Recruiting and Retaining Women in Engineering through Car Maintenance Outreach Program

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Abstract

The Mechanical Engineering Ladies Organization (MELO) at Mississippi State University (MSU) was established in 2014 to help retain women in the mechanical engineering (ME) program and foster the success of those women through mentorship, academic and social support, and networking with women in the workforce. In addition to providing an inclusive environment for women currently involved in ME, MELO also incorporates recruitment and outreach programs for primary and secondary school children. One such outreach effort is the MELO Car Event, where MELO members learn hands-on car maintenance tasks such as changing oil and changing a tire. This event specifically serves to help retain women in engineering by building confidence in their own capabilities. Many women do not come into the engineering curriculum with as much hands-on experience as their male counterparts, but this program aims to fill this gap in the students' practical experiences. In the upcoming year, MELO plans to expand this event to also serve as an outreach event. The overall event will occur in two separate sessions: one for college students led by MELO faculty and another for high school students (male and female) led by (female) college participants. The outreach session exposes high school students near driving age to competent female engineers, providing strong examples of successful women in tech, and can increase STEM interest among high school students through hands-on learning. This paper will serve to establish guidelines for conducting similar events with a long-term objective to evaluate the effectiveness of achieving these goals through this outreach event.

Keywords

Engineering female recruitment, hands-on experience, developing confidence

Introduction

According to 2017-2018 data, the Mechanical Engineering (ME) discipline is the largest engineering discipline by bachelor's degrees awarded, though only about 15% of those degrees are conferred upon women[1]. In other words, of the 23 disciplines examined, ME ranked 1st in degrees awarded, but 20th in degrees awarded to women. Reasons for this gender discrepancy in the ME field include societal/cultural barriers such as engineering skills and aptitudes being considered traditionally masculine traits, differing priorities in work/life balance between males and females, and preparation and encouragement toward ME for pre-college age girls[2–4]. Bossart and Bharti[5] investigated the female graduation rate disparity among different engineering disciplines. They found that women tend to gravitate toward disciplines that they perceive have a societal benefit. They suggested emphasizing the impact engineering disciplines have on society's most difficult problems and including real life engineering examples that provide societal benefits throughout their collegiate education.

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While the differing priorities is personal and not something that can be readily addressed through outreach, the other barriers can be a focal point to address in outreach and in-college instruction of women. Developing women's interest and confidence toward pursuing a degree in mechanical engineering is a primary goal for MELO, and one recent avenue that MELO is creating to meet this objective is through the MELO Car Event and New Driver Orientation. Through the MELO Car Event, (mechanical) engineering female students learn the basic vehicle maintenance skills that many modern college students (male and female) are lacking, with two-thirds of teens unable to change a tire, check or change oil, or jumpstart their car battery[6,7]. Of particular concern is the inability to properly monitor tire safety (air pressure, tread condition, roadside tire changing), since 12% of vehicle accidents involve tire-related issues among inexperienced drivers[8]. These important maintenance skills are taught to college students by female faculty, providing a non-stereotypical example of women's competencies. After the undergraduate students sufficiently learn the hands-on skillsets through the Car Event, they, in turn, teach new drivers these same skills in a separate New Driver Orientation event. The Car Event has taken place twice, in the Fall of 2018 and again in the Fall of 2019. New Driver Orientation will be added in the Spring of 2020 as a local, city-wide event organized and managed by MELO. The focus of New Driver Orientation is in breaking stereotypes that women are less interested/competent in performing vehicle maintenance tasks and leading through example with the intent of improving confidence in ability to perform in a technical discipline. An added benefit includes more preparation and confidence for teenagers beginning to experience vehicular autonomy.

Discussion

In 2018, fourteen undergraduate students participated in the Car Event led by four ME female Faculty members. Each faculty member led a workshop on a specific topic: changing oil, changing a tire and tire safety, jump-starting the battery, and general vehicle safety and preparedness. Since there were only 14 participants, the students went directly from one workshop to the next without requiring that the workshops be run simultaneously. Each workshop was planned to run no more than 20 minutes. Additionally, care in instruction was taken to ensure that students participated in each workshop and did not simply watch as a demonstration. This is a key component needed to ensure that students gain hands-on experience. Ample time must be allotted to ensure that each student can physically participate in the task at hand. Since the event took place in the evening, food was also provided to the participants.

On a large scale, the students found the event effective, with their reported competency improving in all workshop areas. 2018 students were assessed using a pre-event and post-event survey. Figure 1 shows a Likert scale comparison of students' competency in each workshop topic before and after the Car Event, with 1 indicating no competency and 5 indicating total competency.

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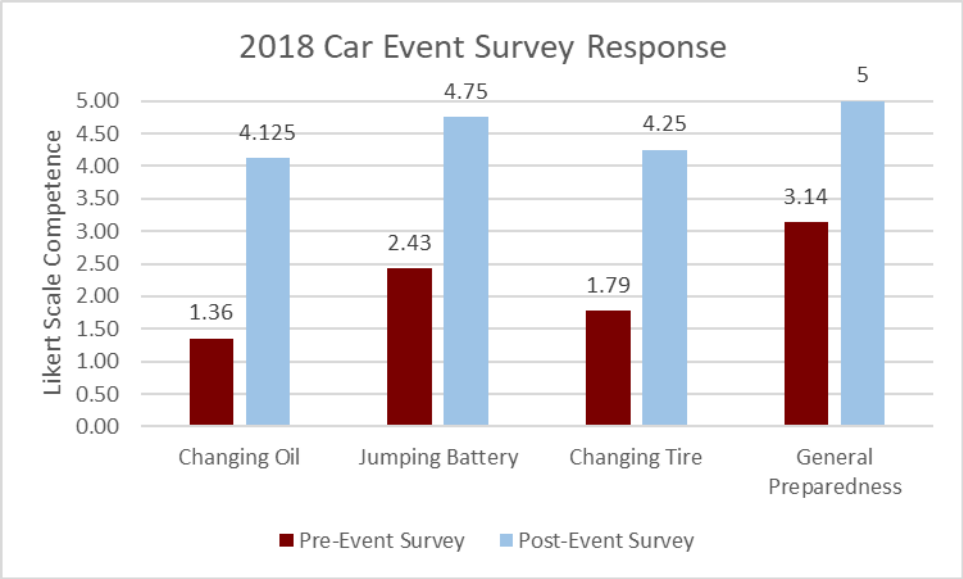

Figure 1. Student competency with basic car maintenance tasks.

All students indicated that the MELO Car Event provided them with improved hands-on maintenance experience. Prior to the 2018 MELO Car Event, the female undergraduate students indicated that they had limited exposure and opportunity to participate in hands-on activities, but that they have an avid interest in learning hands-on vehicle maintenance, see Fig. 2. Figure 2 is also based on a Likert scale from 1 (no experience/no opportunity/no interest) to 5 (frequent experience/lots of opportunity/very interested).

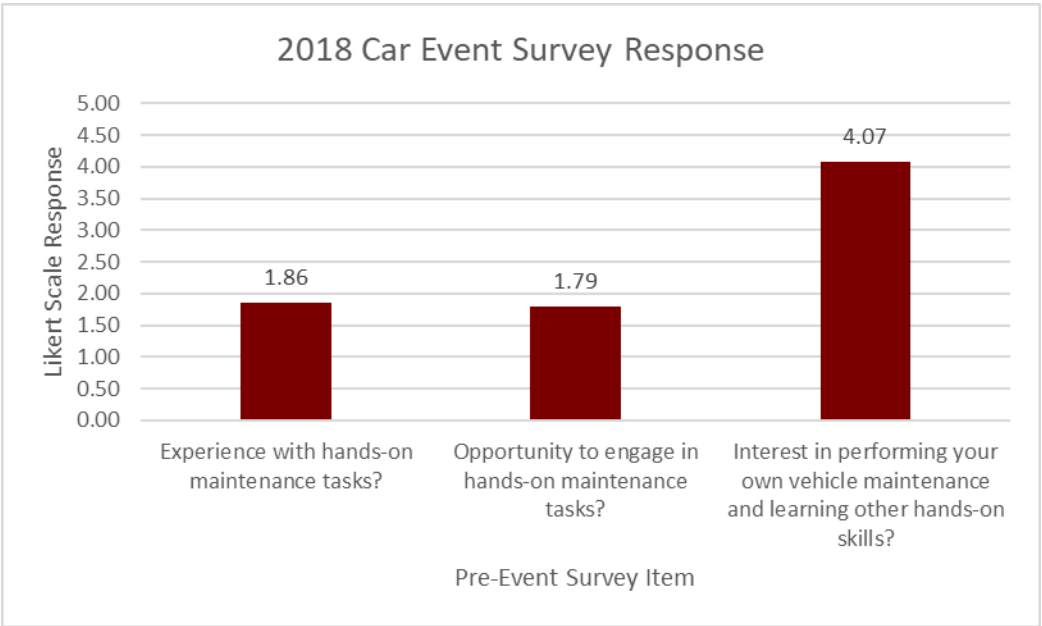

Figure 2. Pre-Event survey regarding hands-on interest and experience

Through the 2018 Car Event, undergraduate female ME students, overall, were satisfied with the hands-on experience gained through the MELO Car Event. Figure 3 shows the survey data for

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comfort level with general maintenance (1 = very uncomfortable, 5 = very comfortable) and overall satisfaction with the event (1 = unenjoyable, 5 = very enjoyable).

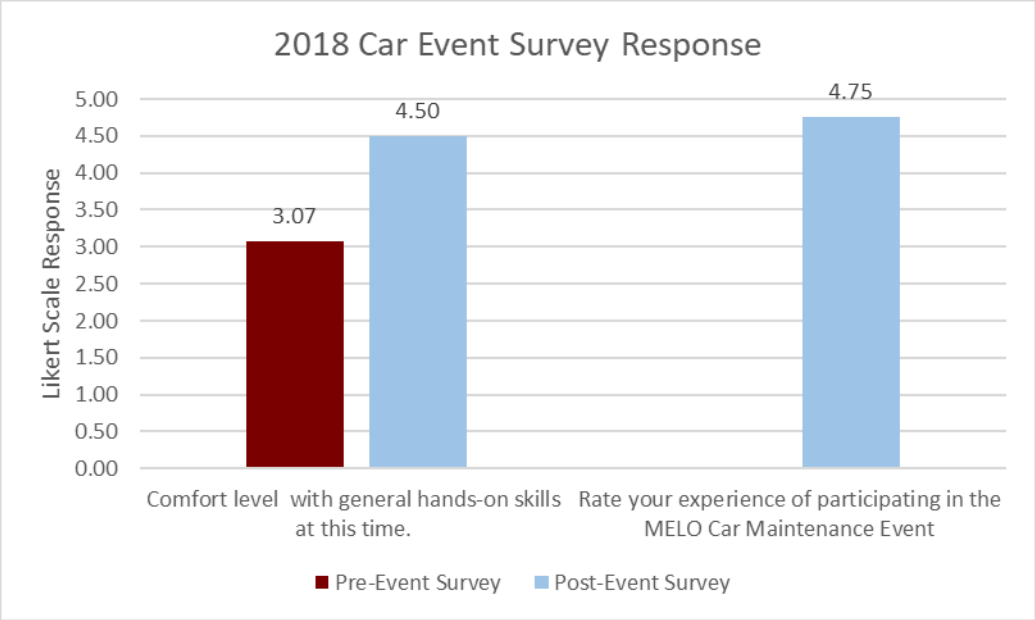

Figure 3. Overall event attitudes.

After the inaugural 2018 Car Event, MELO Leadership decided to continue the event with plans to expand to the New Driver Orientation High School Outreach Event. Suggestions from participants for improvement from the 2018 event included to break the workshops over multiple days or shorten the event, as the event did run over the allotted time. Feedback from students also indicated that changing oil was the least liked workshop of the Car Event, while changing a tire and jump-starting a battery were the most liked workshops. This is likely due to the fact that, due to garage regulations that would not allow students to walk under the lifted vehicle, the oil change was the least participatory and most demonstration-styled workshop, while the remaining workshops allowed all students to be highly involved and perform tasks independently. Additionally, the oil change workshop encountered unexpected delays and delayed the Car Event schedule substantially. In 2019, membership in MELO did not experience much turnover or growth. Therefore, most MELO members had already participated in the 2018 Car Event. Thus, the 2019 Car Event was run as a small scale refresher course with lower participation and did not include the oil change component, though students were still taught how to check oil and identify basic engine components. These 2019 MELO participants are currently organizing and implementing a New Driver Orientation for the Spring 2020 semester.

Obstacles to Implementation

While organizing and implementing the MELO Car Event and gauging interest levels in the New Driver Orientation, several obstacles were encountered. While many students indicate interest in learning these skills, taking the time out of their schedules to participate proves a greater challenge. From initial observations, undergraduate female students, having already selected engineering fields of study, have a higher interest in learning these skills than do new drivers. As stated earlier, breaking the workshops into smaller time commitments and only focusing on

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the most important components, from a maintenance/vehicle safety perspective, are ways to minimize the time commitment and help enhance interest. Also, informing parents of the statistical importance of understanding vehicular maintenance from a road safety perspective may help parents encourage their children to participate in the orientation. Additionally, the logistics of setting up either event can be challenging. Currently, MELO must borrow garage space to have an indoor facility to perform the instruction. When garage space is not available, weather limitations become another concern. A volunteer vehicle must also be identified on which to perform the maintenance, usually the personal vehicle of a MELO member or faculty workshop organizer. While permanent garage space and a MELO-owned demonstration vehicle is a long-term goal, it is not required to begin implementing these workshops. However, careful planning and communication must be utilized to overcome these challenges during the short-term.

Conclusion

Fostering an inclusive, educational environment for young women is paramount in retaining women in technical fields. The MELO Car Event and New Driver Orientation serve to enhance exposure to females performing stereotypically male tasks, to increase confidence in women participants' mechanical aptitude, to teach valuable maintenance and emergency road-side skills to young women, and to provide a social experience for students to become better acquainted with their peers and female instructors. While there are still many improvements to be made to the structure and to participation levels in the MELO Car Event and New Driver Orientation, initial results indicate that the event accomplishes the goal of improving participating women's experience and confidence in mechanical capability.

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