

# Engaging Engineering Students through Creative, Collaborative, Service-Based Projects

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## Abstract

The innovation highlighted here, which may be categorized as **Active Learning (LC3), engages engineering students in creative, collaborative, service-based projects as part of a course.** The project requires the design, analysis, and construction of a structure.

I have implemented the project three times over the past three years, with varied levels of engagement and success.

I would like to expand the project to include scholarship and create a more formalized approach to selecting and funding projects.

## Introduction and Objectives

My main goal for the innovation/project is to engage and motivate the students and help them to see that engineering is creative.

Through this project I hope to:

- **Foster engineering creativity and collaboration**
- Change perceptions of engineering
- Learn what types of projects engage and motivate students

I have been using this type of project in a sophomore/junior level engineering course but hope to extend the ideas to other courses.

## Developmental History

For the past three years I have required students in my Structural Analysis course (ENGS71) to work collaboratively to design, analyze, and construct a structure for a non-profit organization in the community.

Three years ago they created a **play-loft** for a local preschool, two years ago they built a **worm-composting walkway** for the Dartmouth Organic Farm, and this past year they designed and constructed a universally-accessible **treehouse**.

## Learning Activities and Materials

Learning materials that I've developed to support this project include:

- A **process** that involves numerous components as outlined in the Execution Section
- A **design manual** to guide students through the wood design aspects of the project
- **Rubrics** for each phase of the project
- A set of **creativity exercises**

ENGS71 - Structural Analysis Design Manual

ENGS71. Conceptual Design Ideas Spring 2011

Treehouse at Oak Hill Design and Construction ENGS71 - Structural Analysis Spring 2011

Name: \_\_\_\_\_ Group: \_\_\_\_\_

Most Interesting - what did you find most interesting about the presentation? Final Design - what aspects of the group's conceptual design do you think should be included in the final design?

1 - Brigham Cully, Alyssa Boehm, Nate Skakelley, Alyssa Pickett, and Katie O'Leary

ENGS71. Self and Peer Evaluation Spring 2011

Please evaluate each member of your group (including a self-evaluation). For each category give your peer a rating from 0 to 10, with 10 indicating full participation and 0 indicating no participation.

Self:

Participation in group meetings: \_\_\_\_\_ Group: \_\_\_\_\_

Completion of group tasks: \_\_\_\_\_

Overall ability to work as a group: \_\_\_\_\_

Ability to lead the group: \_\_\_\_\_

ENGS71 Treehouse Design Presentations

Conceptual Design Aspects	Full Points	Zero Points	Points
Design Specifications and Details	A complete set of specifications and details is developed.	No specifications or details.	15
Design Justification	Multiple design ideas are compared using appropriate specifications and metrics. A clear justification for the design selected is presented.	Only one design is presented with no justification.	10
Design Drawings	Drawings are neat, readable, and to scale. Dimensions are included.	No drawings.	15
Design Model	A well-constructed physical model of one design aspect is created to scale (2:1 scale). Each group will be members of the review of the design are included. Your points fit together with the rest of the group.	No physical model.	15

### Creativity Exercises:

SCAMPER, Analogies, Brainstorming, Thinking Hats, Design Sketching

## Execution

Each of the projects have included the following aspects:

- **Site Visit** – planned early in the term
- **Guest Speakers** – engineers & contractors
- **Review Board**
- **Conceptual Design Phase** – small groups create a conceptual design that they present to the class and review board
- **Final Design and Analysis Phase** – Each group is assigned to work on one aspect of the project and coordinate with the other groups on their designs. At the end of this phase, each group presents their final design to the class and review board and submits a set of calculations
- **Construction Phase** – small groups construct different parts of the structure
- **Project Celebration** – At the end of each project the class and client meet for a celebration at the site

Funding, permitting, and transportation requirements are facilitated by Vicki, with the help of staff at Dartmouth.

## Discussion

All of the projects were **successful** in that the students completed all phases of the project, including construction, before the end of the term. And in all cases the client was happy with the constructed project. With respect to **engagement**, the students were highly engaged by the play-loft and treehouse projects and less engaged with the worm-composting walkway. Feedback from the students indicates that they really enjoyed the **creative** aspects of the loft and treehouse projects. I plan to continue incorporating a creative, collaborative, service-based project in my courses and am exploring more **global projects** such as affordable housing for Haiti.



I have submitted three education-related **grants to NSF** (to the GSE, RIGEE, and GK-12). The GK-12 (Fostering Scientific Creativity) was funded the other two (focused more on student retention were not funded but I plan to resubmit, likely changing the focus to creativity).

## Completed Projects



## Issues to Resolve

While I feel that this type of project-based activity is well-integrated into my course and is based on sound pedagogy, I'd like to create a more **formalized approach to selecting and funding projects** and extend beyond the local community to **tackle more global issues** such as affordable housing. With a better system in place for funding and finding projects, I could use similar projects in other courses and could collaborate with others on campus to work on larger-scale projects.

In addition, I'd like to focus more on the scholarship of teaching and **engineering education research**: in the area of project-based learning or creativity or outreach.

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