# A Team Leader Model for Biomedical Engineering Design Team Project-Definition Training and Scalable Clinical Observation (Work in Progress)

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# A team leader model for scalable clinical observation in the biomedical engineering capstone design course
# Work In Progress

Overview

A critical step in undergraduate biomedical engineering capstone design projects is problem identification and validation. This process is enriched with training in clinical observation and root-cause analysis. For projects developed around a clinical need, active training in observation for large groups (>50 students) is challenging—many clinical procedures limit observation groups to three students or fewer, are not rigidly scheduled, and physician time is expensive and limited. A team leader model, upon which our design program was conceived, can alleviate these issues, reducing the logistical burden on clinical resources and enabling a peer education system (Figure 1).

Team Leader Training Courses

We employ a team leader model, where students apply and are interviewed by faculty to be selected as a leader nine months before the academic year. The process of selection is described elsewhere (Allen 2013). In brief, students apply for the leadership position. Faculty select leaders based on their academic and extracurricular records and an interview process. We developed two one-credit team leader courses to *precede* the traditional yearlong design team course at our University. This includes a clinical observation and immersion course during intersession and a leadership and project management course in the spring semester (Figure 2). During intersession, leaders complete training in need identification, root cause analysis and validation. The flexible intersession schedule allowed for ~2 weeks of clinical immersion, affording the students a rich practicum in clinical observation techniques. We encourage a spiral approach to project definition that requires several passes through observation, need finding and validation, with each pass increasing in duration and depth. The first pass was observation of a single clinical scenario; the second pass was a week of observation that allows seeing many variations of a clinical procedure, and the third pass is the final weeks of the semester when the projects are selected.

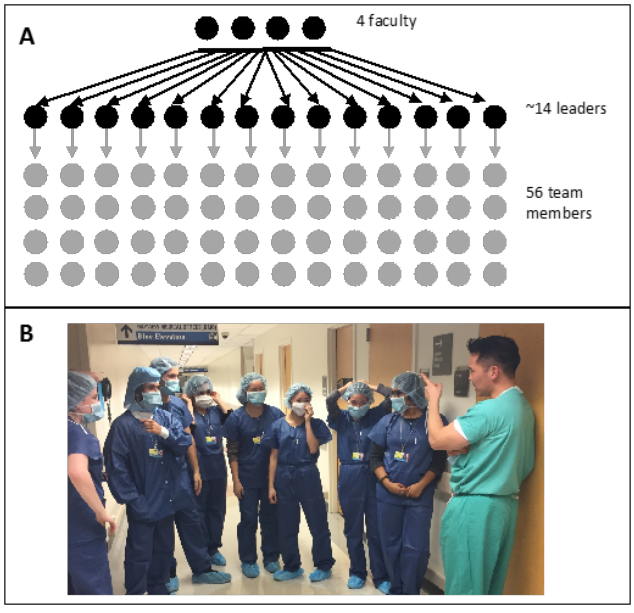


*Figure 1. Team leader structure for training in projected definition and clinical observation. (A) Four faculty advise 14 leaders who subsequently train their team members. (B) Picture of hands-on clinical observation training of leaders with clinical faculty.*

With a small group of team leaders we are able, with support from medical school faculty, to coordinate extended and direct access to clinical mentors in our program. The model allowed us to give limited resources to a small number of students who then translated the learning from those resources to many more. The system is scalable – adding one leader to the immersion course for every four students added as team members. Additionally, during clinical immersion, leaders are combined into teams to simulate the interactions they will have when their future team members join later in the spring semester. This allows them to try out different methods of divided or delegated observation, leading to richer observational experiences. They learn how to work on a team in this type of environment before they lead their own team.

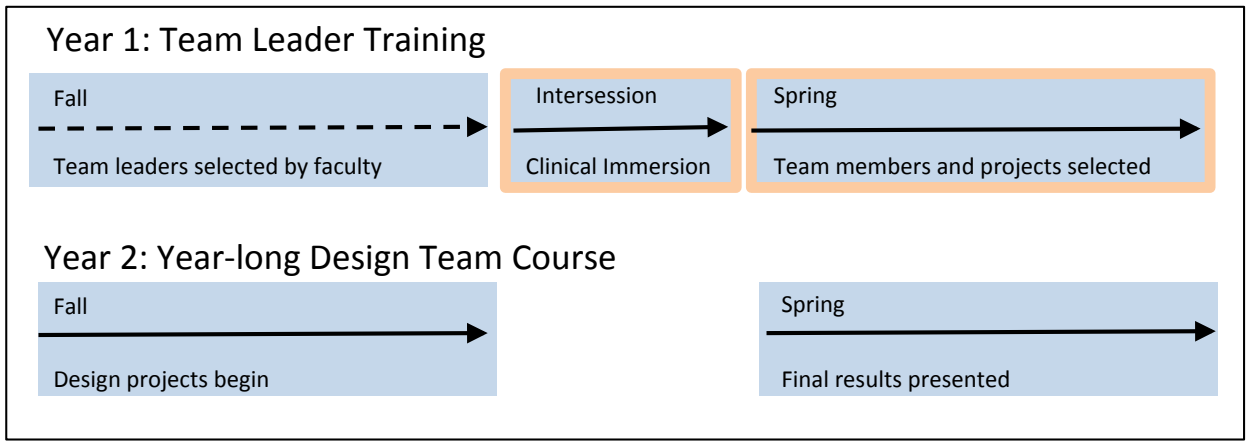


*Figure 2. Overview of undergraduate design team program. Highlights show two one-credit courses train team leaders the year prior to the design team course.*

Following the intersession course, we offer a spring semester team leader preparation course for didactic training in team formation, organization and operation, as well as project management. During this course, team leaders select their teams and led them through targeted clinical observation in project areas of interest. Providing the leaders with upfront training put them in a position to educate their team members and reaffirm the techniques they practiced in the intersession course.

During this spring semester, students who wish to participate in design teams the following year apply on line to be part of the program. Team leaders conduct interviews of applicants for possible design team members. The team leaders themselves work out a system to select team members in a fair manner. The teams are formed just prior to project selection. If more students apply than the program has spots for, they have other venues to satisfy ABET's design requirement, including applying to be a member in the next year.

Instead of de novo needs finding from observation for project selection, teams select project areas submitted by clinical faculty and used learned observation techniques to define specific project opportunities based on a clinical need within these problem areas. Course faculty first vetted of the project area submissions for appropriate scope and then select clinical faculty presented their clinical problems to the class (leaders and team members). There are typically

>60 vetted project areas for the ~14 teams to select from. Coordinating the presentations into two sessions facilitated the primary interactions between students and clinicians reducing the logistical challenges of fourteen teams meeting with 30+ potential clinical mentors. Survey results indicated that 67% of leaders found these presentations "extremely useful" and 33% found it "useful" for project selection.

Teams subsequently selected several project areas to research further. Leaders train their team members in needs finding and validation, and lead their teams in ~6 weeks of targeted clinical observation to assess these selected project areas. All team members participate in clinical immersion for this period. After project definitions and validation, teams developed their own criteria for project selection. The spring team leader course culminated with each team selecting a project for their yearlong design team course. The final deliverable for this course is a design brief detailing the process of need filtering conducted by the team and their ultimate project selection. Due to the large pool of project areas to select from there is little conflict between the final selections. Clinical mentors are notified at the end of the semester if their project areas submission was selected. These mentors can plan and engage with teams if they so choose during the summer prior to the year-long design course.

Results and Discussion

This model gave both leaders and team members the opportunity to experience clinical observation and shifted the logistical burden from the few faculty to the ~14 team leaders and the clinicians promoting their projects of interest. Completing this training ahead of the design team course allowed teams to start with a deeper understanding of medical needs and applications of their project need and practical clinical constraints, a working relationship with their clinical mentor, and primer on team and project management. Survey data indicates that students had a positive clinical immersion experience (Figure 3). Moving forward we aim to collect data from team members related to their satisfaction and learning during the project selection process. Results through the fall thus far demonstrate superior need statements and specifications in general, and prototype development much earlier than in prior years. In addition, all students were motivated to spend part of the summer researching their project areas. Although the program is promising and scalable, the differences in education and advancement in prototype development in the year ahead will be a truer measure of impact.

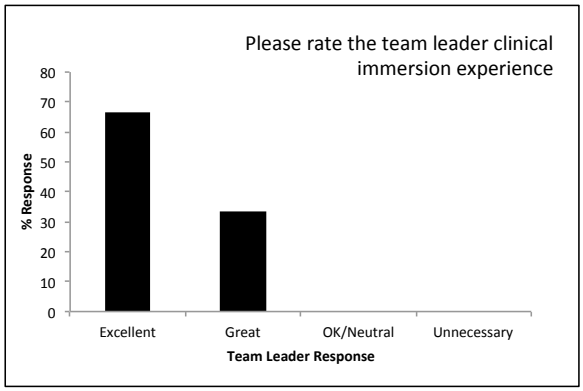


*Figure 3. Survey results from team leaders about their satisfaction with the clinical immersion training during the intersession course.*

## Conclusion

We utilized the team leader hierarchical structure of our program to direct training in project definition and clinical observation. Upfront training of the leaders empowered them to subsequently train their team members and assume the logistical responsibilities associated with clinical observation. Faculty filtering of submitted project areas, instead of defined projects, gave teams the opportunity to use need finding and validation techniques in a targeted approach. Coordinated problem area presentations further assisted with large-scale project assessment by many teams. This system has the potential to impact the depth of student understanding of the clinical need and their ability to identify innovation targets even in large-enrollment design courses. The impact of this program on team members will be measured by end of course surveys.