University of Michigan's Multidisciplinary Design Program: Enhancing Engineering Education

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Abstract

The University of Michigan's Multidisciplinary Design Program (MDP) offers students a wide variety of long-term, team-based projects, with applied engineering and data science featured in many of the project teams. Students partner with research faculty and industry leaders to bridge the gap between the classroom and professional experience. Since its inception, the Program has experimented with new models for experiential learning. In 2017-18 MDP placed over 840 students in over 50 different projects in two broad groupings: industrial-sponsored and faculty research. There are 12 established faculty research teams with over 175 students participating. Examples of MDP faculty research teams include projects to develop, visualize and analyze "Big Data" in the health sector; research to securely use real-time data in manufacturing applications; embedded systems in satellite and sensor networks; vehicle injury prevention model building; and machine learning.

Multidisciplinary Design Program

Approach

The Multidisciplinary Design Program provides over 800 experiential opportunities for students from across the University of Michigan each year. Teams of students apply classroom knowledge toward significant challenges with the support and guidance of preeminent faculty and professionals.

Experiential. Students learn by doing and experience the complexity and messiness of authentic engineering challenges.

Professional Development. Technical skills are necessary but never enough for sustained, long-term professional success. Leadership, communication, and collaboration across disciplines are skills developed while working on an MDP team.

Multidisciplinary. Teamwork. Systems Thinking. Engineering solutions are rarely confined to a single discipline and rarely solved by one individual. Solutions require a holistic approach.

We pilot models of experiential team-based learning primarily in two areas:

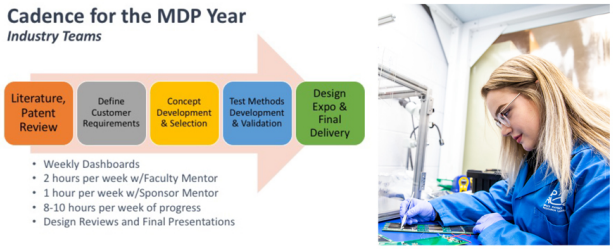
1. Faculty Research Teams
2. Industry Sponsored Design Teams

Student Experience in Faculty Research Teams

The MDP faculty research program has proven highly effective in delivering a sustainable, high quality, and high-volume opportunities to students. The organizational structure and processes of MDP research teams are designed to maximize faculty time focused on educational engagement with students and the quality of the student experience.

Students earn academic credit for a minimum of two semesters, gaining valuable research and design experience. Students are encouraged to participate longer, with additional time and context, to make meaningful contributions, and to foster design and leadership skills. Student teams adopt the internal standards and norms of the faculty research groups, utilizing common project management tools, documentation standards as well as attending standard research group management and strategic planning meetings.

MDP Student Experience



Challenges and Next Steps

Combining a broad range of engineering, data science and other disciplinary approaches in this context can be challenging. Areas for improvement include eliminating barriers to long-term student retention, addressing obstacles to underrepresented groups, and balancing a need for instruction and right-sized challenges in project deliverables. Nevertheless, the MDP program provides enhanced experiential learning opportunities for data science and other students.

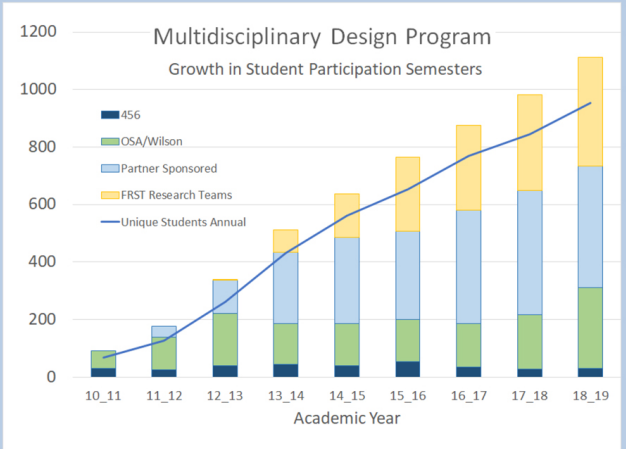
Results

MDP Student Participation	2018-19
Enrolled for credit	843
Data science-related majors	131
Declared MD minor	75
MDP-Funded 2018 on campus summer opportunities	26
Total Projects Available	78

MDP enrolled 843 students from the College of Engineering and 11 other academic units across campus in 2018 for academic credit.

Demand for data science skills is growing. Among MDP research and project-sponsored team students, 57% had data science-related majors, although students with other majors can learn data science skills on MDP teams.

Growth in Student Engagement



Opportunities have doubled in the past 3 years on Faculty Research teams. This trend is expected to continue. MDP's current split is 75% undergraduate and 25% masters students.