

## Novel Industry Engagement approaches for academic projects leading to internships, placements, and entrepreneurship

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### Abstract:

A popular pedagogical approach in engineering education that has been proven to be successful in building problem-solving, design, and collaborative abilities is project-based learning. Giving students freedom to choose the type and scope of the projects they want to work on has apparent advantages but doing so without professional advice or a defined plan of action can lead to confusion, frustration, and unmet expectations. Additionally, engineering schools must give their students the chance to interact with industry during their studies, which can be challenging owing to logistical and time constraints. This paper describes a case study in which undergraduate computer science and computer engineering students met with business professionals to get feedback during the last stage of project implementation. Students presented their concepts to faculty members and industry guests on campus in the form of a project poster. The success of the strategy in raising students' self-efficacy and performance is attested to by internships, employability, and evaluation results, as well as by the satisfaction of the participants. The proposed research continues with suggestions for engineering educators who want to put similar initiatives into practice as well as a brief description of the authors' future goals.

**Keywords:** *Employability; Academic Projects; Industry; Innovative practice*

### Introduction

Activities that involve industry participation are utilized as supplemental material to show students how what they learn in class is used in real-world contexts. Numerous industry interaction initiatives have been studied to see what lessons students learn from them or how they affect them. All of the research's activities have a favorable effect on students' learning, according to earlier research (Rodrigues, 2004; Patil et al., 2012; Schambach & Dirks, 2002; Perkmann, 2007; Smith et al., 2009). There hasn't been much research done to compare activities to discover if pupils learn more from one than another. This

research compares the five activities: internships, industry visits, industry focused final projects, professional organization involvement, guest lectures, and learning about a potential employer. It also defines

aspects of learning: (a) skills used or applied, (b) workplace culture, (c) pursuing a career in the field, and (d) learning about a potential employer. This will give professors a way to gauge the kind of industry involvement initiatives they can incorporate into their lessons. Companies employ the continuous improvement principles of lean manufacturing, six sigma, and lean six sigma to cut down on processes and system waste (Jones, Smith, & Callahan, 2010; Bhuiyan & Baghel, 2005; Todorova & Dugger, 2015). Utilizing tools for continuous improvement will enable the utilization of classroom instruction and more productive industry involvement initiatives.

One of the main objectives of higher education is to produce graduates who are prepared for the workforce and who have both the specialized and general abilities required to function well in business and the workplace. This is especially true for professional subjects like engineering. Over the past 20 years, there has been an increased emphasis on facilitating authentic learning experiences and activities that are relevant to the difficulties that students will face in their future employment. However, current methods of "authentic" learning, including many that rely on technologically assisted tools and environments, frequently involve artificially constructed learning tasks that lead to predetermined outcomes set by the professor; they are in no way a reflection of the complexity and richness of the real world. It is debatable if utilizing outside resources and expertise outside of the classroom is necessary to produce truly authentic learning. In order for learning to be personally meaningful and relevant to students, they must be given the freedom to chart their own trajectories and exercise agency in choosing the contexts and methods for learning.

When evaluating the success of industry engagement, ongoing improvement should be taken into account.

Industries have long used methods for continuous improvement to streamline processes and save costs (Callahan, Jones, & Smith, 2008; Bessant & Caffyn, 1997).

For students to engage in open-ended, self-determined learning while developing a variety of skills and talents that are crucial to the field, project-based learning is a popular pedagogical approach in engineering education. In a project-based computer engineering course at Middle East College, authenticity and industrial relevance were tried, as is detailed in this essay. Students presented their final projects to industry guests individually (for bachelor's degrees) or collectively (for diplomas) during a FORUM 50-50 event that was created in the style of a project poster presentation in order to get feedback and constructive criticism. The activity took place on campus, where all students can view and benefit from one another's efforts. Through the activity, students gained valuable practice in expressing their ideas in front of an academic panel of judges at the university in order to rank their posters and be nominated for best poster awards. They also received expert insight and perspectives on their ideas from an industry audience during the "Talent meets Industry" event in fall 2021 and FORUM 50-50 held in Spring 2022.

### Research Objectives

This study's main objective was to evaluate how industry involvement affected technology students' learning and how it can lead to internships, placements, and entrepreneurship. By giving teachers a way to gauge the effectiveness of the various activities, teachers will be able to include the ones that are most closely related to student learning. Finding student improvements from activities including industry interaction was the goal of the study.

### Similar Studies

#### Project-Based Learning and Student Self-Direction in Engineering Education:

The definition of project-based learning is learning gained through team projects (Thomas, 2000). Thomas (2000) offered the five criteria listed below for creating these kinds of activities. First, projects should be integrated into the curriculum and should be based on the material that the students are learning in the class. Second, these assignments ought to encourage students to learn course-related concepts. Third, there should be constructive exploration associated with project-based learning activities. To offer the students ownership over

the project, the projects should be student-driven. Finally, projects need to have a practical application. To promote student-centered and self-directed learning, engineering schools and instructors use a range of strategies, some of which include problem-based learning, challenge-based learning, inquiry-based learning, team-based learning, and project-based learning. Students learn inductively by seeking answers to questions, exploring various viewpoints on a subject, formulating and testing hypotheses, or solving problems, which mirrors how knowledge and expertise are acquired in real-world settings. A key component of these methods is their open-endedness and emphasis on student independence and inquiry. This contrasts with conventional engineering education methodologies where students are first taught concepts and ideas before being permitted to apply them. student engagement is student involvement with an in-class or out-of-class learning activity (Trowler, 2010).

Particularly in engineering education, where stories of its application abound in the literature, project-based learning has grown immensely in popularity. In project-based learning, students frequently collaborate in teams to organize and complete assignments that demonstrate their understanding. The majority of engineering schools have converted one or more of their conventional lecture-based courses to a project based format, and some have even done so for whole course sequences or programs. The development of general skills and dispositions necessary for success in 21st-century society, such as entrepreneurship, critical thinking, teamwork, and digital literacy, is among the broad advantages listed. They include active involvement of learners, increased motivation and satisfaction, leading to improved academic performance, achievement of educational objectives beyond those prescribed by the curriculum, preparation of students for employment, and achievement of educational objectives beyond those prescribed by the curriculum. However, project-based learning is particularly effective in developing the design and design-thinking abilities that are at the core of an engineer's job. Because of this, engineering schools now frequently include a project-based capstone design course that is required. This course requires students to apply what they have learned throughout the degree to design and construct a product of their choosing.

The creation of a product or performance, typically across one or more semesters, is what sets project based learning apart from related approaches like problem-

based learning. Additionally, project-based learning frequently integrates multiple disciplines and topic areas. Importantly, project-based learning comprises totally realistic, student-driven projects completed in real-world environments, in contrast to problem-based learning, which is frequently organized around hypothetical scenarios or case studies. In addition to accommodating students' varied interests, the absence of an imposed structure and strict guidelines regarding what must be produced can teach pupils how to create their own goals and then self-regulate their progress toward those goals. Despite these advantages, completely open-ended problems or projects whose scope, deliverables, and other parameters are student-determined are not without risks and traps; in fact, such minimally guided or unguided instructional approaches have come under harsh criticism from renowned educational scholars. Students may become extremely frustrated by a lack of guidance and scaffolding, especially at the beginning of a problem- or project-based learning intervention, which may result in demotivation and even failure. Therefore, a significant issue in project based engineering education is to help students define a clear vision and purpose for their projects at the outset while still giving them the freedom to choose the course of action. Even if it is not intended to be commands, kids may view any instructor input as such, therefore it may be preferable to look outside of the classroom for the necessary assistance.

#### **Industry Engagement in Project-Based Courses:**

Universities are realizing that it is crucial to include the broader community in their curricular, instructional, and assessment practices in an era where the value of textbooks and prescribed content in higher education is being questioned and where the teacher and academic institution are no longer seen as the sole authorities on knowledge. Industry professionals and their organizations are widely sought after in the engineering field for advice on program design and evaluation, to give outside representation on advisory boards to meet accreditation criteria, and to provide internships and career placements for students.

However, creating opportunities for these industry professionals to interact with students directly to improve and add authenticity to their learning is more difficult. In addition to the guest lectures, there is much to be gained from having business professionals contact with students directly during the course, for instance by acting as supervisors of their work. Alumni who desire to support

their alma mater are frequently especially motivated to make these contributions by providing interactions through guest lectures. Such interactions with business professionals can aid students in a number of ways, including helping them get ready for the transition into graduate employment, develop a sense of community within the industry, create relationships and networks, and provide motivation, context, and relevance for the theory they are learning.

According to d'Este and Perkmann (2011), student industry interaction benefits not only the students but also the educational institutions and businesses that take part in the engagement activities. Educational institutions have the opportunity to get feedback on their academic programs and any adjustments that may be made to make them better. The institution is informed about skills or information that can be included into future program curricula and courses through student intern and industry feedback (Schambach & Dirks, 2002).

Project-based courses provide an ideal environment for student-industry interaction. The focus of design projects for students—which they frequently complete in conjunction with industry field placements—often centers on creating solutions for partners and clients in business ( Live projects ). However, scheduling for students to spend time in industry can be logistically challenging while they are still fully engaged in their academic work, which tends to be the case in all except the final semesters of their degree program. The necessity to go to campus can make it difficult for professionals in industry to spend much time talking to students while they are on the job, especially during working hours. On-campus involvement is merely out of the question for individuals who reside elsewhere in the state or nation, or who are abroad. Fortunately, there are currently a variety of rich-media synchronous collaboration solutions that may be utilized to solve this issue by enabling remote participation, enabling business professionals and students to interact with one another in real time regardless of their location.

Active learning approaches were developed by Dewey (1997) to increase student involvement in the learning process. (Rodrigues, 2004) offered a variety of active learning strategies, including case studies, individual research projects, group projects, and classroom discussions. Active learning techniques employ students' past knowledge to acquire the abilities needed to solve

challenges. Peer conversations and cooperative learning experiences are examples of active learning activities (Braxton et al., 2000). Students who are doing their Diploma projects at middle east college work in a small group of three to four students. Students also use active tactics to collaborate in small groups to solve an issue (Hwang et al., 2005). Active learning is characterized by Braxton, Milem, and Sullivan (2000) as activities that demand students to complete a task, like solving a problem, and then to reflect on that work.

Due to the experience and information acquired via each engagement activity, the examined literature makes a compelling case for the importance of industry interaction to student learning. With a few exceptions, including those by Rodrigues (2004) and Spicer and Stratford (2001), many earlier studies concentrated on reviewing a single activity as opposed to a number of activities. Other studies have examined a specific activity that falls under the umbrella of student industry involvement, with an emphasis on what students learnt from the activity, how they learned it, and if the activity was successful at enhancing student learning.

Internships benefitted the students in gaining real time experience for the future. According to Cates and Jones (1999), transfer of knowledge or learning during cooperative activities occurs when students take previous knowledge and implement new ideas. Schamback and Dirks (2002) suggested that students can reinforce their previous educational coursework during a cooperative or internship experience. Students can observe workers while on the tour to learn about new technology in the sector and the skills that are employed and can be applied in the job (Townsend & Urbanic, 2013).

Boaler (1997) found that students who received project-based learning instruction were able to comprehend the significance of subjects for upcoming experiences. According to Grossman's (2002) research, projects give students the chance to collect, organize, model, and present data from a technical investigation.

### **Background, Context, and Motivation**

#### **Project Module:**

Project Design and Implementation (PROJ 0004, PROJN 30002.1, PROJS 3002.1) is a project module offered by the department of computing, Middle East College. The aim of the module is to provide students, working individually, with the experience of undertaking a significant product development exercise, from target specification through to product launch. The module is a major individual study

at honor's level in a topic specifically related to the program on which the student is enrolled. It serves as the main vehicle for integrating the modules on the student's program and provides a focus for practical application of the program material. It provides skills and experience in formulating and completing an individual project in the area of specialization. Students learn to adhere to the project work plan, design and develop a solution, test, implement and collect feedback and document it. The module enables the student in understanding and responding to the requirements of real time environments.

During the first three week of the Project module, student explores various ideas and discusses with the respective supervisor. Once they both agree to a topic, student has to submit the initial idea and some basic details as a Project Initiation report (PIR). This PIR gets approved by a departmental committee, looking at the complexity level and currency of the topic selected. Once projects are approved, the students work to design, build, and implement the product over the remainder of the year. The project activities are also supplemented by lectures on topics such as project management concepts and tools, social and ethical considerations, methodology, Literature review, feasibility study etc. Students are expected to apply the knowledge gained from those lectures, from previous year courses, and from their own independent learning as they proceed through each phase of the Product Design Cycle. A good number of guest lectures are also conducted, where experts from industry are invited to share their knowledge with the students. During the end of the year, before the final presentation, the projects are showcased in the form of a project poster, where they get feedback from the staff members for further and final improvement.

#### **Project workshops:**

Students do project as part of their diploma and bachelor exit, these projects are very important as it is culmination of their study, and they use all the skills and knowledge attained throughout the program to come with solutions to real world problems. To provide students with all the skills required and to complete their project, department of computing, middle east college, organizes various workshops every semester for project students. The schedule/calendar of these workshops are shared with project students in the beginning of semester. These workshops provide the latest skills that may or may not be covered as part of the student course of study (table 1 & figure 1). We at the department know the importance of

students working on providing solutions for real life problems, addressing social issues, and converting their project in a business venture. Therefore, as part of project workshops, every semester we organise project souq, where students get to know about importance of working on real life problems (live projects) and addressing social issues (community projects) and what projects they can choose to work on. Over semesters we have improved the way we deliver these project workshops, due to pandemic situation of COVID 19 we switched to use MS Teams to deliver project workshops (Synchronous mode) and we recorded each project workshop for students' future reference (asynchronous). The reason for dip in number of project workshop in Fall 21 and Spring 22 is because we used MS Team recordings for some of our workshop and made it available for students in these semesters.

Semester	Project Workshops
Fall 19	31
Spring 20	45
Fall 20	49
Spring 21	48
Fall 21	42
Spring 22	25

Table 1 – Project Workshops



Figure 1- Project Workshops

**Live and Community Projects:** As part of project work students should work on providing solution for the real-world problems and problems faced by the community/society. Working on solutions for these types of problems will not only enhance employability aspects for our students but also give students an opportunity to be self-employed. In graduation project

students are encouraged to provide solutions for these real-world problems/problems that relates to community/society. Most of the academic project's students do (Diploma or Bachelor) are either live or are community based. As can be seen in table 2 & figure 2 majority of the diploma projects are either live or community oriented, also many of bachelor projects are either live or community table 3 & figure 3.

Semester	Total Projects	Live Project	Community Project
Spring 20	20	10	6
Fall 20	31	17	11
Spring 21	42	21	18
Fall 21	23	21	2
Spring 22	26	12	14

Table 2 – Diploma Project Live/Community

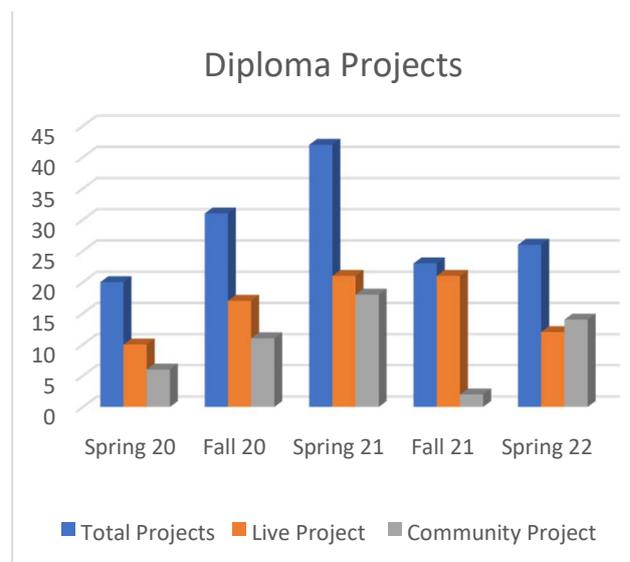


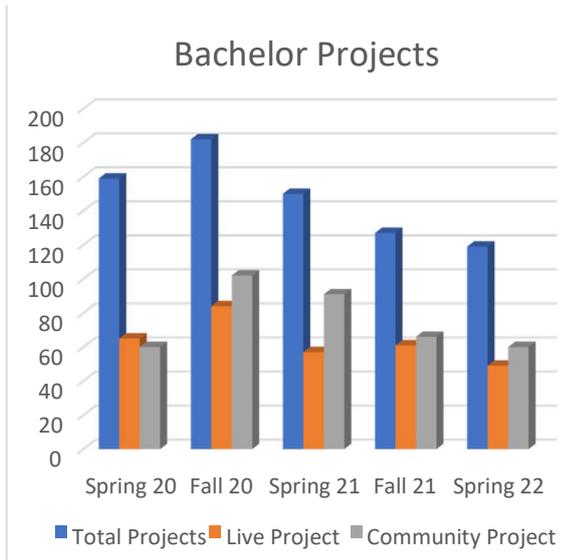
Figure 2

Semester	Total Projects	Live Project	Community Project
Spring 20	159	65	60
Fall 20	182	84	102
Spring 21	150	57	91
Fall 21	127	61	66
Spring 22	119	49	60

Table 3 – Bachelor’s Project Live/Community

Figure 3

With the motivation from staff and support from



department, more and more students work on the either Live project or community-based project. Live project helps them to identify the problems being faced by an organization in real world, and work with them to study and implement the solution. Community project enables students to think beyond and go to the society and find a solution to a problem in and around the society for example a school / hospital or any other relevant issues in society which can be solved using solutions from computer engineering or computer systems.

The efforts from the department staff are clearly visible in the statistics given in figure 2 and figure 3. The numbers are increasing for Live and Community projects and students are motivated to work on the real- life projects.

### Novel Approach

**Talent Meets Industry:** Starting from semester Fall 2021, the initiative was taken from department to invite more industry guests during the poster event to increase the interaction between students and industry. Students were brought together with experts from industry in an on-campus event where the students pitch their ideas and solicit feedback from the experts. In the interest of increasing participation and involvement of the students,

students are given best poster certificate awards and certificate.

**Project Forum 50-50:** During the department “FORUM 50-50” event organised in Spring 2022 semester, industry experts interacted with the students and given them the valuable inputs on improving the projects. Representatives from GLOITT really liked project work of some of our students and they provided internship/placement for 5 students. Around 50 external guests were invited to be part of the activity, with ten accepting the invitation and some declining due to prior commitments but noting a desire to participate in future iterations. Of the ten guests who accepted, some of them were alumni working in industry who themselves had undertaken the course in the past and the others were invited from the department’s professional networks.

**Oman Broadband Project showcase:** As part of departments initiative to showcase the best projects to the industry, the industry representatives from Oman broadband agreed to have a session with some of our project students. They want to see those projects where students have developed applications with innovative solutions. Each student was given 10 minutes to demonstrate their application. Around 10 students completed the training from Oman broadband.

### Improvements planned for future

With the success of “Talent meets Industry” event in Fall 2021 and “FORUM 50-50” event in Spring 2022, these kinds of interactions help and support the students in developing the skills needed for employability and entrepreneurship. We would like to continue having these kinds of interaction in some form or the other.

In coming semesters we would like to ensure more and more industry partners/representatives are invited to the campus and facilitate the interaction between students and industry on a regular basis. One way is to promote this event as a campus placement event, providing more opportunities for the students as well as industry in terms of finding suitable candidates for the job.

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