Developing and Assessing Teamwork Skills in a Multi-disciplinary Course

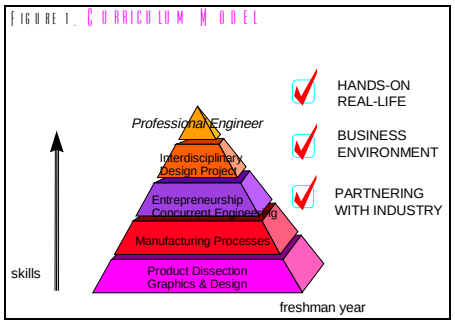
Lueny Morell de Ramírez, Jorge I. Vélez-Arocho, José L. Zayas-Castro, Miguel A. Torres
College of Engineering and College of Business Administration
University of Puerto Rico at Mayagüez
Mayagüez, Puerto Rico 00681-5000

ABSTRACT

*The **Learning Factory** is a new practice-based curriculum and physical facilities for product realization developed by the **Manufacturing Engineering Education Partnership**. The major goal of this curriculum is to provide an improved educational experience that emphasizes the interdependency of manufacturing and design in a business environment [8]. The educational objectives of this curriculum, i.e., the desired skills which we want our students to develop, were determined in conjunction with an Industry Advisory Board and represent their view of the skills and knowledge which are required of the practicing engineering professional. Among the skills developed in the students are design/synthesis, communication and teamwork. These skills have also been identified by the new ABET Criteria 2000 as of utmost importance (Criteria #3). The joint partnership **Technology Based Entrepreneurship**, is the course designed to nurture and develop teamwork and interpersonal proficiency. At UPR-Mayagüez, this multidisciplinary course is taken by engineering, science and business students, and are required to work in teams since day 1. The methodology to develop teaming skills in students as well as assessing student performance is presented.*

INTRODUCTION

In 1994 ***The Manufacturing Engineering Education Partnership (MEEP)*** was constituted. MEEP is a collaboration of three major universities with strong engineering programs (Penn State, University of Washington and University of Puerto Rico at Mayagüez), a government laboratory (Sandia), over 100 industrial partners, and the federal government (funds provided by TRP, Project # 3018, NSF Award #DMI-9413880.). The overall outcome of the project was the development at each of the partner institution of what we call the ***Learning Factory***, a new, practice-based curriculum and integrated physical facilities for product realization**.** The major goal of the program is to provide an improved educational experience that emphasizes the interdependency of manufacturing and design in a business environment, therefore, graduating better engineering professionals exhibiting the knowledge and skills needed to succeed in the highly competitive environment. The multi-disciplinary curriculum, shown graphically in Figure 1, is available as a minor or option at partner institutions. Desired knowledge and skills (which



include communication, teaming, business concerns and project management) are developed in the students include through a series of courses that were either created or re-engineered in strong collaboration with industry. The program developed by the three institutions with a grant from the Technology Reinvestment Program has been institutionalized and is currently offered as minors or options in all three for a year now.

The educational objectives set forth by the partnership, i.e., the desired skills which we want our students to develop include, among others, communication, teamwork, design/synthesis and project management. These skills - which need not only to be developed in the students but need to be measured - have also been identified by the new Accreditation Board for Engineering and Technology (ABET) in its new Criteria 2000 as of utmost importance (Criteria #3).

This paper presents the strategy used at the University of Puerto Rico to develop teamwork skills in one of the MEEP courses, ***Technology-Based Entrepreneurship***, a multidisciplinary course. It also presents the assessment tools used to evaluate the development of these skills.

IMPORTANCE OF TEAMWORK IN AN ORGANIZATION

Workgroups are the basic building block of any organization. To the extent that workgroups are effective, the organization as a whole prospers. The importance of developing teamwork skills in engineering students has been extensively documented in the literature [2, 7, 9, 14, 15,17]. It has been validated by industry itself and more recently by the Accreditation Board for Engineering and Technology (ABET) in its new Criteria 2000 requirements. The main value of teams for organizations is their ability to assemble and empower employees to use their talents to improve the organization [16]. On the other hand, too much cohesion has some undesirable consequences such as overconformity and group thinking. We recognize that in order to be creative, many organizations need more boat rocking, more mavericks, and less mutual admiration. Therefore, in order to develop teamwork skills in students effectively and efficiently the task has to be thoroughly planned and implemented. One also has to adequately assess the development of these skills in the student, in order to determine the success of the learning process and can thereon re-engineer the education process the assessment results, if necessary.

Development of teamwork skills in students was an important element in the MEEP course design. The template used for the courses' syllabi is represented below [10]:

Module	Content	Objectives	Skills	Learning Activities	Assessment Tools

Each course module developed not only had a list of the content to be covered in the course, but of the skills intended to be developed in the students, the learning activities that would accomplish these, and the assessment tools to be used.

NON-TECHNICAL SKILLS FOR TEAM MEMBERS

Some of the baseline non-technical skills for team members recommended in the literature [4,16] are building trust and teamwork, training and coaching other people, leading problem-solving sessions, using group interaction tools, planning, communication (e.g., active listening and getting your point across), and dealing with changes. Due to the importance of teamwork in industry, MEEP included the development of this skill in all of its courses. Therefore, the development of teaming skills in students taking the Technology Based Entrepreneurship course is of critical importance because it is expected that all coursework will be done by teams of students.

TECHNOLOGY-BASED ENTREPRENEURSHIP COURSE

The course ***Technology Based Entrepreneurship*** (***TBE)*** was developed by the MEEP partnership in conjunction with the College of Business Administration. It was designed for engineering, science and business students interested in learning about entrepreneurship from a technology and practice-based point of view, and serves as a key ingredient in experiential learning. The emphasis of the course is on innovation, creativity and communication, and teamwork skills. The course, which is aimed at the development of new products and/or processes, attempts to emulate as much as possible the working environment of a small to medium organization. Students are expected to identify a problem, provide alternative solutions, select the best solution, develop a prototype, and prepare a business plan for the proposed product. Average class size is about 30 students from Engineering and Business. Student expectations and course outcomes are discussed throughout the following sections.

EXPOSING STUDENTS TO TEAMWORK SKILLS EXPERIENCES

The TBE course is designed to expose students and faculty from the ground up to skills needed to work in interdisciplinary technical/business teams. This section describes some of the activities used by the faculty team to develop teaming skills in students.

First Day of Class: On the first day of class, students experience "culture shock" when they see not one, but five or six faculty members (teaching teaming by example) welcoming them and giving them their first orientation and instructions. "Shocks" of different kinds continue throughout the semester as the course develops and the students learn how the course is carried out.

Creation of teams and course rules: The students come from a wide variety of technical as well as non-technical disciplines including engineering, business administration and science. Early in the semester, the participating faculty collects academic information background and forms the students into five to six technically balanced interdisciplinary teams in what are called *Virtual Companies*. In team situations where a high degree of creativity and problem-solving ability is called for, a heterogeneous group is generally the most effective. The members of these virtual companies are selected on the basis of academic background only. This is sometimes confusing to the student who comes into the course expecting to form a team composed of her friends who are also taking the course. The strategies of choosing the

right mix of people and the right-size group are crucial to the success of the autonomous team. Each virtual company is asked to create a name and logo for itself. From then on, the students are treated not as individuals anymore but as a working team with their own team personality and individuality. This promotes pride among the teams.

Team Building: It is expected that each member of the team contributes his/her technical knowledge an skills to have a winning team. The final grade will have both an individual and a team component. During the first week of class, written material on team-building is handed out. In addition, students are given a seminar on organizational behavior and participate in a number of hands-on activities to expose the newly formed teams to situations that accelerate team cohesiveness, build trust and require teamwork. These activities are designed to give the team opportunities to experiment with the presented material on team building and organizational behavior, as well as to allow individuals to get to know one another. Among some of the activities presented in the course is a team survival exercise in which the group is presented with a hypothetical problem that puts the lives of all the team members at stake; survival depends on how well the group works together. Another activity involves taking the teams outside the classroom and exposing them to a number of problems which can only be solved by developing strategies that take into account the physical characteristics of the group members, e.g., crossing an imaginary river of lava using a limited numbers square wooden pieces. The strategies are to develop a norm of teamwork and to encourage cooperative behavior.

Formulation of a problem: Since student teams are interdisciplinary, they do not speak the same technical language or possess the same skills and perspectives. Therefore, they must learn to adapt their communication skills transmit technical/business information to other team members not familiar with their own field of study. Teamwork is fostered when group members pull together toward a common goal. One way of accomplishing this is to make "the task the boss". The underlying premise is that an agreed upon goal, rather than a leader per se, directs the team. Early in the course, the students are asked to formulate and solve an open-ended problem which is not discipline specfic. Later in the course they must develop a solution (e.g., prototype) to solve this problem.

Flexibility and dealing with change: In order to emulate the element of uncertainty encountered by today's corporations as they interact with clients and their environment, this course incorporates a concept we call *Integrated Syllabus Evolution*. The course begins with a basic structure proposed by the faculty in order to maintain the course perspective and to serve as a guide. As the course develops, students' backgrounds and needs demand that the structure be modified. That is, new concepts and activities are added to the basic course structure depending on the circumstances and problems encountered by the virtual companies. This flexibility requires the members of the team to follow through on commitments.

Building leadership: As the semester develops and the design management methodology used in the class unfolds, students of the different disciplines rise and fall as leaders of the corporate team depending on the situation they are working on at the time. For example, an electrical engineering student may be asked to solve a technical problem related to power consumption and battery selection on a proposed product. At that time, he/she is the leader of the group and assigns tasks to the other members. He/she becomes the authority to whom team members come with any questions or problems they may face in carrying out their assignments. Later, when a marketing strategy needs to be developed to sell the company's product, a marketing student will become the leader and assign the necessary tasks. In order to build leadership successfully the teams have to promote pride, respect and accept the informal leaders, encourage and provide emotional support, practice equality and practice equality. At the end of the course, it is expected that the electrical engineering student and the marketing student will have developed not only a better understanding of one another's field of study, but an appreciation for one another's expertise and an idea of how his or her own discipline fits into a real-world corporate environment. At this stage, in order to be successful, teams have to reach out for isolated individuals in the team.

Problem solving: As the course progresses, each virtual company identifies a market niche and, following the design management methodology given focuses on generating and selecting a creative solution. This solution must be technically and economically feasible. But above all, it must satisfy the needs of the customer. The participating faculty believes in the concept of learning by failure, i.e., failure is not penalized as long as the student shows that he has learned from his failure.

Secure resources: The technical expertise of over 10 faculty members is available throughout the semester to answer questions and to coach the virtual companies. This coaching occurs during class since the syllabus includes many sessions of consulting with faculty members. During the semester, periods of classes are used as consulting periods. Student teams consult with the team of faculty their technical and managerial difficulties. One

key component of these meetings is revising how student teams are progressing. The faculty team makes special emphasis in keeping the communication channels open with the student team through early intervention in these problems.

Communicate: As part of the outcomes of the course, each virtual company must prepare a business plan and make a presentation of its proposed product to the other virtual companies and to the team of faculty. A mock-up and/or prototype of each proposed product is required as well. The virtual companies also participate in a project showcase where they present their outcomes to a wider community (other students and faculty and industrial partners). During this activity, all students and faculty on campus have the opportunity to see the products proposed by the virtual companies and give feedback. The virtual companies use this opportunity to gather information about customer expectation and satisfaction, as well as to practice oral and graphical communication. One of the best-known ways to encourage teamwork is to rally the support of the group against a real or imagined threat from outside. The faculty encourages competition with other groups. During the semester and especially during the showcase there is strong competition to be the best team and be recognized by the faculty as the benchmark.

ASSESSING TEAMWORK SKILLS

Assessing the development of teamwork skills is not an easy task. Alverno College, who has a long history in outcomes based education, recommends, among other things, the use of videotapes in addition to a customized tool to assess social interaction and teaming skills in students [1]. Cross and Angelo [3] recommend custom-made assessment tools to evaluate course-related interest and skills checklist.

MEEP developed a series of custom-made project outcomes assessment tools to inform the project's stakeholders (students, faculty, industry, & NSF) about the project's outcomes [11,12]. These included student learning outcomes. This section will describe the tools used to evaluate teamwork skills development in the students both at the classroom level as well as the general outcomes of the program [13]. These forms appear in the Appendix.

Teamwork Experience Student Self-assessment Tool: This form was designed to determine how student teams were working as a team and making decisions in a specific task: product design. The purpose of the tool is to determine if the students are working well in teams, and if there is a need to stress teamwork skills. Students were asked to list in chronological order the steps they went through during the design phase. They had to describe the following:

- process of decision-making
- their perception as to what facilitated the decision-making process, and
- individual contribution to the team.

They were also asked to write down what they would like to do different the next time when they had to undergo the same situation.

Surveys (student, faculty, industry): MEEP developed four surveys, which intended to evaluate if the project's goals and objectives were met. These included curriculum goals such as development of communication and teamwork skills. Copy of the industry and student surveys are included in the Appendix.

Student Teamwork Performance Assessment: Students have an opportunity of evaluating each other's efforts by means of a peer evaluation form. Students rank each other's efforts as excellent, did his/her share, had to force him/her to work, or did not work. Faculty would then average the students' perceptions and give feedback to them.

Course Evaluation and Assessment of Skills and Knowledge: A final evaluation of the course was performed by means of a custom-made tool, which template appears in the Appendix. Both students and faculty completed the form. Perception as to the student mastery of skills and experiences developed in the course was recorded, as well as the effectiveness and efficiency of each of the lectures. In addition, the respondents were asked to judge the course logistics (number of meetings and lectures, kinds of assessment techniques, learning activities, etc.). This document provided important information to re-design the course in its content and learning strategies used.

Other Assessment Strategies: As previously mentioned, TBE incorporates a series of sessions where teams consult faculty. It is very interesting that once the course is in "full gear" the sessions also become "assessment interaction sessions". This occurs in a two-direction mode: faculty qualitatively the progress of teams and the teams themselves also assess their progress in the course in terms of activities and time schedule. This has led to incorporate new topics and professors, re-structure others, and even avoid a faculty member as a resource in the future.

ASSESSMENT RESULTS

Numerous assessments are carried out throughout the semester using the tools presented in this paper. Formative assessment results are used to provide feedback to faculty in addressing issues of the course. For example, results from the Teamwork Experience Self-assessment tool have prompted the faculty to discuss how to conduct efficient team meetings. But perhaps the most significant assessment results are those generated by surveys completed by all stakeholders (students, faculty, other institutions and industry). Table 1 shows some of the stakeholders' perceptions associated to the goals and objectives of the MEEP project (which included the TBE course).

Table 1. Survey Responses to MEEP courses and the Learning Factory (181 survey responses)

Goal	Assessment (strongly agreed or agreed by) (14 faculty, 122 students, 42 industry, 3 other)
Real life problems provided.	100% of industrial partners and 100% of faculty
Communication skills emphasized.	89% of industrial partners, 71% of faculty and 80% of students
Teamwork skills emphasized.	93% of industrial partners, 93%, of faculty and 97% of students
Quality of the program is superior to other typical courses at their institutions.	72% of faculty
LF is well equipped to give students real life experiences in state-of-the-art processes.	71% of faculty
Program allowed them to practice engineering science fundamentals in the solution of real life problems.	88% of students
MEEP courses are more fun than typical engineering courses.	82% of students
Have a better understanding of engineering, and feel more confident in solving real life problems.	78% of students
More confident in their ability to teach themselves.	80% of students
Active learning activities were extensively used.	82% of students

Ninety five percent (95%) of the industrial partners surveyed (a 42% response) believed that they would more likely hire MEEP students than regular students, and 79% thought that MEEP students would be more useful to their respective industries. Some of the comments made by industry were as follows:

- *"(this program) helps students bridge academic and professional careers... more mature and better prepared students."*
- *"MEEP provides education beyond the books and the labs."*
- *".... real day to day engineering, teaching the student how to apply what they have learned in the compressed time frame of real industry."*
- *"All students should be involved."*
- *"... tremendous impact on engineering education (engineering skills and teamwork), plus many side benefits (communication skills, visibility with companies/students)."*
- *"This should be leading formal and informal education... a win-win relation..."*

After offering for 6 semester at UPRM, the average grade for the instructors is over 85%.

LESSONS LEARNED

In developing and assessing teamwork skills in this multi-disciplinary course the faculty team has learned the following:

1. Development and assessment of teamwork skills needs to be carefully planned.
2. In regards to the development of team skills, form teams early on in the course and always treat students as a team. Teach students the basics of teaming with hands on activities. Clearly specify the course and team working rules. Be flexible, recognizing that composition of teams may alter the course structure and sequence. Rotate students roles in teams, allowing leadership and followers skills to develop.
3. Regarding the assessment of teamwork skills, incorporate specific assessment tools to evaluate student performance and provide continuous feedback. Use multiple tools to evaluate performance, modes (self and external assessments) and involve all stakeholders.
4. Be a role model! Faculty teams must set an example of teaming.

This paper shows the strategy designed to develop and continuously assess an interdisciplinary team-based course, Technology Based Entrepreneurship. Furthermore, it clearly addresses important aspects related to how a course may effectively integrate internal and external criteria in its design and assessment strategies. We strongly believe that is a good example of a team learned - team taught experience, which emphasizes practice-based learning-teaching and becomes part of experiential learning portfolio of students.

FUTURE RESEARCH

The authors recognize the need to consider the following research issues in the future:

1. Compare shared leadership (both fculty and students) with traditional classroom settings/environments.
2. TBE success stories, i.e., has the course fostered "incorporation" of alumni.

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APPENDIX – PAPER 1138

University of Puerto Rico
Mayagüez Campus
ADMI 3100 - TECHNOLOGY BASED ENTREPRENEURSHIP

TEAMWORK EXPERIENCES ASSESSMENT FORM

Please answer the following questions regarding your work as a team for the completion of the required task.

TASK(S): PRODUCT DESIGN, DECISION-MAKING

1. In chronological order, list what your team did during the design phase. Explain how tasks were distributed, how decisions were made.

2. What facilitated the decision-making process?

3. What was your contribution to the team when decisions had to be taken?

4. What do you think you would like to do differently the next time when working in a team?

NAME_____TEAM_____

University of Puerto Rico
Mayagüez Campus
ADMI 3100 – TECHNOLOGY BASED ENTREPRENEURSHIP

PEER EVALUATION FORM

Name of the Company: _____

Team _____ Date _____

Evaluator (VOLUNTARY) _____

Please describe the effort of your peers so far.

Use the following code for evaluation:

3 Excellent job
2 Did his/her share
1 We had to force him/her to work
0 Did not work at all

Write the name of your team members in the table below and evaluate them.

Student Name	**Evaluation (From 0 to 3)**	**Evaluation (From 0 to 100%)**

Comments:

Manufacturing Engineering Education Partnership
MEEP
INDUSTRY SURVEY

The Learning Factory is a new practice based curriculum and physical facilities for product realization that has been developed at three institutions: Penn State, the University of Washington, the University of Puerto Rico at Mayagüez in collaboration with Sandia National Labs. Its goal is to provide an improved educational experience that emphasizes the interdependency of manufacturing and design in a business environment. The key element in this approach is active learning - the combination of curriculum revitalization with coordinated opportunities for application and hands on experience.

This questionnaire has been designed to assess the performance and products of this program. Please answer it to the best of your knowledge.

Name:
_____

Company:
_____

Partner University:
[ ] UPR-M [ ] PSU [ ] UW [ ] Other_____

Your Involvement with the program:
[ ] Member of Industrial Partner Board [ ] Expert in the classroom [ ] Involved with students projects
[ ] Other_____

Instructions:

The following items reflect some of the ways in which the Manufacturing Engineering Partnership (MEEP) can be described. Please fill in the numbered circle which indicates THE DEGREE TO WHICH YOU AGREE that each item is descriptive of the experiences you were exposed to and provided by the program. If you have no information or feel an item does not apply, please fill in the N/A circle.

The program allowed students to practice engineering science fundamentals in the solution of real problems.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Professional communications skills were enhanced.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Team work skills were enhanced.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The partner schools learned from each other's experience.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Resources and ideas were shared, avoiding redundant efforts.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Real life problems were provided.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

New technologies for communication were utilized on curriculum content.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The local Industrial Advisory Board (IAB) provided quality strategic and operation guidance to the local institution.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The local IAB supported MEEP's activities providing financial and/or non financial resources.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

There was good communication between industrial sponsors and the institution.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Each institution provided the IAB the right information in a timely fashion.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The MEEP's Industrial Advisory Board (IAB) evaluated the overall progress of the program.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The partnership reported progress and activities related to participation in curriculum development.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The MEEP's IAB provided support in actions/activities that are relevant to the program.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The partnership reported progress and activities related to participation in the classroom teaching.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Students completing the MEEP program are more useful to our industry.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

My Industry and company is more likely to hire a MEEP trained student than a traditionally trained student.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Would you encourage other companies to participate in the program and coalition? Why?
_____

What can be improved with MEEP?
_____

Comments:
_____

Manufacturing Engineering Education Partnership
MEEP
STUDENT SURVEY

The Learning Factory is a new practice based curriculum and physical facilities for product realization. Its goal is to provide an improved educational experience that emphasizes the interdependency of Manufacturing and design in a business environment. The key element in this approach is active learning - the combination of curriculum revitalization with coordinated opportunities for application and hands on experience.

University:
[ ] UPR-M [ ] PSU [ ] UW [ ] Other_____

Major:
[ ] Mechanical Eng. [ ] Chemical Eng. [ ] Industrial Eng.
[ ] Other_____

[ ] Graduate student [ ] Undergraduate student

Involvement with MEEP:
[ ] Taken 1 course [ ] Taken more than 1 course [ ] Research Assistant
[ ] Other_____

The program courses at your institution were offered as: (Check all that apply)
[ ] as part of a minor [ ] as electives [ ] as part of a degree option [ ] required for the major
[ ] Other_____

The courses were:
[ ] interdisciplinary [ ] engineering students only [ ] students from only one department

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Instructions:

The following items reflect some of the ways in which the Manufacturing Engineering Partnership (MEEP) can be described. Please fill in the checkbox which indicates THE DEGREE TO WHICH YOU AGREE that each item is descriptive of the experiences you were exposed to and provided by the program. If you have no information or feel an item does not apply, please fill in the N/A checkbox.

The program allowed you to practice engineering science fundamentals in the solution of real problems.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Professional communications skills were emphasized.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Team work skills were emphasized.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Case studies were extensively used in the courses.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Active learning activities were extensively used in the courses.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Computer technologies were extensively used in the classroom.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Hands-on engineering experiences were extensively used in the classroom.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The courses were set in an industrial like setting.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The MEEP courses you took had more design/manufacturing content than other similar courses at your institution.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The Learning Factory (LF) provided you with a fully integrated activity center for the creation and implementation of products and processes.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The LF facility was well equipped to give me real life experience in "state of the art" processes.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The LF facility was professionally staffed to allow me to experiences the product/process realizations.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

I feel that my participation in the MEEP Program has improved my career opportunities.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

I learn better from classroom lecture then hands-on laboratory experience.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The MEEP courses provided more to my professional development than typical courses.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

My MEEP course(s) were more fun than my typical engineering courses.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Because of the MEEP courses, I have a much better understanding of what engineering is.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

As a result of this course, I am more confident in my ability to solve real-life problems.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

As a result of this course, I feel more confident in my abilities to process information, and teach myself new things, without the aid of an instructor.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The MEEP instructors were superior to my typical university instructors.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

COMMENTS:

MANUFACTURING ENGINEERING EDUCATION PARTNERSHIP
MEEP
University of Puerto Rico
Mayagüez Campus

COURSE EVALUATION
And
ASSESSMENT OF SKILLS and KNOWLEDGE

Course: _____
Instructor:_____

The purpose of this assessment is:

- to determine your perception of mastery/level of knowledge and skills developed by the students in this course, and
- to establish the effectiveness of lectures and experiences, as well as of the logistics used.

The results of this assessment will help the instructor in charge of the course to better plan and adjust the course's agenda in the future.

PART I: GENERAL OBJECTIVES AND SKILLS

Directions:
Using the scale below, please evaluate (*) your perception of the mastery of skills and experience the students developed in this course in the areas specified.

N: no skills/no experience
R: rudimentary skills/very little experience
F: functionally adequate skills/some experience
A: advance skill/extensive experience

area	*
skill 1	
skill 2	
objective 1	
objective 2	

PART II: CONTENT, LECTURES AND EXPERIENCES

Directions:
In this part, please indicate (*) your perception of the lectures and activities' effectiveness, using the following scale:

0: not effective; would eliminate
1: moderately effective; significant changes (specify)
2: effective; minor changes (specify)
3: very effective; would not change

module/lectures	*	comments
Module 1: TITLE		
Module 2: TITLE		
Module n: TITLE		

PART III: COURSE LOGISTICS

Directions:
Please indicate (*) how you feel regarding the various aspects designed for the course, using the following scale:

0: inadequate; disliked, needs re-engineering!
1: somewhat adequate; needs enhancement
2: adequate; minor changes
3: adequate; no change

area	*	comments
Number of meetings		
Kinds of assessment techniques		
Requirements		
Number of lectures		
Number of plant trips		
Topics covered		
Course coordination		
Other:		

Would you recommend this course to other students? Explain.

Do you think your expectations were met?
YES/NO. Explain.

Suggestions:

Your overall rating of the course: _____/10.

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