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GIFTS: Undergraduate Student Professional Development

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The Engineering Lab provides a Makerspace and Resource Room for all College of Engineering students, focusing on first-year engineering students. We collaborate with the College of Engineering, as well as schools throughout the state of North Carolina, to further Engineering Education.

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Introduction

This paper explores the impact and effectiveness of the innovative approach taken by a student-run Engineering Lab in the College of Engineering at NC State University, with guidance and mentorship from a faculty lab manager, in promoting professional development through peer mentorship. By providing students with hands-on experiences, collaborative projects, and guidance from experienced peers, The Engineering Lab fosters a dynamic and supportive environment encouraging continuous learning and growth. The paper analyzes the benefits of this approach for the undergraduate student lab assistants running the lab, and will serve as a model for how other universities can empower students to play a critical role in fostering innovation and development within their communities. This model provides insights into the role student leaders have in promoting professional development and continuous learning among and for their peers, and demonstrates the engineering lab model potential for replication and adaptation in other contexts.

Motivations

Noticing a lack of accessible workspaces for first-year engineering students on campus, The Engineering Lab (TEL) was founded with the intent of providing resources and support for student use in completing their introductory engineering course required projects and providing fundamental design skills and tool usage knowledge. Other engineering labs and makerspaces around campus are generally targeted to upperclassmen and students working on their capstone senior design projects. While these spaces are not generally restricted to freshmen, they are not given priority and thus, have fewer resources available to them. These spaces are not approachable to first-year students, which is why TEL strives to create a space where students feel comfortable to make mistakes and fully interact with the engineering design process under the guidance of Engineering Lab Assistants. The Engineering Lab consists of two small spaces: The Makerspace and The Resource Room.

The Makerspace
The Makerspace is the branch of the Engineering Lab that provides the workspace for students to design and build their projects. The Makerspace also provides tools that the students are able to use in the construction of their designs. These tools include both power tools, such as a Miter saw and drills, and also hand tools, such as pliers and screwdrivers. Students also have access to whatever hardware they may need for their projects, such as screws, nails, nuts, or washers. This space is also conveniently located right next door to the Resource Room, so additional materials are accessible to the students when working in the lab. The only requirement for this space is that the students complete a short safety training on tool usage to ensure the Makerspace is a safe workspace for everyone.

Resource Room
The Resource Room is a valuable resource for these students as it provides materials for the students to use while designing their projects. These materials range from recycled items such as paper towel rolls, foam pieces, and cardboard, to items that would cost more for the students

such as wires, multiple types of motors, arduino boards, and a variety of hardware, such as nails, screws, and scrap wood. Engineering students explore different processes throughout the design process, and try multiple possibilities in the construction of their project due to the accessibility of materials. Post COVID, the Resource Room has seen increased student usage in their preparation for their course project, impacting material consumption and increasing cost of the Engineering Lab, and has led to many changes in the methods the staff uses to optimize these processes in order to better serve the students as well as the College of Engineering.

The Engineering Lab Objectives for Students

The Engineering Lab objectives include the following: Providing real world work experiences for undergraduate lab assistants, increasing lab assistant leadership and peer mentoring skills, and providing a lab space for first-year engineering students to learn tool skills and the engineering design process. The staff has implemented various strategies in order to achieve these objectives. One of these strategies is offering workshops and training sessions on the available power tools, hand tools, and 3D printers for students. Other efforts include encouraging lab assistants to attend engineering outreach events, and setting up one-on-one mentorship sessions between experienced staff members and new hires. The lab also promotes collaborative problem-solving and peer-to-peer learning through team projects, which gives all the lab assistants a chance at project management. By providing these opportunities, the makerspace is able to drive innovation and create a dynamic and thriving team of staff members.

The Engineering Lab Team Lead Objectives
The Engineering Lab Team Lead for "program name retracted" at the College of Engineering is an exceptional career development position for a motivated undergraduate student interested in developing leadership skills in lab and personnel management. The Engineering Lab Team Lead, under the guidance of a faculty manager, is responsible for overseeing implementation of The Engineering Lab and Resource Room programs. These duties include managing undergraduate lab assistants, leading weekly staff meetings, coordinating staff scheduling to ensure adequate coverage of the Engineering Lab, assisting with the hiring and conducting new employee training, communicating with staff to ensure the smooth running of all programs, and assisting with staff job performance evaluations each semester. This position provides unique personal and professional job experience for engineering students interested in advancing their career opportunities upon graduation.

The Engineering Lab Assistants' Objectives
The Engineering Lab Assistant for "program name retracted" at the College of Engineering is an exceptional career development position for a motivated undergraduate student interested in developing leadership skills in lab programming and implementation. The Engineering Lab Assistant is responsible for overseeing several projects in the lab which supports The Engineering Lab Makerspace, and Resource Room programs. These duties include learning how to lead weekly staff meetings, coordinating and communicating with fellow lab assistants to ensure smooth facilitation of lab leadership, and learning how to problem-solve and improve systems. The Engineering Lab Assistant ensures all supply requests are fulfilled and assists students using The Engineering Lab for research. This leadership position provides unique personal and professional job experience for engineering students interested in advancing their

career opportunities during their undergraduate program and increasing their employment marketability upon graduation.

TEL also provides networking opportunities for the lab assistants while developing their team-building, collaboration, and project management skills. Lab assistants have the opportunity to step into leadership roles when taking on personal projects within the workplace. Assistants create plans and procedures in order to complete a multitude of projects, such as introducing a barcode system to the resource room inventory. These personal projects also improve lab assistants' creativity, planning, and time management skills. Lab assistants are able to set their own deadlines and are given almost full control of their project with intermittent check-ins. This is an essential objective of TEL which teaches many transferable skills to its staff.

First-year students' Objectives
First-year engineering students are developing fundamental problem-solving and design skills in their freshman courses. They are supervised by TEL lab assistants who are there to help students work through problems, suggest possible solutions, and be a resource of knowledge for students. TEL lab assistants are mentors and peers for students as they help develop the space for the education of first-year students. In order to help the lab assistants strengthen the skills needed to mentor the first-year students, TEL's faculty lab manager provides professional development and leadership opportunities for the lab assistants in order to improve their technical knowledge and become more team-oriented. The assistants in engineering discipline exhibit diversity in technical knowledge and age, with a range spanning from freshmen to seniors. Thus, the lab assistants may also be considered peers of first-year students, making them more approachable to students. Their presence in TEL helps foster a productive environment, strengthening first-year students' creativity and planning skills.

Implementation Guide
Fall Semester
During the fall semester, the lab assistants place a strong emphasis on team building and preparation for the spring semester. To foster a cohesive and supportive team environment, the staff participates in team-building activities such as weekly team meetings, where employees get to alternate leading discussions on upcoming projects and necessary changes. These activities help to promote open communication and collaboration among team members. Additionally, the staff also focuses on preparing for the spring semester by creating plans and schedules for upcoming events, workshops, and projects. The lab staff also takes the time to research and test new technologies, materials, and techniques that can be used in the spring. By focusing on team building and preparation during the fall semester, the lab assistants are able to ensure that the makerspace runs smoothly and effectively, providing a valuable resource for the wider community.

Spring Semester
During the spring semester, the lab assistants focus on providing leadership, peer mentorship, and supervision to incoming freshman students. This includes organizing lab sessions and training courses for the first-year engineering students to introduce them to the makerspace and its resources. Through supervision and the provision of materials for the freshman's engineering projects, the staff encourages the first-year students to take a proactive role in the makerspace

and provides them with opportunities to grow and develop their own professional abilities. By focusing on leadership, peer mentorship, and guidance, the lab assistants are able to practice their own leadership and mentoring skills while contributing to the inclusive environment provided for the freshman engineering students. The staff foster a sense of community and promotes continuous learning and growth.

Assessment Methods

Assessing the performance of the staff is crucial to ensure they are delivering high-quality and reliable services to the students. To evaluate the professional growth and development of the staff, performance evaluations are conducted each semester by the faculty member and team lead to promote growth and development for the lab students, and overall success in the workplace. These evaluations are a comprehensive assessment of an individual's job performance and provide opportunities for feedback and constructive criticism. Performance evaluations provide valuable insight into the lab assistant's job performance and overall contribution to the organization. They promote open communication and allow for constructive criticism and feedback to be given. This feedback helps the lab team understand their strengths and areas for improvement, helping them to focus on developing the skills they need to succeed in their role. The evaluations also provide a framework for setting performance goals, tracking progress towards these goals, and aligning staff efforts with the organization's objectives, leading to increased productivity and job satisfaction.

The performance evaluations take into consideration factors such as technical knowledge, customer service, teamwork, and problem-solving skills. In addition to performance evaluations, the lab staff's professional growth can also be assessed through self-reflection, goal setting, and opportunities to expand their skills by taking on new projects. The staff is also encouraged to participate in workshops and attend conferences. The combination of performance evaluations and other assessment methods provides a comprehensive view of the lab staff's professional development and helps ensure that they are able to sufficiently provide services to the first-year students using the makerspace.

Next Steps

The Engineering Lab experienced setbacks as a result of the COVID-19 pandemic. However, the dedication of the staff members and faculty manager has helped to revitalize the space and make it available to students once again. The lab assistants developed a survey using Google Forms to receive feedback from the engineering students that have completed FEDD (Freshman Engineering Design Day). The purpose of the survey is to analyze the first-year students' growth and determine the effectiveness of the resources and opportunities that the lab assistants worked to provide. The feedback will be used to improve the accessibility and efficiency of the makerspace and resource room. This survey will be sent to the students once they complete their first-year engineering project, and the results will be used during the upcoming fall semester to make any changes necessary before the next cycle of the engineering projects. By adapting the methods used in the makerspace and resource room based on the experiences of the staff and the feedback from the engineering students, the Engineering Lab will be able to reach the objectives that guide the work of the staff.

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