Experimental Vehicles Program Creates Lasting Partnerships with the National and International Industries

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Saeed Foroudastan is the Associate Dean for the College of Basic and Applied Sciences (CBAS). The CBAS oversees 10 departments at Middle Tennessee State University. He is also the current Director for the Master's of Science in Professional Science program and a professor of engineering technology at MTSU. Foroudastan received his B.S. in civil engineering, his M.S. in civil engineering, and his Ph.D. in mechanical engineering from Tennessee Technological University. Additionally, he has six years of industrial experience as a Senior Engineer and 18 years of academic experience as a professor, Associate Professor, and Assistant Professor. Foroudastan's academic experience includes teaching at Tennessee Technological University and Middle Tennessee State University in the areas of civil engineering, mechanical engineering, and engineering technology. He has actively advised undergraduate and graduate students, alumni, and minority students in academics and career guidance. Foroudastan has also served as Faculty Advisor for SAE, Mechanical Engineering Technology, Pre-engineering, ASME, Experimental Vehicles Program (EVP), and Tau Alpha Pi Honors Society. In addition to Foroudastan's teaching experience, he also has performed extensive research and published numerous technical papers. He has secured more than $1 million in the form of both internal and external grants and research funding. Foroudastan is the faculty advisor, coordinator, and primary fundraiser for EVP teams entering national research project competitions such as the Formula SAE Collegiate Competition, the Baja SAE Race, the SolarBike Rayce, the Great Moonbuggy Race, and the Solar Boat Collegiate Competition. For his concern for and dedication to his students, Foroudastan received MTSU awards such as the 2002-03 Outstanding Teaching Award, the 2005-06 Outstanding Public Service Award, and the 2007 Faculty Advisor of the Year Award. He received the Excellence in Engineering Education Award and Faculty Advisor Award from the Society of Automotive Engineers (SAE). He was also nominated for the MTSU 2005 and 2009-11 Outstanding Research Award. He received two Academic Excellence awards from the Tennessee Board of Region in 2010-11. Foroudastan has also won many College of Basic and Applied Science awards. In addition to this, Foroudastan also reviews papers for journals and conference proceedings of ASEE, ASEE-SE, and ASME, and he has been a session moderator for several professional conferences.

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Currently Courtney Thompson is obtaining a master's of science in Professional Science with a concentration in Biotechnology at Middle Tennessee State University. Thompson is completing her graduate assistantship with the Director of the Masters of Science in Professional Science program Dr. Saeed Foroudastan and with the Associate Dean of the College of Basic and Applied Sciences. Thompson assists with the preparation and submission of grants and publications among other duties. Thompson is also involved with the Master's of Science in Professional Science club and the Graduate Student Association. In addition due to my previous experience as a research assistant at Vanderbilt University she has been published in Diabetologi and other jounals.

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Abstract

The Experimental Vehicles Program (EVP) was created in 2004 as an umbrella program for five different undergraduate experimental vehicle design teams. These projects consist of the Solar Vehicle, Moonbuggy, Baja SAE, Formula SAE, and Solar Boat. The goal of the EVP is to foster undergraduate student development through the construction of experimental vehicles with the guidance of faculty mentors as well as partnerships with both national and international industry leaders.

Students work in peer-led teams to annually design, construct, and test novel vehicle designs for participation in national and international competitions. Due to the competitive nature of each of the events, students must use cutting edge technology and design methods in order to field the very best entries possible. Often times this means creating partnerships with industry leaders who help to mentor the students from the design conception, to the fabrication, through the manufacturing of each vehicle. These partnerships benefit both the students and the companies; students are able to create real-world contacts and gain a working knowledge of the industry that they cannot acquire in the classroom alone. Furthermore, the students are able to use these contacts to garner equipment such as solar panels and wheels. Likewise, the companies are able to receive recognition at national and international competitions as program sponsors as they are advertised on the competition vehicles. Moreover the industries are able to build relationships with future employees who have real-world experience and who have become intimately involved with specialized technology such as “green energy”.

Each EVP project performs a vital function in the professional development of students. The projects provide a forgiving environment in which students can test their classroom knowledge in a real-world setting and learn important skills such as leadership, effective communication, and working as an effective team member. Furthermore, the students in the EVP develop highly versatile and qualified skill sets that will allow them to fill various positions within the workplace upon graduation. In the past 90% of EVP graduates have been able to obtain highly regarded national and international positions upon graduation due to their real-world working experience gained throughout their involvement in the EVP.

Introduction

The Experimental Vehicles Program (EVP) was created in 2004 by Dr. Saeed Foroudastan. The program was initially formed to give Engineering Technology (ET) students a direct application for the skills and knowledge they learn in the course of their undergraduate classes. However, since its inception and due to the success of early projects, the program has grown to encompass

students from various science, technology, engineering, and mathematics (STEM) disciplines across the university. The Experimental Vehicle Program is as an umbrella program for multiple undergraduate research experimental vehicle design teams. The teams currently consist of the Solar Vehicle, Moon Buggy, Baja SAE, Formula SAE, and Solar Boat. The consolidation of the five design teams into EVP umbrella helps to facilitate the endeavors of the individual vehicle teams by centralizing important managerial tasks such as recruiting, resource allocation, and funding procurement. In addition it helps with the sharing of expertise between students and faculty of different backgrounds, as well as that of the local industry community[1].

The EVP provides a platform in which young students are learning that applied research can be fun, educational, and beneficial experience upon graduation. Annually approximately 80 students from all across the College of Basic and Applied Sciences (CBAS) come together to form peer-led project teams. Each vehicle serves as a multi-step process which allows a team of students to expand upon MTSU research by using their knowledge from the classroom to complete the cost analysis, design conception, fabrication, and test novel vehicle designs with the ultimate goal of competing on the national and international level.

Each of the national and international competitions has its own respective showcase sponsored by associations such as the National Aeronautics and Space Administration (NASA), the American Society of Engineers (ASE), and the American Society of Mechanical Engineers (ASME). The competitions are comprised of various events providing unique challenges that test each part of the vehicles construction and performance. These competitions allow MTSU students the opportunity to compete against top engineering schools from around the world.

The project in the EVP performs a vital function in the professional development of Middle Tennessee State University (MTSU) students. Each peer-led group takes an experimental vehicle and develops it from the bottom up, giving the students a first-hand look at what goes into a full blown engineering project. Furthermore, these projects provide a forgiving environment in which students can test and apply their classroom knowledge in a real-world setting and learn important skills such as leadership, effective communication, and working as a successful team member[1]. The students are given the opportunity to actually build and create their own ideas in collaboration with their peers; an occasion that is rare in typical curriculum. This helps to instill confidence in their own abilities for the future as well as develop a better understanding of not only engineering concepts but other STEM concentrations as well.

Project Descriptions

While the goal of each of the EVP vehicles is to strive to encourage advancement in science, engineering, technology, and mathematics (STEM) and to teach students to think about “green” energy they all provide their own unique challenges that the students must overcome in order to be successful. Numerous national and international collegiate competitions focusing on solar power have become extremely well-known among professional societies, industrial partners, and government institutions including the Innovators Educational Foundation, the U.S. Department of Energy, and many others[2].

The Solar Vehicle is powered by both solar and battery power. The objective of this project is to teach both energy conservation and environmental awareness to the undergraduate students. Each year the solar vehicle competes in the Solar Bike Rayce USA which is an international competition sponsored by the Formula Sun Education Foundation. The race takes place on a closed-course and is part endurance and part sprint, with the objective of stimulating interest in science, technology, and alternative energy.

The Moonbuggy is designed and built to simulate the Lunar Rover. Each vehicle is constructed so that it carries two students, one female and one male, and is solely powered by the two students. Each year, MTSU EVP students participate in NASA's "Great Moonbuggy Race" which is a half-mile simulated lunar terrain course including "craters", rocks, "lava" ridges, inclines, and "lunar" soil. To further complicate the race, and force students to think outside the box, students are required to carry the un-assembled vehicle to the starting line and are then judged on assembly time. The competitors then get two attempts at the course with the final time consisting of the assembly time and the fastest time of the two runs. MTSU has won such awards as Safety Award, Best Engineering Design, and Most Unique Design.

The Baja SAE vehicle is designed to be a single seat off-road recreational vehicle that is safe, fun to drive, easy to maintain, and has the ability to be mass produced and sold to the public. The Society of Automotive Engineers sponsors an annual competition to test all components of the vehicles design on various terrains.

The Formula SAE vehicle is designed to be an open wheeled racer and must adhere to strict guidelines set forth by Society of Automotive Engineers. The Formula SAE Collegiate Competition is an annual competition where entries are judged not only by their performance on the track, but also by their technical and engineering innovation. Teams are also required to show manufacturability of their concept, and must prove their design on its merits before proving it on the track.

Finally the Solar Boat craft is designed and fabricated to be powered completely by batteries and solar array. This creates challenges that the students must overcome; each boat much use its energy effectively while being hydro-dynamic. The American Society of Mechanical Engineers (ASME) Solar Splash is the World Championship of Intercollegiate Solar Boating event that takes place over 5 days has been described as a "brain sport"[1]. The first day is spent entirely on a thorough technical inspection of each craft. The remaining four days are occupied with on-water competitions, including sprint, maneuverability, and endurance and speed competitions. MTSU EVP students have consistently placed in the overall top ten and have won awards such as Outstanding Hull Design, Sportsmanship, and Outstanding Technical Report.

Lasting Industry Partnerships

The majority of the EVP vehicles are fabricated within Middle Tennessee State University (MTSU) laboratories. This allows students to obtain a working knowledge of control and power systems, instrumentation systems, modern modeling and testing protocols, and mechanical systems. When parts of the vehicles cannot be fabricated within MTSU laboratories the students

seek outside help. This gives the university and the students' opportunities to create partnerships with leading industrial companies.

EVP intentionally purchases as much of their vehicle components as possible from local businesses. Some of these businesses include the Murfreesboro Outdoor and Bicycle shop and Motion Industries who both provide parts and gears for various EVP projects. Partnerships between the university and local businesses such as Nissan, Saturn, Stratos Boats, General Electric, Siemens, Murfreesboro Water Development, Performance Electronics, and Lane Motors Museum benefits everyone involved and helps the local economy as well.

These partnerships can be extremely beneficial to the students involved in the EVP. The companies that the EVP works with will not only provide raw material for the students to use but often times will become an outside mentor to the project and the students themselves. In addition to their experience in the EVP, the mentorships help students to gain highly versatile and qualified skill sets. The students will have learned the effort involved in initiating and completing an engineering project as well as honed the interpersonal and professional skills needed to make lasting connections in the business world. Mentors and local business professionals are able to aid and guide the students in the best direction for their particular vehicle. Through this process the students are able to create lasting relationships with some of the industry's most influential members. Moreover upon graduation past EVP graduates have benefited from these relationships either by obtaining highly desired employment with EVP partners or by receiving highly regarded recommendations from industry CEOs who have a first-hand knowledge of the students real-world experience and professional demeanor.

International Partnerships

The students involved in the Experimental Vehicle Program truly have an international experience. Not only do these students get exposed to the excitement of international competitions but many of the students that make up the EVP come from foreign countries as well. This allows for students in the program to form lasting bonds while exposing themselves to new cultures. This program allows for international and local students to gain regard for one another while simultaneously learning the art of hands on engineering. These multi-cultural design teams help to acclimate the non-native speaking students to the local engineering terminology while also enhancing their ability to communicate and propagate ideas by improving technical writing through design submissions. In addition the competitive nature of both the national and international competitions fuels the diverse and cross-cultural interactions among team members. Sharing different cultural ideals and technologies allows students to advance their vehicles while broadening their own knowledge as well. No matter what vehicle team the undergraduates are on they are able to garner valuable experiences working as and on a diverse team.

Each of the vehicles within the EVP is entered into national and international competitions. Every year the multinational participation for these competitions increases. The international competitions are especially important for MTSU students to not only share their work on an international level but to also share knowledge and experiences with other undergraduates from different cultures with similar interest. Through lasting friendships the students are able to

expand upon their own knowledge and take from the perspective of other cultures. International competitions are a mainstay in the EVP program and have been nothing but beneficial to the students involved in them.

Conclusion

The EVP projects provide a change in the traditional course structure of lecture, book problems, and exams while offering a great opportunity for inquiry and discovery. The inclusion of hands-on research projects on the freshman level has created interest, enthusiasm, and self-motivation for STEM students. While the research projects require more time than traditional lecture course, the students walk away with a greater understanding of the material and a "real" experience of their chosen field of study[3]. In addition, these projects help students to sharpen their skills for future workmanship, such as team work, understanding responsibility, and making use of techniques learned in class. With prestigious awards won each year by each vehicle and its participating students, this distinguished research program will continue to provide an undergraduate learning experience with the latest advancements in technology[4]. Moreover the EVP students gain an invaluable experience and lifelong relationships while working with international partners.

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