# Reflection Enhances Student Engagement and Team Service Project Implementation in a Bioengineering Honors Program (Work in Progress)

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**Work-in-Progress: Reflection Enhances Student Engagement and Team Service Project Implementation in a Bioengineering Honors Program**

Reflection is a process in which one examines current or past experiences, and then uses this information to make decisions about future actions. In engineering courses, reflection is used primarily to promote cognitive development.[1-3] For example, immediately after an exam, students articulate what helped them do well on the exam and what they could do differently to improve their performance on a future exam. In addition to improving academic performance, reflection is associated with student gains in social skills, civic engagement, and attitudes toward self and learning.

This work-in-progress describes the novel implementation of reflection to enhance student engagement in the Bioengineering Honors Program at the University of Washington, in which senior bioengineering students complete a leadership-based one-quarter seminar and address a need in the bioengineering community through a year-long team service project. Previous work[4] describes the use of reflection to enhance student development of leadership competencies in the honors seminar.

This work-in-progress is focused on efforts to use reflection in the honors seminar to enhance student engagement, and improve team service project outcomes. Innovations include:
1. Use of reflection to provide scaffolding for course content, including new activities involving project selection and establishment of project criteria.
2. Increased frequency of reflection (both before and after each activity or discussion topic)
3. Reflections submitted to instructor instead of online class discussion board
4. Before completing end-of-year individual reflections on their experience, teams complete an evaluation and create a manual for sustainability of their service project

Similar to previous studies,[5-7] we consider several indicators of student engagement:
1. End-of-course student survey data
2. Informal feedback from instructor-student conversations
3. Perceived student effort based on instructor observations of student behavior such as in-class participation, and meaningful contributions to in-class or online discussions
4. Quantitative analysis of student activity, including timely submission of reflections or participation in online discussion board, and length of reflections (number of words)
5. Qualitative analysis of student reflection (keywords coded by instructor)
6. Project outcomes and perceived student effort in team service projects, based on instructor's interactions with teams during 2-quarter implementation following seminar
7. Quality of end-of-project deliverables:
    a. Individual student reflections on experience in the departmental honors program
    b. Team evaluations of project at end of year
    c. Completeness and quality of content of sustainability manuals

For the year-long team service projects, student teams may select any bioengineering-related topic that serves the department, university, or surrounding community. Project proposals are evaluated at the end of the seminar (course is graded credit/no-credit). The project outcomes are

evaluated by both students and instructor, but are not graded. Outcomes and examples of projects from current and previous years will be provided at the conference, including:

1. 3D Printer Curator Program
2. Bioengineering Toy Adaptation for Children with Disabilities
3. Student Stories: Humans of BIOE
4. *Denatured* Bioengineering Journal
5. Bioengineering Educational Outreach
6. Diversity and Ethics Curriculum for Engineers
7. The BIOE Studio: Social Media for BIOE Department

**Reflection increases student engagement: example innovations and preliminary results**
The motivation for this work stems from student feedback from the 2014-15 course offerings, where students responded to weekly reflection prompts on an online discussion board and were encouraged to comment on their classmates' posts. Students felt the weekly discussion board posts, which included either a pre-class thought question for the upcoming week or a post-class reflection on that week's class content, could be better utilized to support or "get more out of" the in-class activities and discussions.

In response to this feedback, in Autumn 2016 we aimed to increase student stake, ownership, and accountability in the honors program through reflection. We implemented innovations in reflection such as submission directly to instructor and increased frequency of reflection (n=20 reflections/quarter in 2016 vs n=10 reflections/quarter in 2014-15). To help scaffold course content (such as selection of meaningful service projects and creation of project criteria, below) with individual reflection, each week the students completed a pre-class reflection to encourage them to think about the topic before the in-class activity or discussion, and then completed a post-class reflection (2 reflections/week instead of 1/week, pre- and post- for each topic).

As described below, we observed striking improvement in overall student engagement when these innovations were implemented, and our observations are supported by excerpts from student reflections themselves as well as end-of-course student surveys. Also, the instructor noted that students were more actively involved in course activities and discussions, and provided more in-depth reflections overall (indicated by an increase in the number of students who completed assigned reflections and submitted them on time, and an increase in the number of words per reflection; data to be presented at conference). In addition, when only the instructor read submissions, we found that students were more candid about how their future choices would be informed by what they were learning in the course. Finally, the increased frequency and quality of student reflections provided valuable formative assessment for the instructor.

Student selection of team service projects
In previous years, project teams were formed using an online discussion board. There was no in-class activity or individual reflection to support this process. Students posted brief descriptions of their project ideas on the class discussion board, and then interested students signed up for the projects. Student feedback from previous years indicated that many students felt they were not given the opportunity to make an informed decision before committing to a project. Many students stated that they were not confident enough to post their proposed project online because their idea was not yet fully developed, and so they abandoned their idea and opted to join a

different project team instead. Finally, students reported that they chose their service project based on the other students on the team, not on their interest or perceived value of the project.

In Autumn 2016, students were assigned a written reflection on 1) identifying a need in the bioengineering community, 2) a personal interest or experience that may be valuable to their team or project, and 3) one skill that they wanted to learn or develop in their project. In the next class session, the instructor reminded students to think about the needs, interests, and skills from their reflections as they brainstormed project ideas with classmates. Then the students outlined their ideas on flipcharts, and presented them in an "Honors Project Gallery" where students roamed among stations. Student excerpts from reflections on this experience include:

- "I enjoyed participating in the Honors Project Gallery because it allowed students time to brainstorm while actively walking around the room. Going into this, I already knew which project I wanted to participate in, but I thought it was a helpful in that each group could identify potential collaborators for their project."
- "This was certainly a useful format. It gave me an opportunity to talk to my classmates and see what everyone was thinking about doing, share ideas and form my own. It had sufficient structure to facilitate productive discussion, but was open enough to allow free flow of ideas. I was undecided before the Gallery and decided on a project afterwards."

Student generation of criteria for team service projects
In the Autumn 2016 offering of the honors seminar, we used a novel "speed dating" interview format followed by small group discussion for students to generate class criteria for team service projects. (Student-generated criteria will be shared at the conference.) This is in contrast to previous years, where the instructor supplied these criteria. Student reflections completed after this in-class activity indicate that students appreciated the opportunity to be held accountable to criteria of their own design. Excerpts from these reflections include:

- "It was good to interview each other to collectively brainstorm ideas and generate lists."
- "[It] really made me think of what I thought the proposal should look like for our projects and what we should be thinking about when designing the projects."

**Student responses to innovations in reflection**
Overall, students were positive about reflection. In one reflection, a student commented that reflection was "cathartic" and "something I never take time to do on my own." Student feedback from end-of-course evaluations indicates that most students saw the value of reflection, although some students experienced reflection fatigue. Student comments include:

- "…personal reflections were stimulating if taken seriously."
- "Some of the reflections seemed unnecessary – like we were reflecting just for the sake of reflecting."

**Conclusion**
In summary, this work-in-progress describes our ongoing efforts to enhance student experience in the Bioengineering Honors Program at UW by increasing the frequency and scaffolding role of reflection. Preliminary results indicate that these efforts improve student engagement in the Autumn seminar and overall program, and promote success in the design and implementation of year-long team service projects.

**Bibliography**

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