# Increasing Engagement with Independent Student Projects Supported by Institutional Resources

*Project RITE Proposal*

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## Research Problem

Traditional classes and assigned projects are a mainstay in our educational process, but research has shown that students learn more and retain the learning better when they define what, when, where, and how they learn. This proposal will assist in acquiring resources to support a newly established Engineering Fundamentals (EF) Innovation and Collaboration Studio (ICS). The mission of the ICS will be to provide space and resources that will be available to all interested students so that they can work on independent projects. Our primary question of interest for this research study is:

*How does participation in the ICS developed self-directed learning skills in students?*

Our research is informed by the theory of self-directed learning (Caffarella, 1993), which is defined as the state where learners are expected to be primarily responsible for their own learning.

- What types of students take advantage of this space?
- What types of projects do students want to work on?
- How does the types of projects and learning map to and support the topics of existing classes?
- How does the collaborative environment enhance the students' learning?
- What types of institutional resources and support are required?

## Literature Review

Similar to "Makerspaces" or "Fab Labs" that have become popular in recent years, the ICS will focus on providing first-year engineering students the opportunity to use new technologies for prototyping and fabrication, such as 3D printers, laser cutters, and CNC equipment. By building on the development of similar spaces at other undergraduate institutions [Georgia Tech Invention

Studio], EF will provide a space to engage students in creative and innovative thinking while building a collaborative community among engineering students, staff, and faculty.

Engineers are faced with the need to come up with creative solutions to the ever-changing demands of a diverse society, both nationally and globally. In order to meet these demands, engineering students need to be equipped with skills in innovation, creativity, and invention (National Academy of Engineering, 2004). While engineers of the early 20th century were engaged in a hands-on, apprentice type engineering curriculum, a shift in the 1930's saw many engineering curriculums in the United States move away from hands-on education and towards a focus an engineering analysis-only curriculum, in order to mirror that of the European model of engineering education (Seely, 1999). In the early 1990's, the US saw a movement to balance engineering curricula with both a focus on engineering analysis as well as a focus on engineering design (Sheppard & Jennison, 1997). To aid in this balance effort, a number of engineering educators began incorporating hands-on experience back into their curricula.

As we move forward in providing students with more hands on experiences to supplement their analytical engineering learning, it is important to create spaces conducive to allowing students to engage in both analytical and creative thinking. One of the ways that a number of universities are building these community spaces is through the development of makerspaces. The purpose and concept of a makerspace is to build a collaborative space for inspiration, innovation, and education. (Dougherty et al., 2012). In these spaces, students are engaged in learning specifically to their interests and needs instead of only learning in a one-size fits all environment. They are also allowed to play, create, and try new techniques.

## Project Significance

Building a collaborative space for first-year engineering students to engage in innovative and creative activities while applying their analytical engineering learning will significantly enhance the freshman experience for the students who use the resource. One of the things beginning students struggle with is how does what they are learning in a physics class pertain to their future career as an engineering. In addition, the structure of a traditional large class inherently limits the ability of students to pursue ideas and interests outside of the classroom. The ICS will provide the opportunity for students to work on projects of their choosing so they can control and experience the pertinence of their projects while at the same time gaining the valuable skill of self-directed learning (Caffarella, 1993).

## Methodology

### *Participants*

The ICS will be open to all UT students, but we will only actively advertise and promote it to freshman engineering students that are taking the core curriculum classes: (EF 151, EF 152, EF 157, or EF 158).

### *Data Collection and Analysis*

To utilize the studio, students will be required to register. Part of the registration process will be a background, interest, and experience survey. A requirement for utilizing the studio and its resources will be to provide online documentation (via blogs or wiki pages) of the results of any work done. An end of semester survey will be given to all registered students. The surveys used as pre-post assessment for the ICS will be informed by the theory of self-directed learning. Post surveys will also investigate topics areas such as projects of interest, collaboration, and connection to course material. Students will be given general direction on how to create and maintain wiki's or blogs posts. These wiki's and blog posts will be analyzed qualitatively in order to look for evidence of self-directed learning activities while participating in ICS activities. The outcomes of this research will contribute to our understanding of how extra-curricular spaces, such as makerspaces, contribute to the development of self-directed learning skills.

## Timeline

- **Current** : The initial space for the ICS has been identified and readied - Estabrook B012. Some equipment and supplies (hand tools, 3D printer, 3D printing materials) have been purchased with operating funds.
- **November, 2014 – December, 2014** : Procure the equipment that will be funded by this grant.
- **Jan, 2015 – April, 2015** : ICS open for student projects. Collect data via observation, surveys, and student documentation of projects.
- **May, 2015** : Analysis and publication of initial results.

## Budget

- MakerBot Replicator 2X 3D Printer (Dual Extruder) or equivalent - $2600
- 1.75mm 1KG Spooled Filament, variety of colors, 10 spools @ $40/spool - $400
- If additional funding is available: Optimized computer for 3D design: Dell Precision Tower 5810 Workstation, 16 GB, 4GB NVIDIA Quadro K4200 graphics, Dual 24" Monitors or equivalent - $3000

## Notes

1. The ICS will utilize several different funding sources such as grants, technology fee, and engineering differential tuition funds.
2. This project could make use of additional funding above the $3000 award.
3. Equipment provided by Project Rite funding will be clearly labeled as to acknowledge the support of OIT and Project Rite.
4. A statement of institutional support will be provided by Dr. Richard Bennett, Director of Engineering Fundamentals.

## References

1. Georgia Tech Invention Studio: http://inventionstudio.gatech.edu/
2. Purdue Ideas to Innovation Learning Laboratory: https://engineering.purdue.edu/ENE/Academics/i2ilab
3. Texas A&M Engineering Innovation Center: http://engineering.tamu.edu/easa/areas/enrichment/eic
4. Caffarella, R. S. (1993). Self- directed learning. *New Directions for Adult and Continuing Education, 1993*(57), 25-35.
5. Dougherty, D., Griffith, S., Hlubinka, M., Rosenburg, J., Hoefer, S., & Chang, S. (2012). Makerspace Playbook.
6. National Academy of Engineering. (2004). The engineer of 2020 : visions of engineering in the new century *Visions of engineering in the new century*. Washington, D.C.: Washington, D.C. : National Academies Press.
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8. Sheppard, S., & Jennison, R. (1997). Freshman engineering design experiences and organizational framework. *International Journal of Engineering Education, 13*, 190-197.