BOARD # 273: NSF IUSE HSI Implementation and Evaluation Project: The Freshman Year Innovator Experience (FYIE): Bridging the URM Gap in STEM.

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NSF IUSE HSI Implementation and Evaluation Project: The Freshman Year Innovator Experience (FYIE): Bridging the URM Gap in STEM.

The Freshman Year Innovator Experience (FYIE) program seeks to improve the first-year experience for incoming engineering students by nurturing essential academic success skills at the University of Texas Rio Grande Valley (UTRGV); a Minority Serving Institution (MSI). Specifically tailored to freshman mechanical engineering students, the program aims to equip them with self-transformation skills to navigate through the amplified academic and professional obstacles brought about by the COVID-19 pandemic. Participants of FYIE engage in two concurrent courses: Introduction to Engineering (Course A) and Learning Frameworks (Course B). In Course A, students undertake a 6-week engineering design project, while in Course B, they work on a 6-week academic career path project. Throughout these simultaneous projects, time-bound interventions highlight the similarities between the engineering design process and the academic career pathways project. The main goal is for students to recognize that the design thinking skills acquired in the engineering design process can be applied to resolve their academic career challenges. The FYIE program was initiated as a pilot in the spring semester of 2023, with instructors from Course A and B introducing the parallel projects. The implementation has continued through the fall 2023, spring 2024, and ongoing fall 2024 semesters, introducing improvements at every iteration, with adjustments made to the parallel projects and the identification of intervention points for self-transformation through analogy. The creators of the program will present the outcomes from the pilot implementations and address the obstacles and future work. This proposed endeavor is aligned with the continuous mission of the College of Engineering and Computer Science (CECS) at UTRGV, which includes: 1) increasing the number of STEM degrees granted to Hispanics, 2) promoting the participation of women in STEM-related fields, and 3) enhancing persistence and self-confidence in STEM fields amidst the challenges posed by COVID-19. The project is supported by the NSF award 2225247.

Project Impacts

The project focuses on increasing "effective STEM education and broadening participation" by developing and/or strengthening student self-innovation through strategically designed activities (CBI). Previous studies have demonstrated that persistence, through sequential pathways mediators including self-efficacy and achievement orientation goals, positively associates with student academic performance.

We are proposing a novel approach to help freshman students solve their academic challenges by using design thinking. We propose that as the students continue their learning of engineering design process tools, they will continue increasing the use of design thinking by analogy toward solving their academic challenges. We believe that this is a novel implementation of design thinking in education, and that it could have an impact in the discipline of design thinking itself.

This project involves training faculty and student mentors. UNIV and INTRO course instructors have been trained in engineering design process, challenge-based instruction, and design thinking to revamp their respective academic and design projects in their courses.

Student mentors have been trained in engineering design process, challenge-based instruction, and design thinking to help coach freshman students with their academic and design projects.

A key impact of this design thinking project is empowering freshman engineering students to leverage their training in this approach (e.g., engineering design process, technical innovation, design creativity, entrepreneurship, and problem-solving) to tackle academic challenges, enhance professional development, and achieve career success (i.e., self-transformation). Early data from IRB-approved data collection (e.g., student surveys) suggest positive impacts on metrics related to self-transformation. Based on discussions with advisory committee members, there is an interest in scale-implementation College-wide. Furthermore, there is an interest in expanding to other UTRGV Colleges.

The overarching goal of the project is to promote retention and persistence of freshman students. We believe that participating students will develop problem solving skills to tackle design and academic problems by using design thinking. The broader impact of this will be more students ready to contribute to US STEM work force. This contributes to the representation of URM in STEM and contributes to social mobility.

Project Accomplishments

We have closely worked with 3 UNIV course instructors to format their Academic Career Path project to follow the CBI (Challenge Based Instruction) steps, which match the design thinking and engineering design process steps.

We have closely worked with 3 INTRO to Engineering instructors to format their mini design project to follow the same engineering design process steps as UNIV Academic Career Path project. We have involved mainly instructors from the Mechanical Engineering Department and run pilots with instructors from other departments in the College of Engineering and Computer Science for future expansion.

We have hired and trained a group of undergraduate mentors that serve as coaches for the UNIV ACP projects and INTRO design projects. The students visit the UNIV and INTRO classrooms to interact with the freshman students and mentor them regarding their respective projects.
We have developed the “self-transformation” component of the project and will be implementing it as a pilot this Fall 2024 semester. The self-transformation refers to key interventions such as reflections and explanations that connect equivalent steps between the ACP and engineering design projects. The purpose of this is to teach students how to apply design thinking to their academic challenges.

We have presented at various regional and national conferences [1-6]. Our publications have been well received by the audience, and we have established contacts with various universities (e.g., Oregon State, UT Arlington) for potential dissemination of the “self-transformation” model.

Through an approved IRB, we have collected and analyzed data from our pilot implementation, which can be found in the Significant Results section of this report.

Summary of Evaluation

The project involved several major activities, such as professional development (PD) for the Challenge-Based Instruction (CBI) approach, technical design innovation projects for MECE 1101 (INTRO), and academic career pathway projects (ACP) for UNIV 1301 (UNIV). Various personnel, including the PI team, faculty, and undergraduate (UG) mentors, were involved in these activities. Their work included developing project instructions, implementing design and ACP projects, training mentors, and conducting professional development sessions. The impacts observed included increased faculty readiness to implement FYIE, successful implementation of design and ACP projects, and positive reflections from faculty and first-year (FY) students. Initial data analysis and dissemination of findings were also conducted, with presentations made at several conferences.

In addition, the PI team has provided a solid plan for future endeavors. They include continuing working with INTRO and UNIV stakeholders and implementing the ACP and Design projects with current and improved artifacts in the "package," continuing implementing ST and data collection and analysis from ST interventions, continuing PD training for faculty and UG mentors, continuing both qualitative and quantitative data collection, and finalizing the workbooks for FYIE. Overall, the FYIE has made meaningful impacts of implementing design thinking in UNIV and INTRO courses for FY students, training faculty and student mentors, and disseminating initial findings at several regional and national conferences.

Results Dissemination

Our preliminary results have been presented at various regional and national conferences [1-6] as well as other academic settings such as the NSF HSI STEM Hub Adelante Conference. The presentation of our work has attracted attention from various engineering educators that are interested in advice and implementation of our "self-transformation" model. We have presented our work at the University of Texas Arlington and shared our work with Oregon State University, and Seattle University.

Future Work

Our plan for the 3rd year of the project is to complete the proposed goals by delivering a "package" that can be disseminated and replicated at other institutions. This "package" includes:

- Syllabus, lectures, resources, assessment, and guidelines for instructors to implement an Academic Career Path project that follows the design thinking format.
- Syllabus, lectures, resources, assessment, and guidelines for instructors to implement an engineering design project that follows the design thinking format.
- The self-transformation interventions that will help students make the connections between academic challenges and design thinking.
- Guidelines for training student mentors to help freshman students with their projects.

Towards this goal, we will:

- Work with INTRO and UNIV instructors to compile their projects into a "package".
- Implement and test the self-transformation interventions to be included in the package.

- Document the faculty training and mentor training to be included in the package to facilitate dissemination and replication.
- Continue with data collection to assess the effectiveness of the project.

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