

Design Teams at a Distance: A First Attempt

Christi Patton Luks and Laura P Ford

Missouri University of Science & Technology/University of Tulsa

Abstract

In the Spring 2015 semester, Chemical Engineering professors at two universities teaching a similar Junior-level course created a design project for teams formed with members from each school. The intent was that students would have an opportunity to develop some real-world skills in teamwork when part of the team is working in another office across the country or, as is frequently the case, across the globe. In this paper, the authors will describe the challenges faced by the students and by the instructors in implementing this collaboration.

Keywords

Design, distance, teamwork.

Introduction

Teamwork skills are an important component of the engineering curriculum. In industry, engineers frequently find themselves working on teams with colleagues across the hall. Frequently, these team members may be from across the globe. In the Spring 2015 semester, Chemical Engineering professors at two universities teaching a similar Junior-level course created a design project for teams formed with members from each school. The intent was that students would have an opportunity to develop some real-world skills in teamwork at a distance. Although the teams did not have to deal with the struggles of language or time zone that an international project would face, they were forced to establish a work and leadership plan with people they had not met. The two cohorts faced other challenges. One group came from a private university (University A) with a substantial international population. The other group came from a state university (University B) with very few students who were not raised in the Midwest. One class was twice the size of the other. The largest challenge was that one group had completed several design projects in previous classes and anticipated a design project in this course. For the other, this was their first chemical engineering design project and the first semester that design had been introduced into this course.

The project required students to simulate a chemical process that would separate a mixture of several chemicals into purified process streams. This process required multiple separation steps with different types of equipment: absorption and distillation. The project was introduced at a point in the semester where one class had learned to design absorbers and the other had learned to design distillation towers. (They would all have covered both topics before the end of the project.) The teams, therefore, had natural leadership of the two primary technical components of the project. It was up to them to develop communication and a leadership structure for completing the project and writing the report. In this paper, the authors will

describe the challenges faced by the students and by the instructors in implementing this collaboration.

Project Overview

The authors of the paper had experience team teaching the Mass Transfer course at University A. When one author moved to University B and was assigned to teach a similar course (Staged Mass Transfer), the authors decided that it would be interesting to continue the collaboration and use this opportunity to introduce the students to working with a virtual team. The content of the two courses was similar, but not a perfect match. At University B, the students take two separate 3-credit courses covering the material in the single 4-credit course at University A. There are three major topics that are essential to these courses: mass transport, absorption, and distillation. At University A, the topics are covered in that order. At University B, mass transport is taught separately in a co-requisite course. In Staged Mass Transfer, they students cover distillation followed by absorption. By the end of the semester, the students at both schools would have covered all of the material.

At University A, the students have a small design project included in most of their engineering courses. A student should have completed at least three engineering designs before coming into this course and would expect a design project in this course. In this course, the students learn to use HYSYS as a design tool. They have been introduced to the software in prior courses, but develop their skills in this course in preparation for the senior design courses. At University B, the class sizes are larger and design is included in the freshman year, but is not addressed again until the senior year. The students have access to HYSYS, but are not taught to use this tool until they take senior design. This semester would be the first semester where HYSYS would begin to be introduced in lower level courses and Staged Mass Transfer would have 8 tutorials.

The projects done at University A typically were introduced three or four weeks before the due date at the end of the semester. A joint project, would take somewhat longer due to communication difficulties. The calendars of the two schools were offset by a week, meaning that timing would be additionally complicated by Spring Break and other academic calendar restrictions. The project would need to be introduced with adequate time for the students from the two schools to coordinate efforts while working around their Spring Breaks. The project should have two separation phases (absorption and distillation) which could be designed independently, then fine-tuned later. Browsing through chemical process design textbooks, a process was selected that seemed to meet these needs: the ~~creation~~separation~~production~~ of formalin (an adhesive in particle board and plywood).¹

Team Creation

The enrollment in the University A course was ~~4849~~ and the enrollment in the University B course was 86. The decision was made to create twelve teams with 4 students from A and 7 students from B. These were much larger than would usually be used (both instructors prefer group size of 3 or 4), but the extraordinary nature of this project suggested that fewer teams took precedence over team size. The students at A would be the lead in absorption and the students at B would be the lead in distillation. The students at University B were encouraged to divide their

very large team into two subteams. One of these would work on the distillation design and the other would take responsibility for the economic analysis. This meant that the very large teams would have three smaller groups of 3-4.

CATME was used to divide students into teams. CATME is a free academic ~~test~~tool (www.catme.org) that surveys students for team formation and for team performance. The team formation questions enable the faculty to group students based on demographics, schedule, interests, and more. Each instructor divided their students into twelve teams, then the aggregate attributes of these teams was used to pair them. Teams were paired to try to avoid having just one woman on the team. Most teams had 3 – 6 women on their team, although 2 had no women and there was one team with 1 woman. Only one team did not have at least one international student.

Real World Problems

The project was assigned midway through the semester after the University B students had been tested on distillation and had completed 3 HYSYS tutorials. Teams were encouraged to gather during the last ten minutes of class to begin getting acquainted and establish a work and communication plan. The project was distributed to University A students in their next regular class session. At this point they had studied absorption (but not yet been tested) and had slightly more HYSYS experience. Teams were encouraged to contact each other quickly because the next three weeks would be disrupted by university holidays. Most teams sent at least one email immediately, but only a few actually made meaningful contact until after the Spring Break holiday. As a result, most groups had effectively lost half of their project time.

After Spring Break, the authors began receiving panicky emails from students that they could not share their HYSYS files. The software is updated annually. University B had updated their software, but University A was holding off on updating until the end of the academic year. As a result, work done by University B was not readable by University A. The work could be saved in a way that could be read by University A, but there was some loss of information in this transfer. Additionally, some groups had selected property modeling techniques that were not available in the older version. Those groups had to start their designs over again with sharable property packages.

The students had been taught different solution techniques in their courses. Although an experienced engineer is aware that there are many different ways that problems can be solved, to a student just learning the material this was distressing. Also, students would ask their instructors for clarifications as the project progressed. An answer would be given in the moment, but communication delays between the faculty as well as clumsily worded questions from students meant that some “clarifications” became more confusing than helpful.

At the end of the project it was clear that the University A students felt like University B was not contributing their fair share and that University B students felt like University A was not contributing their fair share.

Faculty Problems

The faculty spent much more time helping students solve their problem than during a normal project. Typically faculty spend most of their time clarifying the problem statement and making suggestions on how to solve problems encountered in the use of the HYSYS software. Those problems were still an issue, but several new layers of difficulties became even more significant. Students complained when the other team had dropped off the grid and ~~ask~~asked the instructors to intervene. The software version incompatibility required a significant amount of time sending files back and forth testing the workaround. When students complained about communication failures, one professor had to contact the other to ask them to try to prod the non-communicative team cohort into responding to their colleagues at the other school. At University B where design is not part of the tradition for this course, the instructor had to teach the students that there was not a single correct answer and that they needed to try multiple options to find the best answer. At University A, the instructor had to deal with the other side of that frustration.

At the end of the project the faculty used CATME for teams to evaluate their team interactions. The teams had been set up in two halves, so the students from one university could evaluate their teammates from the same school but not from the other school. An effort was made to add a team member that represented the group from the other school since they had not worked with the individual students that closely. Unfortunately, CATME was not set up appropriately for using it in this way.

Conclusion

In the end, the project was interesting. The students at University B appreciated that they were being introduced to design earlier, but most did not enjoy the interaction with the teammates from the other school. The students at University A mostly viewed this new component of the design project as annoying. They did recognize that these skills were useful for their future careers, but they were not happy with it.

The authors intend to do another joint design project in Spring 2016. This first experience has shown many ways to improve the design of the design project. The instructors will provide more resources (such as a Forbes article on “Managing Virtual Teams: Ten Tips”) on how to work together as a team.² More guidance will be given on how to communicate. Team sizes will be smaller. In order to deal with the disparate class sizes and to serve as a control, some teams at University B may be local-only. The authors are corresponding with CATME to see if their program can be adapted for the blended teams needed in this project. If not, the authors have ideas for how to improve the experience for next time.

References

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Christi Patton Luks

Dr. Luks earned a B.S. in Chemical Engineering from Texas A&M University, a M.S. in Applied Mathematics from The University of Tulsa and a Ph.D. in Chemical Engineering from The University of Tulsa. Currently she is Associate Teaching Professor of Chemical Engineering at Missouri University of Science & Technology.

Laura P Ford

Dr. Ford earned a B.S. in Chemical Engineering from Oklahoma State University and a Ph.D. in Chemical Engineering from the University of Illinois-Urbana/Champagne. She is Associate Professor of Chemical Engineering at the University of Tulsa.