

A Gateway Course Redesign Working Group Model

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Abstract

As is described in this Evidence-Based Practice Paper, a grant-supported team in the College of Engineering and Computer Science at Syracuse University provides professional development opportunities for our engineering and computer science faculty that focus on improving the quality of instruction. The team seeks to provide an engaging engineering educational experience for our undergraduates to improve both our retention and graduation rates, thus keeping these students in the engineering pipeline. One of the major goals of the team is to help faculty implement best practices, in the form of student-active pedagogies, in target 1st- and 2nd-year gateway courses, improving the classroom environment and student learning and persistence.

To this end the team created an intensive summer pilot program aimed at faculty who teach gateway engineering and computer science classes. Faculty were invited to participate in the 2017 Summer Gateway Course Redesign Working Group, the purpose of which was to modify gateway classes to include and/or enhance students' active learning and test the success of these changes in their classrooms in the 2017-2018 academic year.

Those who participated in the Program received: peer and technical support, time and space to work on new ideas, a summer salary supplement and an additional supplement after implementing class changes and assessing the success of those changes. Participating faculty had to commit to attend a kick-off meeting, a minimum of four 2-hour working sessions, and a mandatory final presentation. In addition, faculty had to complete assigned homework, identify specific project outcomes and provide a plan to implement and assess the course learning outcomes.

Fourteen faculty participated in the summer 2017 program. During the working sessions, faculty with experience using specific techniques shared their knowledge, guest speakers presented relevant technologies, and faculty discussed adapting methods to various subjects, potential pitfalls, and best practices. 100% of the workshop participants met all of the initial program requirements – 60% met more than what was required – and all presented their work/plans at the final summer meeting. The presentations illustrated the range and depth of innovative teaching techniques that faculty planned to implement during AY 2017-18 including: flipping or partially flipping the classroom; adding or redesigning student and team projects, experiments and demonstrations; creating more opportunities for student low stake evaluations including on-line quizzes and homework; and incorporating games into class time.

To determine the program's success we will evaluate the program after faculty have incorporated the proposed changes into their Gateway Classes. In addition to assessing whether the redesign efforts met each faculty's desired outcomes, we will survey faculty to determine how likely they would have worked on this project by themselves without the support and accountability that the Redesign Working Group provided. If the program proves successful we hope to continue to offer it to faculty and share the model with other colleges and universities.

Introduction

Learning styles and the limitations of a traditional, lecture-based, teaching style in engineering education are well documented [1] [2] [3] [4]. Yet historically, faculty participation in professional development programs to train themselves in diverse teaching methods has not been part of the culture of engineering academic institutions. Beginning in the 1990s there was a national effort to develop ways to involve faculty in training to use more varied teaching methods [5]; such as Active Learning [6], Collaborative Learning [7], Cooperative Learning [8] and Problem-based learning [9] techniques. Previous faculty development programs include SUCCEED and ECSEL Coalitions, FOUNDATION Coalition, GATEWAY Coalition, and the Strategic Instructional Initiatives Program [10] [11] [5] [12], the latter of which acknowledges the importance of developing communities of practice among faculty to better support ultimate instructional transformations.

This paper describes one course development summer pilot program provided by a College-wide faculty development program at the College of Engineering and Computer Science (ECS) at Syracuse University. The NSF-supported faculty development team, Enhancing the Climate for Persistence and Success in Engineering (ECliPSE), partly focuses on creating a culture that supports development of pedagogical awareness and personal experimentation by faculty through providing opportunities for faculty to interact around teaching, offering pedagogy seminars and workshops, and generally maintaining a continued focus in the college on improving teaching practices. Through ECliPSE, an extended program was piloted in 2017 called the Summer Gateway Course Redesign Working Group. The goal of the workshop was to aid faculty who teach gateway engineering courses (primarily 1st- and 2nd-year courses) to develop and implement student-active teaching techniques in those courses.

In this paper, relevant components of the ECliPSE program are detailed, and then the Summer Gateway Course Redesign Working Group set-up is described, including selection of invited faculty, the specific required deliverables, weekly meetings logistics, and examples of individual projects. Evaluation of the success of the Summer Gateway Course Redesign Working Group as determined by the assessments and feedback from individual faculty participating in the program and finally the future direction of the program will be discussed.

ECliPSE overview

Meeting the Graduate 10K+ Challenge: Enhancing the Climate for Persistence and Success in Engineering (ECliPSE) is a National Science Foundation Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP) grant (NSF DUE 1317540) awarded to faculty from the College of Engineering and Computer Science (ECS) at Syracuse University in 2013. This five-year grant focuses on increasing the 1st- and 2nd-year retention and ultimately graduation rates of a diverse pool of ECS students through a variety of approaches, including both direct, student-focused interventions and also through ECS faculty development. Towards the latter approach, faculty development efforts are aimed at creating a “culture of teaching” in ECS, raising faculty awareness of their personal impact on students’ attitudes and learning outcomes via their classroom practices, encouraging faculty to redesign the structure and content of gateway courses in particular to incorporate more student-centered teaching activities, and to implement best practices in innovative pedagogies supported by the education literature in their classrooms in order to enhance the overall classroom and college environment and ultimately student learning and persistence. Specific faculty development opportunities offered by the ECliPSE team have included workshops and seminars from ECS faculty and external invited speakers, monthly discussion groups, and an annual ECS Teaching and Learning Book Club. Currently in its fifth year, the team has recorded attendance at one or more faculty development opportunities by 75 faculty – approximately 75% of the ECS faculty – and 16 faculty have participated in over 30% of the programming opportunities offered. However, through faculty surveys implemented by external grant evaluators on attitudes towards the effectiveness of grant activities, a common theme of “not enough time” consistently emerges in faculty responses. Thus ECliPSE developed the 2017 Summer Gateway Course Redesign Working Group. This program, primarily run from June-July 2017, was designed to provide faculty with a designated time and space, as well as both peer support and financial incentives to work over the summer on a proposed project to modify an existing course that they would then implement in the next academic year.

Working group overview

In the spring of 2017, faculty who were expected to teach 1st and 2nd year gateway courses in ECS in the following academic year were invited to apply for participation in the Summer Gateway Course Redesign Working Group. Invitees were informed that the purpose of the working group was to redesign gateway classes to include and/or enhance students’ active learning in order to improve attainment of student outcomes, and test the success of these changes in the 2017-2018 academic year. Applicants submitted a proposal of the type of redesign project they planned to work on and committed to a minimum number of weekly working meetings during June and July. A Co-PI from the ECliPSE team facilitated the Gateway Course Redesign Working Group. Those accepted into the Working Group and who completed the Group requirements would receive: peer teaching, feedback, and support; time and space to work on new ideas, a \$3,000 summer salary supplement (paid through the ECliPSE grant) and an additional \$1000 supplement after implementing class changes and assessing and reporting the

success of those changes. In addition to the weekly meetings, group members were enrolled in a Blackboard group set up for sharing files and participating in discussions. Each working session's content was primarily based upon participating faculties' interests, but generally included discussion of student-active teaching techniques, faculty or support staff presenting short tutorials on techniques of interest, and collaboration between faculty working on similar projects or classes. Fourteen faculty members (4 tenured/tenure-track and 10 teaching-track) drawn from all of the ECS departments were accepted into the group and agreed to the program requirements. These requirements included:

- Attend and actively participate in a mandatory introductory meeting and working session;
- Attend and actively participate in a minimum of four of nine working sessions in June/July;
- Attend and present the final products at a mandatory capstone program in September;
- Complete any "homework" assigned during the program;
- Prepare these final deliverables by August 1, 2017:
 - Revised gateway course learning and project outcomes;
 - An implementation plan that will help to meet the outcomes;
 - An assessment plan to determine if the desired outcomes have been met;
- Implement and assess the course improvements in the next academic year, and submit the results of the assessment.

Of the participating faculty, eight were working on projects for implementation during the Fall 2017 semester, and the results of six of those implementations and assessments are presented here – two faculty did not implement the project due to personal or technical complications. Six additional faculty worked on projects for Spring 2018 courses; discussions of their proposed projects are also included in this paper, but the implementation and assessment results will not be available until May 2018 and thus will only be included in the conference presentation. One faculty member teaching a Spring 2018 course left the university after project development but before implementation. Table 1 below summarizes the context of the projects worked on by faculty during summer 2017.

All of the courses redesigned by faculty in the Working Group were required by at least one major in the freshman or sophomore year, and all majors in ECS were represented except for Civil Engineering. Scope of the projects varied: only one faculty member did a full course redesign in order to combine what had previously been three separate Intro courses for Computer Engineering, Computer Science, and Electrical Engineering majors into a single course that would be inclusive of all three majors and help to elucidate for students how the three disciplines interact. Nine faculty developed major course components previously unused in their courses. The remaining four faculty worked on one or more revisions to existing course components. Project type also varied, with eleven faculty developing or revising active learning strategies for their classes, broadly defined here as in-class instructional methods that directly engage students in the learning process; e.g. designing in-class, paper-based activities or utilizing student polling techniques. Three faculty worked to include hands-on activities wherein students interact with

physical objects in the classroom, one developed a structure for collaborative learning (students working in informal groups) into class time, and one substantially revised a pre-existing Problem-Based Learning (PBL) format of the class.

Table 1: Summary of faculty projects worked on during the Summer Working Group

Course	Faculty Track	Curriculum Major & Year ¹	Project Type	Project Scope	Project Implementation
Introduction to Engineering & Computer Science	Teaching	ME (F)	Hands-On Activities	Course Component	Fall 2017 ²
Introduction to Engineering & Computer Science	Teaching	CompE (F), CS (F), EE (F)	Active Learning, Collaborative Learning	Course Redesign	Fall 2017
Introduction to Engineering & Computer Science	Tenured	BE (F)	Problem-based learning (PBL)	Course Revisions	Fall 2017
Introduction to Engineering & Computer Science	Teaching	EnvE (F), U (F)	Active Learning	Course Revisions	Fall 2017 ²
Chemical Engineering Thermodynamics II	Pre-Tenure	ChE (S)	Active Learning	Course Component	Fall 2017
Electrical Engineering Fundamentals I	Teaching	AE (J), BE (S), CompE (S), EE (S), ME (J)	Active Learning	Course Component	Fall 2017
Introduction to Discrete Mathematics	Tenured	CompE (S), CS (S), SIS (S)	Active Learning	Course Component	Fall 2017
Engineering Materials Properties and Processing	Teaching	AE (S), ME (S)	Hands-On Activities	Course Component	Fall 2017
Engineering Computational Tools	Teaching	AE (F), ME (F)	Active Learning	Course Component	Spring 2018
Thermodynamics	Teaching	AE (S), ME (S)	Active Learning	Course Component	Spring 2018
Electrical Engineering Fundamentals II	Tenured	BE (J), CompE (S), EE (S)	Active Learning, Hands-On Activities	Course Component	Spring 2018
Experimental Methods in Biomedical and Chemical Engineering	Pre-Tenure	BE (S), ChE (S)	Active Learning	Course Component	Spring 2018
Engineering Computational Tools	Teaching	BE (F), ChE (F)	Active Learning	Course Revisions	Spring 2018
Chemical Engineering Thermodynamics I	Teaching	ChE (S)	Active Learning	Course Revisions	Spring 2018

In support of these efforts, faculty learned various methods for recording video for pre-class activities, explored the use of multiple in-class polling technologies, learned about new features in online course content management systems (e.g. Blackboard), developed or revised student

¹ Curriculum Years are Freshman (F), Sophomore (S) and Junior (J). Majors are Aerospace Engineering (AE), Bioengineering (BE), Chemical Engineering (ChE), Civil Engineering (CivE), Computer Engineering (CompE), Computer Science (CS), Electrical Engineering (EE), Environmental Engineering (EnvE), Mechanical Engineering (ME), Systems & Information Science (SIS) and Undeclared (U).

² Faculty member did not implement course redesign project in intended semester.

projects, grading rubrics, and wrote in-class activities and quiz-bank questions. Additionally, each faculty proposed how they would assess the relative success of implementing their various projects in the classroom. Assessment methods were not prescribed – with a wide variety of project motivation, type, and scope, and to give faculty more ownership over implementation and assessment, they were allowed to define success on their own basis. Proposed assessment methods across all of the projects included use of conceptual pre-/post-quizzes, qualitative feedback from students and TAs via surveys, student attendance rates, and quantitative evaluations of student work either as a fraction of students meeting a specified outcome or by comparing averages on exams or assignments to previous course offerings.

Discussion and future workshop directions

Of the six faculty who implemented their redesign projects in Fall 2017, all additionally completed an assessment of the course improvements. By their own previously-defined metrics, five of the six felt that their projects had been at least a partial success as measured by quantified student learning outcomes and/or student attitudes and comments. The sixth instructor felt that the evidence gathered was inconclusive. All six indicated that they planned to further revise and re-implement their course improvements in the next course offering.

As part of the deliverables for completion of the Working Group, faculty were also asked to submit reflections of their experience in summer program. These reflections were a valuable means of helping faculty express their thoughts and provided feedback to the organizers about positive aspects of the group and possible improvements for the next offering. Three main themes were apparent in most of the faculty reflections, specifically: (1) idea sharing; (2) group accountability; and (3) self-imposed higher expectations based on the provided stipend.

Idea Sharing - One of the greatest benefits faculty stated came from the working group was the opportunity to work with colleagues from other departments. Traditional faculty teaching often provides few chances for interaction with faculty members outside of one's own department. As a result, faculty particularly enjoyed the sharing of ideas. Learning about techniques or technologies that other faculty use in their classrooms was inspiration for changes made. Below are some faculty quotes:

“I personally gained knowledge on how to better assess activities that I want to try in class. Such as Pre- and Post- quiz assessments.”

“The working group created a team environment that informed me of the various styles of teaching that the faculty has adopted in their classrooms. There was a lot of wisdom in the group, and the faculty members shared the pros and cons of their teaching styles, which was useful information in developing the flipped classroom.”

“During some of the meetings I had the chance to learn about some new technologies that were used by my peers in their classes. Although they were not directly related to my project, I gained new ideas and expanded my collection of potential tools for teaching. The atmosphere of the workshops was very supportive. We had ample time for genuine exchange of teaching tips.”

Group Accountability – Another major benefit faculty stated they received from the group was the sense of mutual accountability that arose between the members over the summer. Faculty reflected that the group created an accountability that helped them be more productive. They also attributed their increased productivity to the collegiality and supportiveness that developed in the group. All the participants reported that they were more productive on course changes than they would have been without the summer group. For example:

“The group was undoubtedly the motivation to stay on track on implementation of the flipped classroom. I would have not have implemented the flipped as successfully as I did without the guidance, experience, and best practices from the group.”

“I finally worked on learning a new video technique and developing a new student project on process optimization that I’d been wanting to do for a couple years but never quite found the time for. And because I didn’t want to embarrass myself in front of my peers, I worked much harder on my projects during the summer than I would have on my own.”

Stipend – Finally, numerous faculty members expressed that providing faculty with some summer funding allowed faculty to allocate time for the projects and incidentally set a higher expectation on the quality of the work produced. Some representative comments include:

“Regular required meetings tied to a stipend incentive did force me to work consistently on developing the course throughout the summer. It was incredibly effective for me.”

“Each member of the group receives stipend for the work they complete. Personally, I like this arrangement as I will set higher expectation to my work because of that. I also expected each participant to contribute more during our workshop meetings, which turned out to be true. Without the workshop and the contributions of each participant, I may not be able to implement my project up to the current stage.”

“I would likely have pursued the concepts outlined above, but I think it likely that my work on this project would have been deprioritized relative to other projects, resulting in perhaps some but not all of the above changes being made. So, I think the impact of the group was one of degree. The financial support no doubt contributed to me being able to prioritize this project to the extent that I did.”

Faculty also provided suggestions for improvements to the program. Multiple faculty suggested working in a room better suited to breaking out into small groups - the conference room that the group was held in during the summer did not provide capability to break off into sub-groups, unlike many of the newer “collaborative classrooms” faculty apply to teach in to deliver student-active lectures.

One faculty member wanted more accountability for completion of the items they needed in order to fully implement their course improvement project:

“I wish the deliverables were more organized and were a requirement up front, before the start of the semester...with the onslaught of deadlines throughout the semester, I fell behind, and it became impossible to carry on with the flipped format longer than I had initially completed [by the end of summer].”

Other faculty wished there had been more frequent deliverables and reporting to the group so that more feedback could be elicited from the group and incorporated into their project. Some comments indicated that faculty would have liked more structured work time, whereas others liked the relatively open format of most of the working sessions.

While it's clear that faculty members' projects varied in both course expectation and scope, overall faculty thought the Working Group enabled the development of their course improvements, and that the assessments of their course changes demonstrated that they were, in fact, improvements. Additionally, the introduction of the summer course redesign workshop program had a broad impact across the College, with faculty participation and implementation from all departments in the College. As such, the ECliPSE team is pleased with the pilot of this program and hopes to continue it in future summers for faculty teaching 1st- and 2nd-year courses who were unable to participate in 2017, and expand to faculty teaching upper division courses as well.

Additional assessments of the Working Group will be completed after the conclusion of the Spring 2018 semester, when all participants have had the opportunity to implement and assess their projects. ECliPSE will aggregate and summarize all of the assessments performed by the faculty in their courses in order to determine any effects on student attitudes and learning outcomes can be attributed to this specific program. An external grant evaluator will be performing individual faculty interviews to further elucidate changes in faculty attitudes as a result of participating in the Working Group.

Based upon faculty feedback and initial project assessments, future offerings of the Summer Gateway Course Redesign Working Group at Syracuse University will likely include the following revisions: earlier, more frequent, and more clearly-structured deliverables during the

course of the two-month working period; facilitating faculty break-outs during work days; more frequent and earlier sharing of individual faculty members' project progress among their peers for feedback opportunities. Additionally, in order to better ascertain the effects of each course project on student attitudes and learning outcomes, require faculty to include in their assessment plans a common survey to be administered to students, and additionally require a quantitative assessment metric of outcome attainment. Finally, the grant team is considering restructuring the split stipend payments to provide a smaller initial payment upon completion of the summer requirements, and a larger stipend after implementing and assessing the course changes. ECLiPSE recognizes that once the grant has ended, funding for the stipends will be the responsibility of the College, and thus we may also consider to what degree the total amount could be lowered while still providing an attractive incentive to faculty – especially for tenured and tenure-track faculty who may otherwise focus on funded research activities during the summer.

Overall, as a result of ECLiPSE grant activities, engagement of faculty in educational reform across the College has steadily increased since 2013. An external grant evaluator has been assisting with assessment of all of the programming offered through ECLiPSE and its effect on faculty attitudes and practices and ultimately student retention and graduation rates: these assessment results are forthcoming in future reports.

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