VTE VOCATION, TECHNOLOGY & EDUCATION

CASE STUDY

University of Wisconsin-Madison mechanical engineering experiential design project case study

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ABSTRACT

This case study explores the experiential learning course of Interdisciplinary Experiential Design Projects (ME 351/352) within the Mechanical Engineering Department at the University of Wisconsin-Madison. Central to the engineering curriculum, this two-semester capstone sequence integrates human-centered design principles and hands-on learning to bridge academic knowledge with real-world applications. Students carry out client-driven projects, developing technical, communication, and project management skills through iterative design, prototyping, and testing. With active collaboration from faculty, industry sponsors, and peers, the course prepares students for the workforce by addressing the "skills gap" between academic training and industrial demands. Key features include a structured yet flexible course design, stakeholders' analysis, dedicated design spaces, and weekly feedback mechanisms, fostering technical innovation, professional growth, and industry engagement. This study highlights the experiential learning course's value in enhancing student employability while providing industry partners with recruitment opportunities and innovative solutions, it also points out certain challenges and corresponding action plan for continuous course improvement.

Key words: experiential learning, engineering capstone design, project-based teaching & learning, interdisciplinary design, human-centered design, workforce development, prototyping and testing

INTRODUCTION

The Wisconsin idea, which originated from the University of Wisconsin-Madison (UW-Madison) President Charles Van Hise, has become one of the most influential philosophies in the field of education.[1] It emphasizes that education should influence people's lives beyond the boundaries of the classroom and promote extending academic resources and expertise beyond the university, thereby contributing to public service, guiding policy, and fostering community engagement that addresses societal challenges. This broad perspective of education is reflected by many employers, who now expect graduates not only to understand fundamental principles but also to apply those principles in real-world scenarios. Therefore, students at UW-Madison are encouraged to participate in experiential learning programs, internships, and service-learning projects. Experiential learning aligns with these expectations by providing students with the experiences needed to meet modern workplace demands. Such experiences are integral to students' academic programs and are designed to enhance their employability by providing practical skills and professional experience.

In the university's Mechanical Engineering (ME) Department, experiential learning is a pivotal component

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of the curriculum, providing students with comprehensive, practical experiences that allow them to synthesize their academic learning. Specifically, the Interdisciplinary Experiential Design Projects course (ME 351/352)[2] allows students to build a bridge between the classroom and industry *via* a human-centered design project. This team-based project connects students with a variety of real-world clients, including potential employers, and requires them to apply various skills that will help them succeed after graduation. In this case study, we write holistically about the ME capstone design sequence (ME 351/352), including the learning objectives, course design and structure, and seminar delivery as well as the student-led project tasks, such as meeting with faculty consultants and clients, students' project work, and learning outcome evaluations.

INDUSTRIAL DEMAND FOR WORKFORCE DEVELOPMENT

It is widely known that industry demands practical, adaptable skills that can be immediately applied to solve real-world problems and balance technical and soft skills. In contrast, higher education emphasizes theoretical knowledge, specialization, and critical thinking, preparing students to gain a more profound understanding within a more structured academic framework.[3] As a result, college graduates often display a substantial "skills gap" when joining the workforce after graduation, requiring them to fill this gap at work to meet business demands.[4] The employability narrative by Moreau and Leathwood effectively frames colleges as solely responsible for giving students skills that satisfy employer demands, as illustrated in Figure 1; spur economic growth; and facilitate social mobility.[5] This perspective on the role of higher education, which sees the "employability" concept effectively embedded in coursework, graduation requirements, and accountability frameworks, has become one of the most influential narratives shaping postsecondary policy and practice around the world today.

VALUE PROPOSITION OF EXPERIENTIAL TEACHING AND LEARNING

Higher education institutions encourage and often require students to engage in some form of experiential learning to help them develop the necessary skills to succeed in the workforce. In engineering, these experiences typically come from undergraduate research,[6] service-learning courses, internships, co-ops, student organization activities, and capstone design courses. Capstone design courses in engineering provide students with real-world experience in designing and building solutions to clients' problems. Clients include industry sponsors, community members, researchers, student organizations, and the students themselves in the case of entrepreneurial projects. Clients present their requirements to student teams, who are then tasked with determining solutions that meet their clients' needs by engaging in a design process. This process of developing solutions for clients greatly benefits students and allows them to develop many of the competencies and employability characteristics described in Figure 1.

However, the benefits are not limited to students. Clients, particularly industrial sponsors, gain access to students for recruitment and become visible to the faculty and larger student body of the departments with which they engage.[7] In addition, these design projects provide sponsors with low-stakes opportunities to develop their younger engineers. By engaging with student design teams and guiding them through the design process to develop satisfying solutions, young engineers can continue to advance their competencies and employability characteristics, thereby becoming part of a stronger, more competent, and more reliable workforce. Acting as clients and mentors throughout courses, young engineers coach student teams about business needs, product strategies, product design, and final deliverables. By the end of a project, the employer will have provided a solution to its needs, provided its younger employees with valuable experience in managing a team, and possibly vetted students before making job offers.

There are many experiential learning courses at the UW–Madison, including the following representative examples: (1) Interdisciplinary Experiential Design Projects (ME 351 and ME 352);[2] (2) Biomedical Engineering Design Projects (Biomedical Engineering BME 300, BME 400, BME 402);[8] (3) Business Practicum (General Business GB 777 and GB 790); (4) Computer Science (Computer Science COMP SCI/ STAT 403).

This case study discusses the Interdisciplinary Experiential Design Projects course in the ME department. This course, consisting of ME 351 and ME 352, offers a unique, hands-on experience that bridges the gap between theoretical knowledge and real-world application. The course focuses on the early stages of the design process, from initial concepts to detailed prototypes, and requires students to manage the project over two semesters. These early stages not only allow students to apply the technical skills they have learned in their coursework but also require them to engage with clients, ensuring that they develop communication and project management skillsets that are directly applicable to the industry. Participating in this course prepares students with practical skills in designing and fabricating interdisciplinary systems and devices. It also significantly

Framework for 21st century learning		21st century competencies		SEA factors		Forms of graduate capital		Characteristics of employability frameworks	
Learning skills	Creativity	Cognitive competencies	Cognitive processes	Approach to learning	Attention control	Human capital	Knowledge	Capital components	Human capital
	Critical thinking		Knowledge		Growth mindset		Job performance		Social capital
	Problem-solving		Creativity		Metacognition	Social capital	Networks & contacts		Cultural capital
Information skills	Information literacy	Intrapersonal	Intellectual openness	Intrapersonal skills	Adaptability	Cultural capital	Cultural knowledge		Psychological capital
	Media literacy		Work ethic		Conscientiousness		Cultural awareness	Career management	Signal management
Life and career skills	Adaptability		Positive core self-evaluation		Self-efficacy	Identity capital	Work identity		Self-management skills
	Self-direction	Interpersonal	Teamwork	Social skills	Active listening		Career insights	Contextual factors	Labor market structure
21st century themes	Global awareness		Leadership		Collaborative skills	Psychological capital	Resilience		Personal circumstances
	Civic literacy				Empathy		Adaptability		

Figure 1. Select skills informing student employability. Dark green represents the skills that are taught and practiced frequently in college engineering classrooms; light green represents the skills that are sometimes taught or practiced; uncolored represents the skills that are rarely taught or practiced. SEA, social, emotional, and affective.

boosts their visibility and attractiveness to potential employers, enhancing their future careers.

According to Thomas, one of our students in the Interdisciplinary Experiential Design Projects course, he and his team learned various skills, including translating client requirements into engineering specifications, negotiating scope and deliverables, and managing a long-term project. As a result, he and his teammates increased their competence in applying classroom knowledge to real-world problems and began to bridge the skills gap, making them better prepared as engineers to tackle the real-world problems they will experience after graduation.

This case study about UW-Madison's ME Interdisciplinary Experiential Design Projects provides an overview of the course, details about projects and student teams, and information on the course structure and learning objectives and our approach to core instruction and evaluating students' learning outcomes.

INTERDISCIPLINARY EXPERIENTIAL DESIGN PROJECTS

Course overview

Changes to the Interdisciplinary Experiential Design Projects course at UW–Madison began in 2013. These changes were based on trends among peer institutions and academic research on project-based learning, such as that by Dym *et al.*[9] At the time, the department had two capstone design courses, and the decision was made to require a more in-depth, two-semester sequence. Since its inception about 10 years ago, the design sequence has transformed from an elective course supporting a small cohort of about 10 teams to a flagship design course supporting all students in the department. Through continuous improvement *via* feedback from students, teaching assistants, faculty, and clients, the teaching team has improved the course curriculum, made the course the centerpiece of the undergraduate student experience, expanded the course to support more than 250 students and 60 projects per year, and engaged a variety of clients and projects. Figure 2 shows the historical enrollment data and the significant improvements made during the past 10 years. The course focuses on human-centered design and strongly emphasizes iterative prototyping to develop solutions to client needs.

The capstone design sequence is offered both in the fall-spring semester and the spring-fall semester to accommodate students' schedules and consists of two 3-credit courses: ME 351 and ME 352. During the first-semester course (ME 351), students engage with a curriculum emphasizing project planning, effective team dynamics, communication, problem definition, conceptual design and evaluation, and rapid prototyping processes. During the second-semester course (ME 352), students engage with a curriculum emphasizing detailed design, fabrication, optimization, design trade-offs, feature addition, and testing. The course emphasizes iterative design and stresses all forms of prototyping, from analytical to physical and from focused to comprehensive.

Course prerequisites are senior standing within the ME curriculum and ME 331 Computer Aided Engineering. In addition, Inter EGR 397 Engineering Communication is a corequisite. Students are expected to engage for a total of 135 h per semester (9 h per

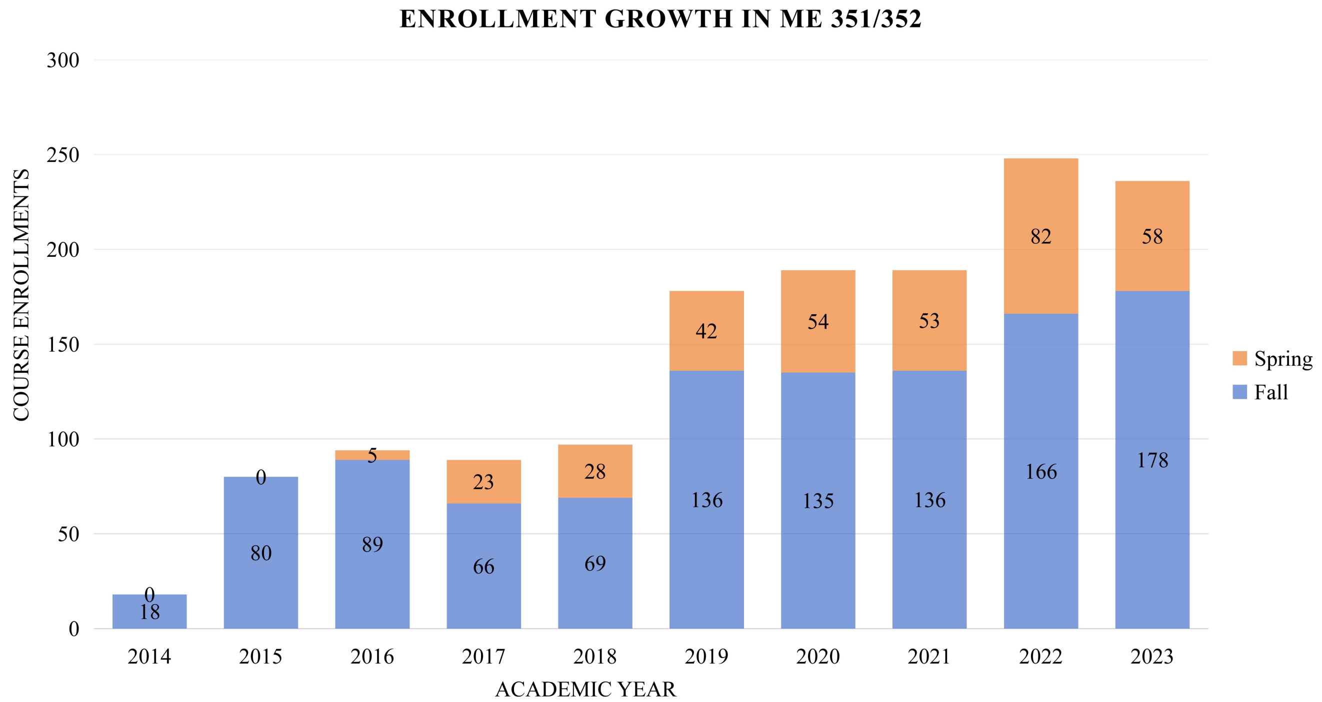

Figure 2. The experiential capstone design course enrollment situation in the past 10 years.

week) with various course learning activities, including attending weekly 1-hour faculty consultant meetings (12 h), attending weekly half-hour meetings with teaching assistants (6 h), attending 8-10 seminars (8-10 h), reading and applying lesson content, writing weekly and milestone reports, preparing presentations, and providing feedback to their peers on their work.

Course projects and student teams

The design cohort in the 2023-2024 academic year had 256 students and 64 teams, with most teams having four students. Each team managed a unique project that tasked them with developing a solution to a client's problem. These projects challenge students to apply their academic knowledge and skills in a practical, real-world setting, while the clients ensure that the projects have a clear purpose and meet industry standards. They often involve designing, creating, or improving a product, system, or process to meet specific client needs or solve a particular problem. Generally, a good capstone project should have three primary attributes: (1) have multiple aspects so that students can delegate work and take individual ownership of a significant part of the design; (2) be challenging enough for students to stretch their communication, technical, and project management skills; and (3) provide students with multiple opportunities to build prototypes, both analytical and physical, that they can use to gain feedback from their clients and other stakeholders, allowing them to reflect on their work and develop designs that better satisfy client needs.[10] These attributes can also be used to recruit potential course sponsors for suitable projects. Like the projects they bring, clients are unique, but we generally categorize them as industry sponsors, faculty and graduate researchers, engineering competitions, community members and organizations, and entrepreneurs. During the 2023-2024 academic year, the course had a diverse group of clients representing all of these groups.

Once suitable projects are organized, it is crucial to match students to projects that pique their interests and are relevant to their career goals. There are myriad ways to do this, none of which is perfect.[11] We offer students the opportunity to form teams and make proposals to work on specific projects or to voice their preferences *via* a survey. The former allows students to have agency in what they will work on, while the latter allows the course coordinator to form and match teams to projects to increase the chances that a project will be successful.

After matching student teams with projects, team building becomes the next critical factor in a project's success. To help students build their teams, we provide seminars and lessons on project management and effective team dynamics. One outcome of these seminars and lessons is the definition of clear team roles. They are required to define four roles—facilitator, communicator, accountant, and administrator. However, they are also allowed and encouraged to add to these roles and clarify them to suit the needs of their team. The roles defined by the course exist to help students work through basic project management tasks. The facilitator ensures that weekly tasks are distributed among group members, as well as calling meetings and monitoring progress. The communicator takes charge of communication tasks, including preparing for meetings, taking notes, and organizing reports. The accountant manages the project budget, makes appropriate purchases, and ensures that spending stays within the budget set by the client. Finally, the administrator takes responsibility for the project team's website, a project poster, and a showcase exhibition.[12]

Course structure

As stated earlier, the objective of this course is for student teams to define and solve a client's problem. Therefore, each team is assigned a faculty consultant[13] and a teaching assistant. Faculty consultants provide students with the necessary technical and project management guidance to help them accomplish their objectives, while teaching assistants provide teams with course and resource guidance. Although students have access to many resources for the course, their primary resources are their faculty consultants, teaching assistants, and clients. All are important, but engagement with faculty consultants during meetings, writing in-progress reports, and reviewing milestones are core student tasks in this course.

Students meet with faculty consultants weekly, which should be arranged by their teams and faculty consultants during the first week of the course. These meetings can take place on any day of the week, depending on the schedules of those involved. Students submit weekly progress reports to their faculty consultants and teaching assistants (TAs) at noon the day before a meeting. This report captures the tasks their teams have completed over the past week; the completed tasks, as a technical report; and the tasks for the coming week. This report is intended to form the foundation for teams' discussions with their faculty consultants during weekly meetings. As the students discuss their work and reports with their faculty consultants, they take notes and revise their progress reports based on feedback. Immediately after the meetings, they take a short time (10-15 min) to finalize any revisions and send the final versions to their faculty consultants, TAs, and clients.

The tasks that form the primary substance of these weekly reports are derived from students' engagement with their clients and faculty consultants and course material delivered weekly *via* seminars and online lessons. The course material is designed in the form of tasks assigned at the beginning of each school week. The course curriculum covers the design process, project management, prototyping, communication, *etc.* Students should think about the course content in these tasks as a set of tools that, when applied well, will help them write better progress reports more quickly, give structure to their design process to help them focus on their work, and, overall, help them develop better solutions to the client's problems. However, applying these tools well can take time and effort. Therefore, students are encouraged to contact faculty or a TA for help. Ultimately, the teaching team wants all the course materials to be applied in a way that helps students do better work more efficiently.

As students process and apply course material and engage with their faculty consultants and clients, they can begin to tailor their efforts to the strengths of their team members. Although we ask students to define the four clear roles discussed earlier, students are encouraged to coordinate their project tasks based on their technical and soft skills. Taking the Harvest Cart team as an example,[14] one student on the team who was particularly good at SolidWorks, a computer-aided design software provided by the university, helped greatly in assembling the CAD; Thomas Jiang and another student on the team contributed to prototyping and testing based on their skills and familiarity with manufacturing equipment; and the fourth member of the team took care of a large portion of report-writing tasks due to their stronger writing skills as a native English speaker.

Learning outcomes

The essential learning outcomes for the course are provided below. These are derived from the idea that the design process is open-ended and messy, with no clear-cut, single path. For most students, this can be frustrating but very rewarding for those who are patient, persevere, and ask for help and feedback on their work. We believe good designs require iteration over all aspects of the design process, meaning that the more our students reflect, make corrections, add features, experiment with new ideas, rework prototypes, interact with their clients, *etc.*, the better they will define their client's problem and develop a satisfying solution.[15] We want them to maximize these iterations, so we encourage students to start work early and not be afraid to fail. In the end, we want students to be able to achieve the following: (1) use the design thinking process to define and solve the client's problem; (2) define and understand the importance of stakeholders relevant to their client's problem; (3) use research effectively to increase their knowledge and guide their design work; (4) empathize with stakeholders to translate requirements into engineering specifications;[15] (5) apply engineering knowledge from other courses; (6) teach themselves quickly when encountering new problems; (7) prototype and test effectively and efficiently; (8) communicate their work effectively and efficiently; (9) use a computer effectively to solve engineering problems.

We evaluate these outcomes when students engage with their faculty consultants and teaching assistants at weekly meetings, since we grade their weekly progress reports and review their midterm presentations and reports. These presentations and reports include a project proposal, a conceptual prototype, a midyear review, a working prototype, and a final review.

Core instruction

Since this experiential design course emphasizes student teams' problem-solving skills, classroom instruction is limited. Nevertheless, the instruction provided includes seminars and lessons intended to provide students with guidelines, references, and other resources relevant to design. As discussed by Dym *et al.*,[9] design thinking and strategy planning are typically challenging for undergraduate students due to their limited experience. Course seminars, though not a panacea, are designed to help students become aware of these challenges and to provide them with tools to use as they work. The hope is that these targeted seminars will help students focus on developing skills that will help make their course projects successful and help them in their future careers.[9]

During seminar sessions, we teach students (1) the essential skills of project management, (2) how to write effective weekly progress reports, (3) how to communicate with clients and faculty consultants and how to build their team, (4) how to research previous solutions and find relevant patents and standards, (5) the best ways to plan and execute prototypes, and (6) what is patentable and how the patenting process works. These seminars are provided by course instructors and internal and external contributors. For instance, on the teaching team, Dr. Katherine Fu[16] presents effective team dynamics and has crucial conversations with the student project team. Such research-based seminars provide students with critical skill awareness training to help them avoid cognitive design biases, contributing to better team performance and decision-making.[17] Milwaukee Tool,[18] a local solution provider, discusses its design methodology and the importance of this methodology in product development. The Wisconsin Alumni Research Foundation at UW-Madison presents the patent process,[19] helping students understand what is patentable and the support they have when they discover something new or innovative.

Although these seminars present valuable information to students, they are not the core form of instruction for the course. Instead, faculty consultants provide the core instruction at weekly meetings.[20] From a student's perspective, these weekly sessions are consistently ranked highest in their value to help them learn. These meetings require students to reflect on their work, prepare efficiently to communicate what they have accomplished, and act on feedback provided by their faculty consultants.

In addition to seminars and weekly meetings, we provide students with text resources. Due to the breadth of the ME discipline and the wide variety of projects we support, there is no required textbook for the course. Some textbooks on product development, mechanical design, and technical communications are listed below. These have been helpful in the past and are provided to students as a reference should they seek out more information on common design topics: (1) *Product Design and Development* by Ulrich and Eppinger;[21] (2) *The Mechanical Design Process* by David G. Ullman;[22] (3) *The Craft of Scientific Writing* by Michael Alley;[23] (4) *The Craft of Scientific Presentations* by Michael Alley.[24]

Evaluation and grading

Table 1 shows the grading breakdown for ME 352. Note that the grading breakdown for ME 351 is similar, but with a little more weight on the participation grade. The table shows each assignment's general category and percentage weighting on the final grade. Each assignment is designed to ensure regular engagement and accountability and to provide a means of assessing student work, leading to the successful completion of the project. Students are awarded grades both individually and as a team.[25] A detailed description of each assignment and how it is graded is as follows. (1) Evaluations (20%): At the end of the semester, evaluations are provided by students, teaching assistants, and faculty consultants. The structure of these evaluations provides guidance to students about our expectations, while the evaluations themselves allow instructors to provide each student with individual grades based on their performance. (2) Weekly Progress Reports (20%): These reports are shared with the faculty consultants and teaching assistants one day before the meetings. They are graded by teaching assistants and have slightly higher stakes than faculty meetings. Their purpose is to help students reflect on the work done so that they can better plan for future work and to facilitate feedback between the teams and their faculty consultants. (3) Weekly Faculty Meetings (10%): Meetings are held weekly and require agendas, meeting notes, and progress reports to be submitted one day prior. This is a low-stakes grade intended to help students communicate and reflect regularly on their

Table 1: Grading breakdown for ME 352

Category	Assignment	Number	Percent (%)
Participation	Evaluations	1	20
	Progress reports	12	20
	Faculty meetings	12	10
Individual presentation		1	10
Working prototype presentation		1	10
Final review	Presentation, Poster, and Prototype	1	15
	Report	1	15
Total		29	100

ME 351 is similar with 10% more weight on participation and 10% less weight on the final review.

technical achievements and project progress. (4) Individual Presentation (10%): Each student presents their individual contributions and progress in week 5 of the course. These presentations are designed to provide individuals with a chance to highlight their contribution to the physical embodiment of their designs and to receive feedback on their work. These presentations should help teams distribute work equally among team members. (5) Working Prototype Presentation (10%): This is a low-stakes team grade that helps students stay on track with their design development, encouraging them to work together to meet their clients' needs. Prototypes should be significantly more advanced than the prototypes they developed in the first semester. (6) Presentation, Poster, and Prototype (15%): This is a comprehensive presentation at the end of the course showcasing the final project, including a detailed poster and the final prototype. This is a team grade. (7) Final Report (15%): A thorough written report that encapsulates the entire final design, from client requirements and design specifications to prototyping and testing. This is a team grade that provides formal documentation of the work done by the team to design a solution that meets its client's needs.

Learner support and resources

The course is heavily based on providing student teams with the resources they need to complete their projects, generally broken down into curriculum, instructional, and physical resources. The curriculum and instructional resources are discussed above. Physical resources, and the support provided with them, are discussed below and are crucial for helping students design, build, and test prototypes. When engaging with curriculum and physical resources, students are always encouraged to reach out to the teaching team for guidance and support.

The course has several designated design spaces for students to perform hands-on tasks, including the Makerspace and TEAM Lab,[26] run and supported by the College of Engineering, as well as several dedicated ME spaces. These dedicated ME spaces, including the ME Design Lab, the storage room, and the ME Design Studios, designed for different purposes, allow students to work on their senior design projects. However, all spaces are shared, so students are expected to be respectful of others and follow general rules. More details on each space are provided below.

TEAM Lab and Makerspace

The TEAM Lab and Makerspace are large spaces (> 20,000 ft^2) that serve the entire College of Engineering. They provide students with manufacturing and prototyping equipment (lathes, end mills, table saws, band saws, and drill presses). Students entering ME 351 have training on the basic equipment and can upgrade their training as the need arises. Most manufacturing for projects occurs in these spaces, although some students work with their clients and outside vendors for parts requiring more skills or advanced tools not available in these spaces.

Storage room

The function of the storage room is to provide students with scrap material and storage space for prototypes. The storage room is not used for manufacturing (*i.e.*, no cutting, grinding, sanding, finishing, or painting) or testing of any kind.

ME Design Lab

The ME Design Lab has two primary purposes: (1) as a general meeting space for design teams; and (2) as a lab space where students can assemble and test their prototypes. Students do not need permission to work on their prototype in this room; they just take it from storage, set it up, and work. The lab is equipped with high voltage, compressed air, a fume hood, and chilled water, among other things. All of these can pose hazards and or cause property damage, so working with any of them requires some level of supervision and training. Prototypes can be left in the room indefinitely if there is a need and with the permission of the teaching team. However, the lab is a shared space, so students should store their prototypes in the storage room whenever possible.

ME Design Studios

The design studios serve as virtual design spaces and regular meeting spaces for all design teams. The "D"-shaped tables in both rooms are designed for collaborative learning and are each equipped with two College of Engineering computers with typical engineering software. Since there are only two computers at each "D"-shaped table, students may wish to bring personal laptops. As with the "D"-shaped tables, the entire space is designed to feel and be collaborative. That is, the teaching team strongly encourages teams to talk with other design students and design teams about what they are working on. As with all the other design spaces, these studios are shared, so students need to be respectful of others using this space.

Access to these spaces varies slightly, but they are generally available to students during normal business hours on weekdays. Most of the spaces are closed on weekends. In these spaces, safety is paramount; students using them are required to read through safety guidelines to understand the hazards and to learn the rules to follow. Some spaces, such as the TEAM Lab and Makerspace, require students to attend and complete additional training on how to safely use equipment. Rules in these spaces are designed to help keep students and equipment safe.

At the end of the course, when prototyping is complete, students are responsible for arranging with their clients what they would like to do with their prototypes and for cleaning any allotted storage space. The teaching team and lab staff guide them through the clean-up process when the time comes.

Course challenges and improvement plan

Although the course has been taught for over 10 years, providing more than 2000 students with valuable hands-on learning experiences to develop various skills demanded by industry (Figure 1), the course has experienced several significant challenges. For example, even though project sponsorship is free with in-kind support from industrial partners, recruiting the well-scoped and challenging projects described above that match the interests of our students has always been a challenge.[27] The number of projects required also presents a significant burden on the department and course coordinator. Additionally, the teaching team has a minimal budget to support student teams as they build prototypes, which is why high-quality industrial projects are essential. According to Dutson *et al.*'s publication,[28] funding for capstone design courses could range anywhere from $40 per project to upwards of $33,000 per project in the late 1990s. Nearly 60 projects in 2023 required significant funding, in addition to the instructional resources provided by faculty and teaching assistants.

Our capstone course has increased industry access to our engineering talents, and many students have received job offers from the same companies with which they worked on their capstone design projects. However, we are still working to retain better companies that engage with our design teams. We are attempting to better understand our relationships by giving companies opportunities to provide feedback on their experiences with their teams and by giving students the opportunity to provide formal feedback about their project clients. Ultimately, we aim to improve sponsor engagement with their respective student teams. Such evaluations between students and sponsors are essential for designing a more personalized engineering capstone design experience.[25,28]

To help develop higher quality projects and better relationships between sponsors and student teams, the ME 351 and 352 teaching team has collaborated with the Office of Corporate Relations (OCR)[29] at the UW-Madison College of Engineering for a more diverse group of sponsors, some of which are encouraged to provide paid sponsorship depending on their project needs and their interest in improving the curriculum and student learning outcomes. Meanwhile, OCR has identified the Experiential Learning in Emerging and Novel Technologies (EXLENT) initiative[30] as a significant federal funding source that could address budgetary challenges related to TA training and curriculum development. It is recommended that the teaching team explore this funding opportunity to secure the necessary resources for enhancing these critical components of the program.

CONCLUSION

Inspired by the Wisconsin Idea,[1] the Interdisciplinary Experiential Design Projects course (ME 351/352) at the UW-Madison exemplifies the transformative impact of experiential learning in engineering education. By integrating human-centered design principles, practical problem-solving, and collaborative teamwork, the program bridges the gap between theoretical knowledge and industry demands. Students gain technical, project management, and communication skills through client-driven projects, iterative prototyping, and continuous feedback. Furthermore, the course fosters valuable connections between academia and industry, benefiting both students and sponsors through enhanced employability and innovative solutions. Despite challenges such as securing high-quality projects and funding, ongoing improvements and collaborations with stakeholders continue to strengthen the program's impact. Ultimately, this course highlights the essential role of experiential learning in preparing engineering students for the complexities of real-world challenges while addressing workforce development needs.

DECLARATIONS

Author contributions

Zhang XJ: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Writing—Original draft, Writing—Review and Editing, Visualization, Supervision, Project administration. Jiang CT: Data curation, Visualization, Writing—Original draft. Sun J: Methodology, Validation, Formal analysis, Writing—Original draft, Writing—Review and Editing, Project administration. Cheadle M: Writing—Review and Editing, Data curation, Supervision. All authors have contributed equally to the final version of the manuscript.

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Ethical approval

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Conflict of interest

The author has no conflicts of interest to declare.

Data availability statement

No additional data.

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