

First Year Engineering collaborations with traditional engineering departments, to introduce students to foundational concepts, through hands-on laboratory exercises.

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GIFTS PAPER - First Year Engineering collaborations with traditional engineering departments to introduce students to foundational concepts through hands-on laboratory exercises.

Introduction and Background

First Year engineering students at The Ohio State University are required to take a two (2) course sequence in their first year and one of the goals is to ensure that they are exposed to practical labs that introduce them to different engineering disciplines. The use of laboratory exercises is an engaging tool that can have strong impacts on student learning.

The use of practical experiments in science and engineering learning is not an uncommon practice, as it is widely believed that it aids in better understanding of concepts by students. Edward (2002) asserts that while this belief exists, there is a paucity of literature that assesses the direct effectiveness of labs. The author concludes that self-identity is an essential quality that allows undergraduate engineering students to be transformed into competent functioning professional engineers. As a result of engineering students seeing themselves as practitioners, Edwards (2002) reports that laboratory work is a major component of their development. When laboratory exercises are well designed, they can contribute to the integration of theory and practice and cause students to engage in discovery.

Carnasciali et al. (2013) contend that the majority of engineering students in their study (66%) did not determine their major prior to attending the university. This would seem to suggest that a unique opportunity exists to help steer students in the areas of their perceived competences and passion. It is upon this premise that the effort has been made to enhance our lab opportunities in the first year.

Curriculum Development Approach and Description

At The Ohio State University, the Department of Engineering Education has sought to engage the traditional departments in the College of Engineering, when developing Fundamentals of Engineering (FE) lab curriculum. In some ways, this represents a necessary departure from the previous practice of developing these labs independently. The first such collaboration has been between the Department of Engineering Education (EED) and the Materials Science and Engineering (MSE) Department. The advantage of initiatives of this ilk, is to expose students to real and relevant applications in traditional disciplines, thereby allowing them to make decisions about their undergraduate pursuit. The proposal was to create a laboratory exercise which allows for a full exploration of the materials paradigm. It explores the four (4) tenets of material science, namely structure, processing, properties and performance. Figure 1 shows the physical setup for this lab and the objectives were achieved by using nylon fishing line for processing, by applying a rotational force until the line coiled and formed into a spring. This was based on extending work done initially by Haines et al (2014).



Figure 1: Lab setup for the Material Science and Engineering (MSE) Lab

Students were able to further investigate what happens to the same material when it is further processed. The second example of processing was to heat treat the spring with a heat gun under load. After successful treatment which served to alter the entropy in the material, this spring became artificial muscle and demonstrate the ability to do work (force x distance). The students were then asked to conduct an economic analysis regarding the feasibility of the cost of production of their spring vis-à-vis springs with similar properties in the market.

Conclusion and Future Work

As students are exposed to traditional disciplines through hands-on labs, the possibility exists that their intellectual curiosity can be piqued as the student then benefits from practical exposure instead of a serendipitous encounter. As we continue to implement this and similar labs, we have the opportunity partner with the engineering disciplines to conduct research on the impact of this exposure. The eventual ambition is to study the effectiveness of this approach and to develop a robust framework for assessing the direct impacts of these labs on choice of major.

References

- [1] Carnasciali, M., Thompson, A., Thomas, T., “Factors influencing students’ choice of engineering major” 120th ASEE Annual Conference and Exposition, (2013) 407-416
- [2] Haines, C. S., D Lima, M., Li, N., Spinks, G.M., Foroughi, J., Madden, J. D.W., Kim, S.H., Oliver, R., Fang, S., Jung de Andrade, M., Göktepe, F., Göktepe, O., Mirvakili, S.M., Naficy, S., Lepró, X., Oh, J., Kozlov, M.E., Kim, S.J., Xu, X., Swedlove, B.J., Wallace, G.G. and Baughman, R.H., “Artificial Muscles from Fishing line and Sewing Thread” *Science*, Vol. 343, (2014) pp. 868-872
- [3] Edwards, R., “The Role of Laboratory Work in Engineering Education: Student and Staff Perceptions” *International Journal of Engineering Education*, Vol. 39, Issue 1, (2002) pp. 11-19