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GIFTS: Preparing Teaching Assistants to Encourage an Entrepreneurial Mindset in First-Year Engineering

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Introduction

This Great Ideas for Teaching, and Talking with, Students (GIFTS) paper focuses on an Entrepreneurial Mindset (EM), which is a collection of mental habits that augment engineering skillsets to amplify the societal impact and value creation of engineering solutions. In the first-year engineering program at The Ohio State University, this mindset is defined using three key attributes referred to as the "**3Cs**" and developed by the Kern Entrepreneurial Engineering Network: demonstrating constant **curiosity** about an ever-changing world, forming **connections** across diverse sources to gain insights, and **creating value** across social, economic, and environmental systems.

Teaching assistants (TAs) at The Ohio State University provide much of the grading, feedback, and one-on-one help to students in the first-year engineering program. To effectively incorporate an EM into curriculum and their pedagogy, TAs must have a comprehensive understanding of fundamental EM concepts. There is a scarcity of literature, however, about how to best train TAs on EM Learning (EML). Furthermore, assessment techniques for the evaluation of EM mastery for members of the instructional team are only just beginning to be elucidated. This paper begins to explore the effectiveness of a training module for first-year engineering undergraduate teaching assistants (UTA) through a qualitative analysis of responses to three open-ended prompts. All UTAs are themselves undergraduate students at the sophomore through senior level. UTA responses to the following prompts are explored in this paper: (1) Craft question(s) you might use to spark curiosity, (2) Brainstorm source(s) apart from the required curriculum that students can use for design inspiration, and (3) Provide an experience from your own undergraduate experience you perceive as EM-aligned.

Training Module & Analysis Methods

Our training module consisted of a text document containing descriptions of EM and the 3Cs, an instructional video for each of the 3Cs, and a short reflection survey including three open-ended prompts about EM. A total of 38 UTAs completed the training module. UTA responses to the three survey prompts were analyzed using qualitative coding. A team of researchers each independently coded the data into categories and, where necessary, resolved differing results as a team. The categories were chosen based on an in-depth review of the data before the coding process to determine common themes.

Results

Prompt 1: Craft question(s) you might use to spark curiosity. This prompt produced a wide variety of responses and was designed to encourage TAs to brainstorm questions that can develop the critical thinking skills and curiosity of their students. The most common theme identified in responses was asking students to consider the needs of their users and how users with different needs might react to their proposed design (Fig. 1). Other common themes that emerged included asking students why their design

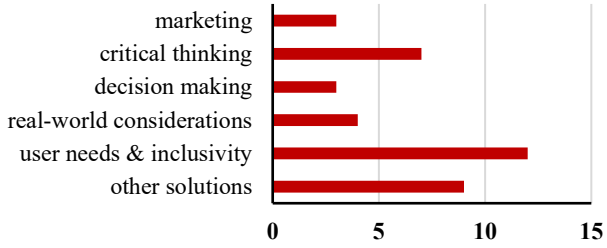

Figure 1: Qualitative coding themes from the curiosity survey prompt

was preferable to other solutions, how students decided on their final design, and how the previous way of solving the problem they solved was flawed (Fig. 1).

Prompt 2: Brainstorm sources apart from the required curriculum that students can use for design inspiration. Many TAs suggested that students should learn about the user experience by seeking out personal experiences (Fig. 2). Others suggested inspiration through media, other courses, or outside research. One TA suggested students should research the Arthritis Foundation's recommended "arthritis safe" products so they can learn from those designs. Although this was the only response in the inclusivity category (Fig. 2), it was particularly relevant to EM and could be used as a beneficial example of connecting design and outside resources in a way that considers value creation for different populations.

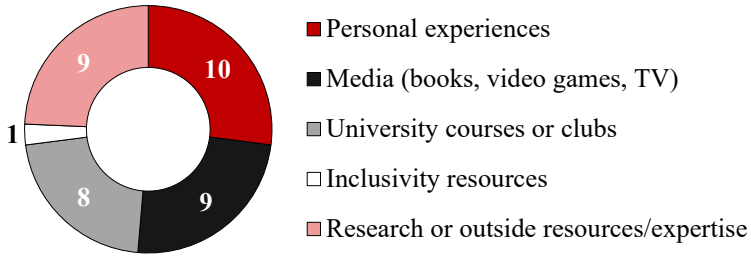

Figure 2: Categorical themes from the brainstorming resources prompt

Prompt 3: Provide an experience from your own undergraduate experience you perceive as EM-aligned. The most common response in this category was the semester-long project-based course from the first-year engineering program that involves designing a robot, a nanotechnology research project, or designing a product. Other common responses were labs or software design projects from first-year engineering courses. The remaining TAs responses were *giving presentations* and *internships*.

Conclusions and Future Work

Collectively, TA responses from Prompts 1 and 2 (Figs. 1-2) exhibit a diverse set of curiosity questions and inspirational information sources that we expect to compile as a resource for all TAs to use in their instruction of student groups. Additionally, responses to the third survey prompt provide insight into what courses, assignments, and projects TAs believe are heavily EM-aligned and, in doing so, provide a list of curricular components for which instructors may focus EM formal learning or research initiatives. Moreover, we found that TAs used the open-ended survey questions to explicitly reflect on their own EM-aligned experiences. In this way, we expect that our training module not only better equips TAs to integrate the 3Cs into their teaching, but also encourages student TAs to exercise their own 3Cs mental habits. TA responses to all three prompts about EM indicate that most TAs understand the essentials of EM and believe EM is being taught in the first-year engineering courses they teach. The responses also indicate that TAs most value user needs and inclusivity, business and marketing skills, and real-world engineering experiences (Figs. 1-2). Future work in this area is to incorporate the results from this analysis into future TA training modules. We are also pursuing approaches to assess the effect of the training module on UTA EM mastery as well as on first-year student proficiency on EM learning objectives. Training modules will be shared as a resource for other engineering programs in the future.

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