# Course Redesign – Embedding High Impact Practices (HIPS) in STEM Courses

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## Abstract

High-Impact Practices (HIPs) will ensure that students have access to well-designed, engaging academic experiences. Incorporating HIPs into courses can increase student engagement and learning. The HIPs approach promotes active learning characterized by: a) an emphasis on the interaction of students with their instructor through in-class activities; b) collaborative instruction between the student, the instructor and peers about substantive matters; c) instruction providing heads-on and hands-on experiences; d) frequent feedback and guidance for improvement; and, e) connections of disciplinary content and applications of knowledge and skills to real-world problems. However, HIPs can only make a difference if the faculty are equipped with the proper pedagogical tools to adopt them in their classrooms. To support the faculty in developing HIPs in their courses, the New York Institute of Technology Center for Teaching and Learning conducted a 5-day summer Course Redesign Institute. During the Institute, participating faculty members reimagined their courses from the learner's point of view and redesigned them to promote significant and enduring learning. In this paper, we describe the multi-step process for course design and the "spiral approach" for course redesign. Lessons learned from previous semesters are incorporated into any needed redesign and/or refinements of the HIPs as part of the process for updating each course syllabus each semester. Two courses serve as examples to demonstrate how to implement HIPs in basic STEM engineering courses.

## Introduction

Kuh asserts that college degrees are valued by society and empower the individual; however, persistence and completion of the degree is reflective of the quality of the learning experience [1]. To strengthen academic success, faculty development in effective teaching strategies, such as High-Impact Educational Practices (HIPs), is needed [2]. HIPs ensure that students have access to well-designed, engaging academic experiences. Incorporating HIPs into courses can increase student engagement and learning. The only way HIPs can significantly impact a course is if the faculty are equipped with the proper pedagogical tools to adopt them in their classrooms. Towards this goal, the New York Institute of Technology Center for Teaching and Learning conducted a 5-day summer Course Design Institute (CDI). During the CDI, faculty participants read the book [3], designed or redesigned courses built on learner-centered design principles, developed a revised final or near-final syllabus, and learned how to apply research-based teaching and learning principles to course design. Nine faculty members from the Department of Electrical and Computer Engineering and the Department of Computer Science participated in the CDI resulting in five redesigned courses. In the following sections, the redesign of two courses incorporating HIP principles is summarized. This is the first step of a spiral approach to a systematic course design of the engineering and computing sciences curriculum. These two courses are at the freshmen and sophomore levels. More undergraduate courses in the sophomore and junior will be pipelined for a redesign embedding HIPs and active student engagement strategies.

**Redesign of the Career Discovery (ETCS 105) Course**

The Career Discovery course, (ETCS 105), normally taken by engineering freshmen students, was redesigned in the CDI. The main goal of the redesign is to help students to gain an understanding of how to think and act like an engineer or a computer scientist. In addition, the redesign provides ways to capture student interests in their first year and guides them in developing their capabilities for graduating and applications for future career opportunities.

According to the updated course syllabus, students work in teams to learn the use of mathematical and scientific tools, how to apply them in hands-on designs to solve the problems (for instance, using 3-D printing, Arduino, and Matlab), and present their solutions and design ideas to a general audience. The freshman students have the opportunity to work alongside a group of senior design students, conduct an informational interview with industry experts, or work on an undergraduate research project to enhance their hands-on learning experience. Having completed this class, they will have developed worthy experiences that prepare them for their first college-level internship.

More specifically, the HIPs embedded in the re-designed ETCS 105 syllabus include: (1) self-reflection by engaging students at the beginning of the semester to create and showcase their own video profile about the reasons they chose their major, what motivates them, and how they imagine themselves in the future, (2) gaining basic understanding of the professional fields by demonstrating the applications of various engineering and computer science disciplines through faculty presentations, short videos, reading assignments, visiting research labs, and interacting with senior design teams, (3) guiding students to reflect on how their values and interests align with their selected major and what skill sets are needed and how to build them, (4) building communication skills using assignments of create another video similar to the video at the beginning to reflect on what has changed in their opinion about engineering majors and their future career path and showcase their videos to the class at the end of the semester, and (5) building team work using group video assignments to document on fascinating engineering and computer science applications and showcasing the videos to NYIT community.

**Redesign of the Electric Circuits I (EENG212) Course**

The course Electric Circuits I (EENG212) is a fundamental course for electrical engineering students. As such, EENG212 is a prerequisite for various electrical engineering courses. Successful completion of this course is crucial for student retention in the program. Furthermore, this course is one of the first electrical engineering courses students typically encounter. An engaging and exciting experience in this course will help spark or ensure their interest in engineering.

Faculty reviewed the syllabus of EENG212, identified potential issues hindering the implementation of HIPs, and revised the syllabus to incorporate HIPs. Three sections were identified in the syllabus for revision: (1) Catalog description, (2) Student Learning Outcomes, and (3) Schedule. In the catalog description section, the topics of the course were simply provided without any details. The student learning outcomes section listed the skills students are expected to gain at the end of the class adhering to the standard (a-k) student outcomes. The schedule section extended the course outline to include a weekly schedule matching chapter/section titles from the textbook. Overall, these sections provided information from the viewpoint of the instructor. For a student encountering the material for the first time, the content of the syllabus was not easily accessible due to technical jargon used. Additionally, clearly defined goals for the course at a level that students can understand and appreciate in alignment with their current knowledge were lacking.

In the revised syllabus, the catalog description section began with simple definitions and relevance of electric circuits in everyday life, as well as in electrical engineering. Although the list of topics is also provided as before, it is emphasized that this list includes jargon that may be unfamiliar, but the material will be covered in a simplistic manner. The student learning outcomes section is enhanced with the list of courses that will be based on EENG212, and how EENG212 can help students prepare for these courses. For each outcome, prior knowledge required (e.g. Algebra) to successfully achieve this outcome is given. The most important changes in the syllabus were in the schedule section. Here, rather than simply listing each topic, a real-life question relevant to each topic was added. These questions can be answered using the material provided once that particular topic is covered.

To incorporate HIPs into the class, we plan to: (1) Ask students to review material before the class, and identify jargon that they are not familiar with and have them research on this material to come up with their definitions on the jargon used. (2) Have students research the real-life questions added to the syllabus schedule before the class and have discussions in the class. (3) Incorporate mini-projects as part of homework around the real-life questions addressed in the class.

## Conclusion

In this paper, we demonstrated the implementation of HIPs in undergraduate engineering and computer sciences courses via course redesign. We presented the detailed HIP components implemented in the two courses at the freshmen and sophomore levels and the approach to engage faculty in course redesign and syllabus revision. The data on the impact of these revisions are being collected and will be presented in our future work. This work covers the first step of a spiral approach to course design, where lessons learned will be applied to more advanced courses in the future.

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