and solving real world problems and processes3. This idea aligns with the results of a student survey performed in 2004 which revealed that students feel that the best place for them to develop personal ‘employability’ skills is through work experience (Tymon, 2013).

Several pedagogies have been identified with Experiential learning such as group case assignments, simulation games, descriptive/analytic field projects, and consultative field projects, assessment centers, forums, group discussions, panel meetings, live cases, writing experiences, student-written textbooks, internship programs, job search preparation, on-the-job training, field trips, among many others. Most popular forms include: internships, cooperative education, practicums, service learning, externship/job shadowing, apprenticeships, fellowships or scholarships, and volunteer activities. All of these experiences can then be used to build a strong resume3.

---
1 http://www.instructionaldesign.org/theories/experiential-learning.html
2 Association for Experiential Education http://www.aee.org/
3 Northern Illinois University, Faculty Development and Instructional Design Center facdev@niu.edu, www.niu.edu/facdev
<table>
<thead>
<tr>
<th><strong>EXPERIENTIAL LEARNING PEDAGOGIES</strong></th>
<th><strong>CHARACTERISTICS</strong>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apprenticeship Experiences</td>
<td>Provide students an opportunity to try out a job usually with an experienced professional in the field to act as a mentor. Apprenticeships are a type of on the job training which may lead to certification. Many skilled laborers learn their trade by doing an apprenticeship.</td>
</tr>
<tr>
<td>Clinical Experiences</td>
<td>Are hands-on experiences of a pre-determined duration directly tied to an area of study such as nursing students participating in a hospital-based experience or child development and teacher education students participating in day care and classroom settings.</td>
</tr>
<tr>
<td>Cooperative Education Experiences</td>
<td>Are more extensive than internships and will usually span two or more semesters of work. Co-ops are paid professional work experiences and are tied very closely to the student's academic work. During the co-op experience students participate in advising and the co-op will be structured to meet the student's academic and/or career goals. Co-op experience usually is included on a student's transcript in addition to being awarded designated credit hours for its completion.</td>
</tr>
<tr>
<td>Fellowship Experiences</td>
<td>Provide tuition or aid to support the training of students for a period of time, usually between 6 months to one year. They are usually made by educational institutions, corporations, or foundations to assist individuals pursuing a course of study or research. Post-graduate fellowships assist students at the graduate level while post-doctorate fellowships provide monies for those who have already achieved their doctorate degree.</td>
</tr>
<tr>
<td>Field Work Experiences</td>
<td>Allow students to explore and apply content learned in the classroom in a specified field experience away from the classroom. Field work experiences bridge educational experiences with an outside community which can range from neighborhoods and schools to anthropological dig sites and laboratory settings.</td>
</tr>
<tr>
<td>Internship Experiences</td>
<td>Are job-related and provide students and job changers with an opportunity to test the waters in a career field and also gain some valuable work experience. Internships can be for credit, not for credit, paid or unpaid.</td>
</tr>
<tr>
<td>Practicum Experiences</td>
<td>Are often a required component of a course of study and place students in a supervised and often paid situation. Students develop competencies and apply previously studied theory and content such as school library media students working in a high school library or marketing majors working in a marketing research firm. Practicum experiences also allow students to design and develop a project in which they apply knowledge and develop skills such as a doctoral student preparing the components of an online course.</td>
</tr>
<tr>
<td>Service Learning Experiences</td>
<td>Are distinguished by being mutually beneficial for both student and community. Service learning is growing rapidly and is considered a part of experiential education by its very nature of learning, performing a job within the community, and serious reflection by the student. Service learning involves solving some of society's issues; such as, homelessness, poverty, lack of quality education, pollution, etc. One of the goals of service learning is to help students become aware of these issues and develop good citizenship in learning how to help solve some of these problems.</td>
</tr>
<tr>
<td>Student Teaching Experiences</td>
<td>Provides student candidates with an opportunity to put into practice the knowledge and skills he or she has been developing in the preparation program. Student teaching typically involves an on-site experience in a partner school and opportunities for formal and informal candidate reflection on their teaching experience. The on-site teaching portion of this experience can range from ten to sixteen weeks, depending on the program.</td>
</tr>
<tr>
<td>Study Abroad Experiences</td>
<td>Offer students a unique opportunity to learn in another culture, within the security of a host family and a host institution carefully chosen to allow the transfer of credit to a student’s degree program. Students studying a foreign language will perfect the accent and greatly expand their vocabulary—a skill retained for life. Making new friends, and travel and decision making, are also key parts of the study abroad experience.</td>
</tr>
<tr>
<td>Volunteer Experiences</td>
<td>Allow students to serve in a community primarily because they choose to do so. Many serve through a non-profit organization—sometimes referred to as formal volunteering, but a significant number also serve less formally, either individually or as part of a group. Because these informal volunteers are much harder to identify, they may not be included in research and statistics on volunteering.</td>
</tr>
</tbody>
</table>

Table 1. Different forms of experiential learning pedagogies

4http://internships.about.com/od/internships101/p/TypesExperEd.htm
The essential components of experiential learning include: something personally significant or meaningful to the students; personal engagement; reflective thought and opportunities for students to write or discuss their experiences; total personal involvement (senses, feelings and personalities); students bring previously attained knowledge into the process; sense of trust, respect, openness, and concern for the well-being of the students. Experiential learning is sometimes related as experience-based projects; some examples include role playing, service learning, internships, studying abroad, open-ended projects (guided discovery), group projects and field study (Andresen, 2000). As it can be seen, the common denominator is the collaboration with industry, government, or nonprofit organizations that actively participate to provide enhanced educational learning experiences that helps to bridge the gap between theory and practice as discussed by Treuer et al. (2010). Therefore, the goal is to design educational learning environments where students can gain engineering experience while applying the knowledge learned in class assuming that students involved in this experiential learning will be motivated to remain in the field, reducing the student’s attrition that has characterized the engineering programs, and STEM disciplines in general, in the last decade.

In the context of university career services, experiential learning is commonly defined as the students’ opportunity to gain practical experience related to their major before they finish their college degree and usually includes cooperative education, internships, service learning and volunteer work. No matter what approach is being used, the pedagogical value of experiential learning relies on its ability to strengthen technical skills while nurturing soft skills, qualities, and understandings to be successful in diverse and multicultural working environments (Andrews & Higson, 2008). In particular, the NMSU Department of Industrial Engineering has been fostering global and cultural competency through experiential learning by creating educational environments that favors a new type of global engineer, with a broad range of skills and knowledge, above and beyond a typical industrial engineering (IE) curriculum.

It is expected that the new industrial engineering graduate will be ready to enter into the professional life with a strong technical background and being sensitive to the challenges posed by economic globalization, diversity and cultural differences. Therefore, it is important to develop educational strategies that complement the traditional engineering education approach of producing engineers with hard technical skills with the incorporation of project based educational experiences in real world scenarios. Usually, local industries willing to collaborate with engineering departments represents the most appropriate environment to provide these opportunities. The literature extensively reports that colleges and universities utilize active learning as educational strategy to facilitate the application of technical knowledge and soft skills to real-world scenarios. However, little information is available in the literature about experiential learning and its capability to build and foster the necessary skills and abilities for new engineering graduates to obtain gainful employment, in today’s highly globalized working environments.

In this paper we will present a summary of the educative experience designed and implemented to blend the development of hard and soft skills with experiential learning via a innovative industry-university partnership. The attempt to motivate students to increase their cultural competency along with a brief description of this partnership will be also provided. It is expected that this partnership will help to produce global engineers that are broadly knowledgeable,

culturally competent, by the students’ immersion on learning environments where experiential learning is applied. The results of this study could be useful to engineering educators interested in rounding-up the academic profile of new engineering graduates.

I. Institutional Background

New Mexico State University (NMSU) was founded in 1888 as Las Cruces College under the leaderships of Hiram Hadley, a respected educator from Indiana. Under the provisions of the Morrill Act of 1862 and subsequent federal legislation, the special mission of land-grant institutions was established to provide a liberal and practical education for students and to sustain programs of research, extension, education, and public service (NMSU, Policy Manual, 2007).

In 1969, the first Bachelor of Science in Industrial Engineering (BSIE) degree was awarded at NMSU. Since that time, the industrial engineering course of study has evolved into a well-respected and competitive program with the main goal to produce graduates who can design and analyze production, service, and distribution systems for manufacturing and service industries as well as for government and research organizations using mathematics, physical and social sciences along with the principles of engineering analysis and design. The NMSU Industrial engineering Department (IE) offers the student a general industrial engineering education and is committed to prepared graduates able to meet the demands of a economy increasingly globalized. To this end, the IE Department emphasize practical or experiential learning throughout the curriculum. For instance, the IE Department have implemented a number of changes in the undergraduate manufacturing courses that are linked and transferred to consecutive classes in order to provide gainful hands on activities (IE 217, IE 152, IE 375, IE 467 and IE 478). This integrative approach has helped to introduce a greater focus on injection molding, CAD/CAM and simulation. As a consequence, these courses have reached a better integration and the enhancement of industry experience among IE graduates.

II. Educational Model: B-Ready in Engineering

The particular nature of industrial engineering education to train students about the optimization of complex process or systems motivated the creation of an educational model able to link the knowledge learned in the classroom with its application in real case scenarios. Therefore, the present model or learning pedagogy does not fit exactly any of the categories given in Table 1; instead, this model can be described as an hybrid category, blended with characteristics from several experiential learning pedagogies such as Apprenticeships, Cooperative Education, Field Work, Internships, Practicum Experiences. This model is a non-paid shadowing experience that offers students an opportunity to apply their knowledge and skills in a semester-term team project in a realistic industry environment under the guidance and supervision of a mentor and a accompany liaison.

The model is a blending of experiential learning pedagogies that has been denominated as B-Ready in Engineering Program and practically is an hybrid experiential learning approach responding to university and industry expectations about enhancing graduates employability and work readiness by providing students with real world experience in a controlled environment that helps to meet ABET criteria without modifications to existing curriculum. The program will support the following ABET outcomes: identify, formulate, and solve engineering problems; function in a multidisciplinary team; communicate effectively; and knowledge of contemporary issues while building students' self-efficacy through direct interactions with industry professionals. This model will increase the students' employability by facilitating the creation of
meaningful connections to the real world of work, and will develop the students' ability to navigate and negotiate the social, political, and practical dimensions of a workplace.

The model allows teams of 4 students to participate in this experience; they work under the supervision and guidance of a graduate student acting as peer mentor, who is responsible to assist and support the team during the completion of their project. It is required that the team spend two hours a day during twelve weeks, collecting information and learning about the working environment. The idea is that students have the opportunity to translate knowledge into action while they are allowed to act as consultants in a controlled environment inside an industry that agrees to partner in their education.

These experiences are done for class credit and are unpaid and they are a good way to get exposure to a career field and job environment with little time commitment on the part of the students. IE students that participate in this experience are benefited by the opportunity to witness real world scenarios and to develop a sound engineering judgment when they are supposed to identify problems or to provide solutions supported by the theoretical and technical tools learned in the classrooms. The model considers knowledge, skills, and practice as the catalytic components of new behaviors in the engineering students. Typically, a student is supposed to acquire knowledge and skills in the classroom via cognitive activities to start developing and engineering mindset. However, if these knowledge and skills are not applied in a reasonable timeframe, chances are the knowledge will be forgotten very soon, preventing the educational loop to be closed and consequently limiting the learning process. An effective educational model has to provide the appropriate environment where the student is able to try and test what they just learned in the classroom; this is particularly true in engineering education.

Figure 1. The B-Ready in Engineering Program is a blended model of several experiential learning pedagogies

The B-Ready in Engineering Program was founded in the sophomore and senior curriculum series of IE 316 Methods Engineering & IE 478 Facilities Planning taught at the NMSU IE Department. With the purpose to apply knowledge and skills gained from previous engineering coursework, these two courses are taught in sequence to approach engineering problems as seen in the professional engineering life. IE 316 introduces participants to methods engineering and work measurement fostering the development of critical thinking, self-assessment, and team
work. After a good understanding of these topics are attained, students moved to IE 478 where they are trained in the art and science of facility design and planning. For two consecutive years this approach has been able to round out the student’s professional profile by adding the necessary cultural competency required to produce a global engineer.

The model consists of five components: identification and selection of industry partners and potential projects; attendance to in-class mini-lectures & assignment of pertinent readings supporting the selected project; student’s training previous to their incorporation to the project; monitoring students’ progress by supervision of peer & industry mentors and class instructor; continuous evaluation and assessment of the learning experience through weekly reports and a final project presentation to the company’s CEO. These components are briefly discussed in the following section.

III. Model Components

1. Identification and selection of industry partners and potential projects.

The first component of the model is the identification of the organization or industry partner through interactions with several local industries that expressed their interest in partnering in the education of potential employees. Engineering New Mexico Resource Network will be instrumental in helping to identify practitioners from business, companies/industry, government offices, or non-profit organizations willing to bring professional practice into engineering education and to play an important role in the education of future engineers. The practitioner partner plays a key role in the creation of meaningful learning experience for students; their motivation to participate could range from altruism to looking for potential employees and opportunities to communicate to university educators about what they are looking for in new
employees. Among other strategies to identify potential partners for these collaborations there is attending to the Industrial Engineering Department Industry Night that is being held every semester at the NMSU IE Department. This department has a long tradition of keeping excellent relationships with local industries; every semester the IE students’ organizations coordinate and foster the event with the support of faculty and administrators of this department. During this event company representatives also interact with faculty and students informing them about job opportunities and hiring requirements.

Two or three weeks prior to the beginning of the semester, will start the process of identifying companies, setting up objectives, defining project goals & performance because all this information must be provided in the course syllabus. The syllabus will contain course objectives, learning outcomes, justification about the experiential learning students are involved, contribution of the course in meeting their professional component, relationship of the course to the program objectives, student requirements, grading information, safety training information, rubrics for training involving safety training and training on how to approach the project, a rubric of the project explaining all details to be accomplished, detailed scheduled about course progression, content materials, and detailed timeline.

This model assumes that students will be able to visit the participating industry once a week for a maximum of 12 weeks during class time. Therefore, the industry partners are preferably targeted and selected among local industries; however, in special circumstances industries in cities located no more than 45 miles away from NMSU will be also considered. In a timely manner, the students will be provided with a list of partner companies along with potential projects; the idea is that students will have the opportunity to select a company and/or project of their preference. Once the partner has been selected, close communication helps to define two or three potential projects as well as goals and performance measurements for the students. The number of projects implemented will depend on the number of students interested in that particular industry. After this stage is completed, then the logistics of attendance is defined; usually, the preferred time will be class time but also how far the partner facilities are located, and the required transportation will be taken into consideration as well. Of course students’ availability is also included in this formula.

Teams of three to four students are integrated allowing them to form the groups themselves; they commit to a minimum of two hours meeting per week to evaluate and document their work in preparation to the final report. The instructor and graduate students meet with the groups once a week for a minimum of two hours to follow up the advancement of their projects. A liaison from the company side provides guidance, information, company tours, other necessary resources and guidance as well as to introduce students with the company or organization’s workers. The liaison also works closely with the graduate student to ensure the successful completion of the projects. It will be of key importance the identification of the company liaison and the graduate student. The company liaison will be instrumental in the definition of the projects while the graduate student should be trained to play the role of peer mentor for the students participating in the program.

After this preparatory stage is completed, the logistics of attendance will be defined, usually the preferred time will be during laboratory class time; however, location of the facility may be also considered. Students’ social styles are assessed to build both, awareness and to develop interpersonal versatility to ensure a more productive team working experience. Students will be
required to spend a minimum of three hours per week to work on the project. The students will select the place they want to work on from a given list. To support the project selection, students will have a field trip to the companies to learn about their manufacturing processes and goals. During this field trip, the student will meet the liaison assigned to work with them and the objectives of the project to provide more information about where they want to go. The instructor will travel with each group once a week. The graduate student or peer leader will spend the whole laboratory time with students at the company. Projects will be done in nine stages with two reports and one midterm presentation and one final presentation. The midterm presentation will be informal, more like a meeting with me just to go over the initial report. The final presentation will be a formal presentation where industry representatives will be present. Students will present findings to their corresponding company. Students will handle a power point presentation and a written report.

The nine steps are

1. Observation/data collection
2. Brainstorm solutions/methods
3. Analysis of solutions/feasibility/cost analysis etc.
4. Research for selected method/rough draft of user procedures.
5. Midterm presentation of report.
6. Implementation/finalize user procedures.
7. Observation/data collection.

During the first two classes the students will gather information and will be allowed to ask questions to understand the project requirements and to brainstorm for possible solutions. Students will meet with the graduate student and the company liaison to plan the midterm presentation; the Liaison, will decide if the proposed solution is acceptable and if so, he will present it to plant manager, quickly and concisely for his/her approval. At this point, the students may begin the implementation stage. The students will work with company employees to implement results and liaison will follow up at the beginning and periodically. The implementation will most likely be done without the students being present especially if it is a lengthy process, thus they need to have clear instructions and a clear plan. As time allows, the students could then make observations on efficiency/time and cost savings, and compare with previous observations. The final report will then be presented with all the results and final presentations will be held on campus with a maximum of 20 minutes. In addition, graduate student will meet with his/her corresponding liaison to prepare weekly reports or projected time tables, Gantt charts, etc. Graduate student will provide the liaison with copies for a follow up on the progress.

Throughout this process, we will ensure that students are exposed to situation in which they will experience interactions with persons from different backgrounds and levels of education; for example students collaborate with blue and white-collar workers who may not necessarily have college degrees but who possess years of experience. These interactions provide the students with the opportunity to learn and work effectively with people that face and solve problems differently. This will make the student more sensitive to the importance of healthy relationships in the working environment to address work related issues effectively.
2. Attendance to in-class mini-lectures & assignment of pertinent readings supporting the selected project.

Previous to the students’ assignment of projects to, they will received the theoretical foundation required to approach their projects through in-class mini lectures. This in-class training will provide a technical background information that encompasses theory, knowledge, and skills pertinent to the class level that will inform their behavior and performance during their attendance to the companies. The class curriculum considers specific topics to be covered during the first four weeks of classes; along the semester other appropriate tools are presented. During this time, the students also received relevant information about course goals and objectives, grading scales, and assessment and evaluation tasks and activities. This step is very important in helping the student to learn about the class and/or instructor’s expectations.

3. Student’s training previous to their incorporation to the project

Student’s preparation begins in their first course by introducing the students into the concepts that going to be applied in their project at the selected industry. The general methodology used to introduce the students into the required concepts consists of related text-book readings, mini-lectures courses. Once the main course topics are covered the next step is to form work teams and to assign projects. In the pilot stage of this project, students were allowed to decide how to integrate the working groups or teams, because emphasis was placed on the logistics of the collaboration. However, in subsequent semesters, the instructor will be in charge to organize the teams to ensure that students from different backgrounds are motivated to work together. The goal is to provide the opportunity to start developing cultural competencies among students participating in the project. The students are surveyed at the beginning of the semester to evaluate their ability to interact with students from diverse cultural backgrounds and to assess how useful the experiences was in fostering cultural competency. This evaluation is supposed to be repeated at the end of the semester to measure the increment in cultural awareness that this learning experience had in the students participating in the project.

4. Monitoring students’ progress by supervision of peer & industry mentors and class instructor

A key component of this collaboration is the appointment of a graduate student or peer or mentor that will inform, guide and supervise the student during the time the students attend and who will be in closed communication with the company liaison in order to keep the project running and to ensure that the projects will be completed in a timely manner. This mentor will have a very important participation in the students’ evaluation because they will provide constant feedback to the instructor about qualitative elements of the final assessment of the students learning experience. The assessment comprises weekly project report, final group presentation, and mentors’ feedback and evaluation for the students. The grading system is assigned per semester.

5. Continuous evaluation and assessment of the learning experience through weekly reports and a final project presentation to the company’s CEO.

The 5th component closest the educational model; the groups prepare a professional presentation to the company Board of Directors in some cases depending on the preferences of company’s administrators. Throughout this process, students will be exposed to situations in which they will experience interactions with persons from different backgrounds and levels of education; for
example students collaborate with blue and white-collar workers, not necessarily possessing college degrees but having valuable years of experience. These interactions provides the students with the opportunity to learn and work effectively with people that face and solve problem differently. This makes the student more sensitive to the importance of healthy relationships in the working environment to address work related issues effectively. In general, college experience by itself provides opportunities to work with a diverse populations. In the current project, populations are integrated by a combination of domestic and foreign students but also students from different parts of the country from different ethnic groups. This contributed to the development of cultural awareness among the students participating in the project.

Completing the educational cycle, cultural competencies are developed throughout the model components by exposing the students to interactions with industry personnel at several levels including staff engineers, technicians, and blue-collar operators with different cultural and ethnical backgrounds. The whole experience ensures the development of the students’ ability to value diversity and to work effectively across cultures, while learning and practicing fundamental concepts of industrial engineering such us lean manufacturing, time studies, line balancing, quality control, and safety engineering in a real world scenario.

The literature reports similar successful experiences where academic institutions are getting prepared to face challenges of globalization by partnering with industry. It is expected that this partnership will help to produce global engineers that are broadly knowledgeable and culturally competent. So far this collaboration has been in place for two academic years resulting in eight students benefited from this partnership; currently three of them are permanent members of the engineering staff in one the industry partners. There is an increasing interest among IE students to be part of this program; currently twenty-four students are enrolled in the second cohort. This paper provides evidence of the main findings of this educational experience and it is expected that this model will be soon institutionalized as an apprenticeship program.

IV. Enhancing Self-Efficacy Beliefs

This proposal will provide a foundation of students’ self-efficacy beliefs through Field Work Integrated Learning (FWIL) environments. These environments have the ability to set the foundation of the students’ self-efficacy beliefs. Self-efficacy is defined as “the judgment of one’s capability to organize and execute the courses of action required to producing given attainments and that influences the choices, effort and persistence of human behavior but it varies in its level, strength and generality (Bandura, 1984). A much simpler definition is that self-efficacy is one’s personal belief about his or her capability to take action toward an attainment. Freudenberg et. al. (2010) reported that self-efficacy is an important measure of an individual's capacity to cope with learning and performing, whether at the university or at the work place regardless of whether this integration occurs in industry or whether it is real or simulated. He also reported that self-efficacy studies of first year universities students in Australia have identified self-efficacy either as a predictor of persistency and satisfaction with their studies and academic performance (Freudenberg, Brimble, MacDona, & English, 2012). This means that a lack of student self-efficacy can undermine student satisfaction, persistence with studies and academic performance. Bandura (1984) proposed that a person’s self-efficacy is not stagnant and can be develop through mastery experiences, modeling, social persuasion, and psychological states. In addition to its predictive properties, self-efficacy is also associated with improved work performance. In this connection, self-efficacy is partnered with behaviors such as
persistence in the face of uncertainty, the setting of higher goals and reduced levels of learned helplessness.

V. Conclusions and recommendations

This learning experiences facilitates the student’s integration of their academic work, hard or technical skills with real-world practice; the experience also has the potential increase the employability of the student because they are able to network inside the company and to establish good relationships with key employees acting as their mentors during the duration of the project. However, this is completely optional and is not considered part of the program.

The program benefits the students by adding value to their engineering education increasing their quality as future engineering graduates because this educative experience has the ability to provide meaningful industrial exposure in a multicultural and multilingual professional environment. Because of the fact that this educational model has a win-win approach, it is also valuable to mention that also the industry benefits from this collaboration by obtaining important information that has been documented by the student during the entire semester; also they receive the copy of the students’ final power point presentation and a hard copy of the final report. On the other hand, the students are able to develop practical engineering skills as well as soft skills such as communication, leadership and human-relations skills. On top of this the students received the opportunity to increase they awareness about cultural competency. Finally, it can be concluded that through experiential learning also faculty and engineers from industry are able to share expertise in formulating and solving engineering problems.
References


