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INdustry Sponsored Projects InspiRing Engineering Success (INSPIRES): Designing an Experiential Learning Course for Second-Year Students (Work in Progress)

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INdustry Sponsored Projects InspiRing Engineering Success (INSPIRES) - Designing an Experiential Learning Course for Second-Year Students: A Work in Progress

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Abstract

INSPIRES is a multidisciplinary experiential learning course, delivered in Fall 2024 to target second-year students. This two-credit hour course was a modified version of a course offered in the past and designed to provide an introductory framework to guide student teams through project planning, management, and successful completion of real-world engineering challenges. Throughout the course, students integrated previous knowledge to complete engineering analysis; practiced elements of the engineering design process; developed and implement project plans; and practiced professional skills, such as working on teams and communicating technical outcomes effectively. Industry mentors/clients were recruited and provided topics for teams that resulted in three industry sponsored projects, one startup based, and one student organization project. An online platform (EduSourced) was implemented for external mentors, in addition to the university blackboard system (Canvas) for internal use to grade assignments and monitor progress. Students were assigned teams via project bidding through EduSourced and were selected for projects based upon their project bidding interest, availability, and other major demographics. An outline and description of course activities will be presented with individual team project results. In addition, the implementation of the EduSourced educational software for use by external mentors/clients will be discussed.

Introduction

In Fall 2024, an experiential learning course was created to provide students with opportunities to work on industry sponsored, multidisciplinary team projects that addressed real-world engineering challenges. The course entitled, "INdustry Sponsored Projects InspiRing Engineering Success (INSPIRES)" was based upon a previous offering from 2018within Texas A&M University's College of Engineering (COE) targeting juniors and seniors. The curriculum was purposefully designed to include experiential learning criteria [1, 2, 3, 4] as well as metacognitive educational strategies [5, 6, 7, 8, 9] that have been long proven to offer enhanced academic experiences for undergraduate engineering students. This course targeted second-year students, offering a semi-rigorous, two (2) credit-hour course to prepare students for upper-division coursework and industry internships. Often, in engineering education, second-year students aren't deliberately targeted and are vulnerable to falling through retention gaps [10, 11 12, 13, 14, 15]. Therefore, targeting second-year students for INSPIRES was important to introduce underclass students to upper-academic and professional workforce expectations.

Throughout the course, students were required to integrate knowledge from previous courses to engage in engineering analysis, learn and practice elements of the engineering design process, develop and implement project plans, and practice professional skills such as working on teams, project management, and communicating technical outcomes effectively. As a pilot project,

student recruitment consisted of an initial email sent to poll students still listed as first-year students during the Spring 2024 semester. From the initial email, approximately thirty-nine (39) students responded they would be interested in signing up for the course. Another email was sent one week prior to the Fall 2024 semester, to remind students to sign up for the course, when registration was again open. The final result was that seventeen (17) students, all starting in their third semester, registered for the course and did not drop-add the course during the first week of courses. This course was co-taught by two experienced instructors and contained different elements across projects that enabled students to engage with mentors/clients and meet academic and professional requirements.

Course Design Elements

The main purpose of the course was to provide an introductory framework for project management and ensure teams worked through a process to complete a project. Because the course was two-credit hours, a 50-minute lecture was scheduled weekly on Wednesday afternoon, and a one-hour (1hr)/40-minute lab was scheduled weekly for Friday morning. The lecture portion provided opportunities for instructors to inform students about weekly topics to be integrated into course assignments and reports. The 1hr/40-minute lab sessions were less structured to allow for working team meetings, with individualized instructor support, and time for mock presentations, writing, or project planning sessions. The end result for the course was a 15-minute presentation with 5-minute Q&A session and a comprehensive report that allowed students to formulate over the course of the semester and build upon previous ideas.

The course was designed to include three main objectives:

I. *Provide Real-World Scenarios* – real-world settings were necessary to understand the depth and breadth of engineering challenges. The application of academic principles applied to these settings provided an ability for students to develop their working knowledge of industry issues while developing interpersonal skills needed to succeed in engineering.

II. *Cultivate Teaming and Project Management Skills* – this course encouraged effective teaming techniques and attempted to focus time management to enhance academic, personal, and professional performance. A main focus of the course was to practice teaming skills and for students to learn how to run effective meetings.

III. *Workforce Development Skills and Introduction to Industry Expectations* – throughout the course, it was essential for students to engage in self-awareness and understanding of personal strengths and work habits. Though not emphasized enough throughout the semester, creation of some course elements explored ways to create psychologically safe environments for teammates and co-workers. Though there were time constraints during the course, this final objective proved to be more essential for student teams to practice and cultivate as the client and course expectations were elevated.

Learning Objectives

Learning objectives for the course included an ability for each student to a) apply academic knowledge and engineering skills to a real-world problem, b) develop a project scope, major project deliverables, and a project schedule, c) practice the fundamentals of the engineering design process to develop a solution(s) to an industry-defined project challenge, d) create a solution which meets design requirements and standards set by the industry client, e) develop skills for effective team collaboration, f) develop skills for effective communication, both written and verbal, to complete technical and work-related projects, f) develop professional skills by interacting frequently with peers and engineers from industry.

Though the course provided many essential academic and professional elements, instructors were concerned that students would not register for the course, as it was not a "required" course within their curriculum and could possibly serve as an avenue to show internship-like or industry experience. In addition, project topics were not finalized when the course was first advertised through email. However, this did not seem to affect registration as students were minimally solicited to sign-up for the pilot course experience. Once students were registered, they did not drop the course during drop add or during any other period for the semester.

Projects and Developing Partners

The initial idea of the course was to have industry partners that were willing to work with students and mentor them throughout the semester. However, due to time limitations and travel constraints, project partnerships consisted of two projects offered through one industry partner (Williams Corporation), one project was sponsored by a start-up company (AIEnergySolutions), a robotics project associated with a student design competition (VEX), and a community service project through a local business (Stall and Oats). These projects all contained different parameters, expectations, and had different complexities throughout. However, students and the faculty were able to navigate differences throughout the semester that resulted overall in a seemingly uniform experience. The following are project descriptions as presented to students to consider during the first week of class. Students were fully solicited by providing the project description, a summary of technical skills required, and project deliverables in the EduSourced platform where they bid on their top three projects. Instructors then considered their bid choices as well as their skill-sets to determine the project teams. Project bidding occurred by the first lab class meeting and team assignments were implemented by the second week lecture (third overall class meeting).

1. *Pipeline Manufacturing Material Defect Testing (Williams Corporation)* – this project team was tasked with developing a reliable and efficient field-test process for employees to identify hard spots on pipes using a portable hardness tester and acquire data. The field process was correlated with laboratory-based micro-Vickers hardness testing to understand the measurement differences and uncertainties. The project team was then tasked with establishing a tolerance range for portable hardness measurements.

2. *Offshore Swing Rope Transfer Alternative (Williams Corporation)* – in the petroleum industry, swing rope transfers are one of the most dangerous transfer methods of personnel in

offshore construction and operations. Yet, they remain one of the only viable methods for transferring personnel from a small offshore vessel to an unmanned structure. This team project was to develop a concept design for an alternate means of personnel transfer within the identified project constraints, including vessel sizing, power restrictions, sea states, and economic factors. This project emphasized that people, and their safety, are important to carry out engineering operations. The question was posed, what can engineers and project managers do to ensure they are making someone's life better, safer, or easier?

3. *Computer Vision AI Model to Improve Product Assembly (EnergyAISolutions)* - Energy AI Solutions' ASAPA software performs multi-modal AI analysis to reduce errors with product assembly; improve intelligent and collaborative assembly troubleshooting; and reduce cognitive error and response time. Product features include: 1) product assembly assistant and 2) visual inventory assistant. The product assembly assistant enables users to submit pictures during the product assembly process to obtain feedback on next steps. The visual inventory assistant enables users to submit a picture of inventory items to automate inventory cataloging and obtain feedback on missing and/or suggested items. This project was designed to provide students with hands-on exposure to AI, and knowledge of how to build a Computer Vision AI model on Microsoft Azure and use it to perform image analysis against images taken from a common cell phone. Students will develop and implement a test which will apply the software on a simulated manufacturing setup (Legos) to demonstrate the system's ability to match objects (Legos) against instructions to determine current and next steps in the construction process, identify inventory objects & compare inventory lists to suggest relevant missing objects. Lastly, the sponsor was seeking assistance in obtaining feedback from Federal teams on useability and system integration considerations.

4. *Flooding and Water Drainage Solutions* - Stall and Oats, Equine Boarding Facility – this project grew from the amount and frequency of rain in the College Station, TX area. With the frequency and quantity of rain at any given time of year, intermittent flooding issues arose at a local equine boarding facility and had a potential to affect the health and safety of residents. This INSPIRES team worked with three clients/mentors and a Civil Engineering PhD student to assess the problem and create reasonable solutions. This project team developed several concept designs to provide workable solutions for the owners that were technically sound, could be implemented with a limited budget, were environmentally friendly, and equine safe. Throughout the process, this team found that solutions required research and a thoughtful process to consider areas engineers are not necessarily familiar. They were challenged with the amount of responsibility to ensure solutions were both safe and effective.

5. *Assistive Robot (VEX) for the Disabled/Elderly* – this project was derived from the availability of robotics equipment and parts from three existing competitive robotics teams and a peer mentor. An experienced peer mentor was hired to work with instructors and support the team for successful outcomes. Initially, the project description focused on developing solutions for elderly people or people with disabilities and their struggle with day-to-day activities. An altruistic message centered on how robots can be beneficial and designed to make lives easier.

The peer mentor described a scenario to develop a robot to complete certain tasks to simulate a real-life situation, such as grabbing/lifting odd-shaped objects and moving them to a target, or following an autonomous path, and lifting itself off the ground to grab an object. This project provided an open-ended scenario that allowed the team to explore and implement their own ideas of what could be needed or beneficial to certain populations.

Learning Platforms

An electronic platform (EduSourced) was implemented for external mentors, in addition to an internal university blackboard system (Canvas) for internal use to submit/grade assignments and monitor progress. It's important to mention that external users (industry/mentors) did not have access to Canvas. Therefore, EduSourced was implemented for students to communicate milestones and progress in the form of reports and information for industry mentors to review and further guide teams in their progress. The platform contained many built-in elements that were easy to navigate and customize throughout the semester. During the semester, EduSourced was utilized for a mid-semester 360-review to garner feedback from industry/peer mentors, and team members themselves. EduSourced was also used for the final project peer evaluations to assess and confirm team dynamics. As previously stated, this platform had ready-made survey elements embedded from previous experiential learning or capstone courses through their customer database. The Table below shows an example of a 360 Peer Evaluation.

		Peer 1	**Peer 2**	**Peer 3**	**Self**
Leadership	Does this individual demonstrate thought leadership in team activities and meetings?	4	5	3	4
	Does this individual show enthusiasm for the tasks and encourage other members?	4	4	3	4
Teamwork	Does this individual initiate ideas and take necessary steps to further the project without being prompted?	4	5	4	5
	Does this individual promote and enable individual responsibility while achieving team/group harmony?	5	4	5	4
	Does this individual treat others with respect?	5	5	5	5
Competency	Does this individual exhibit a clear understanding of project goals and propose useful solutions?	5	4	4	4
	Does this individual understand concepts and are they able to relate them to their peers?	5	4	4	4
	Does this individual express themselves clearly and articulately?	4	4	5	5
		4.5	**4.375**	**4.125**	**4.375**

Technical support for EduSourced was also top-notch with staff available to assist remotely to explain ways to navigate or customize the platform to suit the needs of students and instructors.

In retrospect, EduSourced could have been utilized more during the course. Canvas was a standard alternative as university grading systems were built-in. EduSourced technical support mentioned that they are working on the ability for EduSourced and university Canvas applications to link together. This would be an enhanced feature available in the near future.

Grading

Course grading was dependent upon in-class attendance, participation, and completing assignments. Grading was on a 90%, 80%, 70% scale and consisted of individual assignments/attendance/participation (10%), team weekly reports (30%), mid-semester reports (10%), mid-semester presentation (10%), teaming 360 review (10%), final PowerPoint presentation for clients (20%), and a final comprehensive report (10%). Final grades considered contributions to team assignments and intermittent peer evaluations, on the EduSourced platform. Semi-regular emails were also sent biweekly to project clients/mentors to inform them of upcoming course activities and ensure they were aware of academic expectations in addition to their agreed-upon project deliverables. With the course deliverables and expectations, it was observed that student skills in report writing, communication, and presentation skills were lacking. Over the course of the semester, students were given an opportunity to significantly improve by re-doing some of their work. With this opportunity, students were able to re-work assignments and deliver higher quality written assignments and presentations. From midterm grades, several of the teams brought their scores up two letter-grades and were aware of the high standard that was expected and will be expected in future courses.

Summary

The INSPIRES course with focus on sophomore year students was a pilot for Fall 2024 that successfully passed 17 students in 5 projects with either industry, community or other mentorships. Final grades for the course consisted of A's (59%) and B's (41%). This course is a work in progress as a few changes regarding information sequence and assignment order will be discussed for future offerings. The result of the course was to provide students with real-world project scenarios and face challenges of everyday projects and professional working. Throughout the course, students were encouraged to improve their performance, both in team collaborations and project deliverables. As expected, students were confused at the beginning of the course as far as "real expectations" however, providing opportunities for them to improve upon their performance, communication, and especially their writing was essential for their ultimate and overall success. Each team had their own dynamics that team members learned to navigate. Each industry client provided different interactions and environments for student team members to discuss and make decisions about how to effectively communicate and with what frequency. As previously mentioned, clients/mentors were more available during mid-term presentations, on surveys, and setting up individual meetings or field trips for students to attend. Ultimately, the pilot course was successful and it will be offered next Fall 2025 with the intention of making the course a permanent offering for second-year students.

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