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Understanding the Impact of Industry Sponsorship for Student Teams: A Case Study

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Motivation: the rapidly-changing job landscape and its impact on student preparedness

The rapidly changing job landscape is causing significant challenges for educators and industry alike. The World Economic Forum (WEF) published their Future of Jobs 2023 Report[1], which highlights the impact technology has on various career sectors. Technology, digitalization, and sustainability are highlighted as sectors with some of the fastest-growing roles and analytical and creative thinking are still the most important skills for the workforce today. These same skills, however, have been highlighted as lacking in new engineering graduates as they enter the workforce[2], [3].

This lack of preparedness for real-world problems that students face upon leaving school leads to significant frustration for both employer and employee. Students find themselves intimidated to tackle the large, boundary-less projects in the working world[4], [5] and unable to navigate large projects due to a lack of professional skills in areas like teamwork, project management, and business management[5], [6], [7].

The WEF 2023 Future of Jobs Report indicates that an estimated 44% of workers' skills will be disrupted in the next five years and six in ten workers will require additional training to keep up with their roles by 2027[1]. Many are looking to continuing professional development to handle much of this upskilling (though the WEF report highlights only half of workers have access to the training they need), while others turn to higher education as a place for this skillset training shift to take place. These rapid shifts are often too challenging to keep up with for formal curriculum changes[2]. Engineers have not stopped needing to understand theoretical concepts. In fact, without this foundational knowledge, being able to apply skills such as conducting finite element simulations or Life Cycle Assessments (LCAs) is much more challenging. But the data is there, showing that this fundamental knowledge is no longer enough to properly prepare students for the start of their careers. This leads us to the question: how can industry and academia work together to prepare the next generation of students?

Student Engagement in Higher Education

Student engagement is a term often mentioned in education to ensure students are getting the most out of their learning experiences. It is linked to things like improved critical thinking, practical competence, skill transferability, improved cognitive development, increased persistence, and moral and ethical development within students [8].But what does it really mean? The National Survey for Student Engagement (NSSE) highlights two aspects of student engagement in their definition: the amount of time and effort a student puts into their education and how the institution uses its resources to involve students in activities known to enhance student learning [9]. This definition highlights that the engagement does not lie solely with the student; in fact, there is a whole component where higher education institutions (HEIs) can contribute to what their learners are experiencing and what they can get out of it. (It is important to note that involvement in course activities does not mean engagement; students can have perfect attendance and not be engaging with the content[10].) According to a study by Krause and

Coates [11], student engagement can occur in five areas: (1) intellectual, (2) student to staff, (3) peer-to-peer, (4) online, and (5) outside the classroom. The table below highlights a few key traits of each of these areas.

Table 1: Student Engagement Category Key Traits [8], [11], [12], [13]

Engagement Category	Key Traits
Intellectual	Challenge
	Real-world context for material
	Learning Strategies
Student to Staff	Feedback
	Students' perceptions of teacher's interest in their progress
Peer-to-Peer	Collaboration
	Discussions with diverse colleagues
Online	Encourage independence and self-learning
	Software and tools used
Outside the Classroom	Inclusive university community
	Sense of belonging

Going back to the question of this paper (how academia and industry can work together to prepare students), a few of these engagement areas stand out as places for collaboration: intellectual, online, and outside the classroom. Industry is great for providing real-world context for course material and, depending on the industry, have their own training and tools to support self-learning. The focus of today's paper, however, will be on collaborative efforts outside the classroom in the form of industry support for student teams, and in this case, Formula SAE.

Background: Formula SAE

Before addressing Ansys industry support for student teams, a bit of background on Formula SAE competitions will help set the scene. Formula SAE involves a student design team creating a prototype Formula-style race car for a fictional company. The goal is to assess its potential as a production item, targeting non-professional weekend autocross racers. Every student team undertakes the task of designing, constructing, and testing a prototype according to a set of rules. These rules serve the dual purpose of guaranteeing on-track safety (as the cars are operated by the students) and encouraging innovative problem-solving. The competition is divided into combustion and electric engine divisions, with the main distinction lying in the rules governing the powertrain.

The prototype race car undergoes evaluation in various events, with the points structure for most Formula SAE competitions encompassing static events such as design, cost and manufacturing, and presentation. The evaluation also includes dynamic events such as acceleration, skid pad, autocross, fuel economy, and endurance.

Before participating in dynamic events, the vehicle undergoes a technical inspection to ensure rule compliance, including checks for braking, rollover stability, and noise levels. In addition to these scheduled events, industry sponsors give awards for exceptional design achievements. These awards cover areas like E-85 ethanol fuel use, innovative electronics, recyclability, crash worthiness, analytical design approach, and overall dynamic performance.

Formula competitions extend beyond the Americas; both Formula SAE and a comparable event known as Formula Student encompass 20 different competitions across the globe. These competitions take place in Australia, Austria, Brazil, China, Croatia, Czech Republic, Germany, Hungary, India, Italy, Japan, Netherlands, Russia, South Korea, Spain, Switzerland, Thailand, and the United Kingdom. In addition to the combustion and electric divisions within FSAE, Formula Hybrid emerged as a spin-off with a unique focus on gasoline-electric hybrid power plants, then Formula Student Electric began which tasked students with creating a racing vehicle powered solely by electricity, and finally in 2017 the Formula Student Driverless category emerged.

Ansys Student Team Support

The support provided by Ansys for all student teams, not just Formula SAE, can be found in detail elsewhere [14], but can be summarized as having three main areas of focus: access to free software, training, and support.

Free Software Access

First and foremost, student teams are solving real world problems and need industry-level tools to solve these problems. As part of the Ansys Student Team partnership program, teams get free access to Ansys tools with no mesh constraints, allowing them to solve these complex problems.

Software Training

Ansys provides access to hundreds of free training videos which are developed by either Ansys engineers or university educators. The asynchronous online format of this training makes it more accessible than in-person or synchronous online events, given the nature of student’s schedules and need to quickly upskill at any point in the project. Two specific strategies are employed for student team software training. The first is creating specific training content focused on common challenges faced by student teams, such as simulating the aerodynamics of an FSAE car. The second focuses on the commitment to supporting students in gaining industry-relevant skills; teams can gain free access to the Ansys Learning Hub, which is the Ansys commercial software training platform.

Support

Support goes beyond just access to software training. Ansys participates in formal training events coordinated by various competitions, either online or in-person. These events allow teams to meet with technical experts and competition judges to ask their specific questions. Ansys attends these events so students can have direct access to engineers to ask their detailed questions, as well as better understand the usage of simulation in Industry.

Ansys also runs its own student team webinar series, focused on specific tools and tips to help student teams succeed in running successful simulations.

Another important aspect of the support is being present at competitions. By having a strong presence via a booth or event during the competition, Ansys employees have the highest change of being able to engage with teams in person from all different regions will be in one place. Ansys uses these opportunities to have direct contact with teams, answer questions, highlight new features, and provide training resources to get them ready for their next design phase.

Investigating Impact of Ansys Student Team Support: a Case Example

The sheer number of teams supported by Ansys means that it is not possible for individual teams to receive one-on-one mentorship. This can make it difficult for our organization to understand the impact we are having. To try and explore this impact we chose to have a casual discussion with the University of Pittsburgh (Pitt) FSAE team, Panther Racing, to whom we have been a longstanding sponsor. The goals of this discussion were as follows: (1) understand the usage of Ansys support provided to team, (2) see if any trends emerged in terms of impact due to Ansys support [both positive and negative], and (3) continue to strengthen the relationship between Ansys and Panther Racing with the hope of collaboratively working to improve the Ansys student team support program.

This discussion occurred over Teams for approximately one hour with members from both Panther Racing team and Ansys on the call, as well as an external team mentor and alumni. The students were aware of the purpose of this call and are either authors on the paper or listed in the acknowledgements, due to the lack of IRB for this study (more details in the Limitations section). The questions asked to the students and alumni during the interview can be found in the appendix at the end of this paper.

Panther Racing Student Team Background

Panther Racing was founded in 1988 by students and faculty of the University of Pittsburgh School of Engineering. For the first handful of years, it began as a group competing in SCCA (Sports Car Club of America) which was hosting autocross events in the surrounding area. 1992 saw a name change to “Pitt FSAE” and a switch to the Formula SAE competition. The team has produced vehicles and competed in this ever since.

At the heart of the team’s philosophy is a commitment to education. More than just striving for success in competition, the team is dedicated to nurturing students in engineering, business, leadership, and teamwork. This commitment is not tied to any curriculum or course credit but is driven by the members' intrinsic passion for learning and personal growth.

While mostly comprised of mechanical engineering students, the team also appeals to other engineering majors and majors from elsewhere at Pitt. Currently, about two-thirds of the team members are undergraduate engineers.

Simulation has been a core tool for Panther Racing since the team could access it. Current members are unaware when simulation usage in the team started; given the fact Ansys’s founder, John Swanson, went to Pitt, it is safe to assume simulation was rapidly picked up. Currently, simulation tools are used by the team for mechanical design, heat analysis, and computational fluid dynamics.

As simulation tools improve and as students' imaginations expand, designs get more complex to maximize performance. Simulation is useful to validate hand calculations and explore possible design changes without having to invest as much time and money into actual fabrication. Since FSAE cars get almost entirely re-fabricated every year, there is not enough time for teams to sufficiently test all possible designs. Simulation allows for early iterations of designs to be tested with reasonable confidence and make educated decisions on which designs to actually fabricate and test. Three specific areas of simulation have been critical for us in the design process:

1. **Mechanical design** is critical for component analysis since a racecar necessitates lightweight parts that are high-performance. Due to toeing the line between reliability and performance, it is vital to ensure designs are sound and can stand up to the loads they will experience. For example, machined components in the suspension and braking system that need to be as light as possible but are safety critical are run through a gauntlet of hand calculations and simulation to ensure they maximize performance while not compromising the safety of the driver.
2. **Heat analysis** has been vital for any parts where it is good to know how they are experiencing heat and how to control that. Historically, primary use has been on brake rotors to determine which designs experience heat in an acceptable way, which ones disperse it faster, and which ones can still perform under the temperature ranges required. Newly, with a transition to an electric vehicle instead of a gas-powered internal combustion engine, heat simulation has been used for water blocks inside the battery pack that cool the individual cells to ensure they do not overheat. Simulation allowed analysis into the heat coming out of the cells and details about the flow requirements into the water blocks to ensure proper designs to efficiently pull heat out of the cells.
3. **Fluid flow** is an extremely difficult concept to calculate over complex geometries by hand. For example, the external wings and other aerodynamic elements have complicated flow and experience drastic variations in airflow as the vehicle drives around the track. This flow directly leads to downforce, which increases the vehicle's grip and allows for faster overall speeds on the track. Again, with the new transition to electric and the addition of water blocks to help cool the battery pack, the flow within the water blocks is complex but is directly tied to the efficiency in cooling the cells. These complicated flows are extremely difficult to calculate by hand, allowing computation via CFD opens up design capabilities and increases the ability to get closer to optimal designs.

Over the last year, the Pitt team has been able to work with Ansys to develop specific training for CFD in FSAE and has had conversations about what would improve training specific to FSAE teams.

Discussion Summary and Findings

In exploring the experiences and perspectives of the Formula SAE student team at the University of Pittsburgh regarding the efficacy of Ansys software and support, a nuanced narrative emerges, illuminating the multifaceted impact on academic and professional pursuits. Through an interview with current team members and alumni, insights were gathered regarding the role of Ansys tools in (1) competition success, (2) student experiences during degree programs, (3) transitions into the workforce, and (4) suggestions for improvement.

Competition Success

An overarching theme that resonated throughout the discussions was the instrumental role of Ansys software (particularly Ansys Mechanical and Ansys Fluent) and support in driving success in Formula SAE competitions. One team member remarked, "Ansys tools have been crucial in our design process, allowing us to iterate quickly and predict performance with confidence." This sentiment was echoed by alumni who emphasized the competitive edge gained through proficiency in Ansys simulation, citing its significance in securing job opportunities and excelling in engineering roles.

Additionally, participants highlighted the instrumental role of Ansys support platforms, including the Ansys Innovation Courses (AIC) and Ansys Learning Hub (ALH), in augmenting their simulation proficiency. These resources provided foundational knowledge and practical guidance, facilitating the initial steps in navigating Ansys software. Despite initial challenges in navigating the abundance of information available, individuals acknowledged the value of these platforms in offering structured learning pathways and introductory tutorials. Furthermore, direct support from Ansys application engineers emerged as a crucial component in troubleshooting designs and addressing queries. Engaging with Ansys experts allowed team members to receive tailored assistance and expert insights, enabling them to overcome technical hurdles and optimize their simulation workflows effectively. The collaborative exchange fostered a culture of continuous learning, empowering participants to leverage Ansys software to its fullest potential and achieve impactful outcomes in their Formula SAE projects.

Student Experiences during Degree Programs

A recurring theme was the gap between theoretical instruction and practical application, particularly concerning simulation tools like those developed by Ansys. Students emphasized the need for more hands-on experience and project-based learning opportunities to bridge this divide effectively. "Our classroom education provided a foundation, but it's the hands-on projects like Formula SAE where we truly apply what we've learned," remarked one team member.

Transition into the Workforce

An additional aspect highlighted by both current students and alumni was that the proficiency gained in simulation software through involvement in Formula SAE has had a notable impact on students' job interviews and career prospects. The alumni highlighted how their experience with Ansys tools during FSAE projects provided a competitive advantage in job interviews. Recruiters and hiring managers often recognized and valued candidates' practical experience with simulation software, viewing it as a testament to their ability to apply theoretical knowledge to real-world engineering challenges. One alum mentioned, "During interviews, I could speak confidently about my role in FSAE projects and how I used Ansys to optimize designs and troubleshoot issues. It definitely set me apart from other candidates." This sentiment was echoed by others who emphasized how their hands-on experience with simulation software enabled them to discuss complex engineering concepts with clarity and depth, ultimately enhancing their credibility as prospective hires.

Alumni emphasized how the skills developed during FSAE projects, such as the ability to scrutinize and validate engineering analyses, proved invaluable in various professional settings. One alum recounted an experience where, despite lacking access to simulation tools in a job role, they were able to apply their knowledge to validate designs using hand calculations and simple tests. This adaptability showcased the transferability of their skills, demonstrating that the critical thinking and problem-solving abilities honed through FSAE projects were applicable across diverse engineering contexts. Such experiences underscored the enduring impact of FSAE participation in cultivating practical engineering skills, enhancing graduates' effectiveness in their professional endeavors.

Suggestions for Improvement

Suggestions for improvement centered around enhancing access to experienced mentors and streamlining resources for learning Ansys software. Alumni emphasized the value of learning from common mistakes and pitfalls, suggesting that a repository of best practices and case studies in which things go wrong could aid in developing students' proficiency. Additionally, there was a call for more tailored training programs focused on automotive applications, aligning with the specific needs of Formula SAE teams.

Key Takeaways

From this discussion with Panther Racing, it is clear that the Ansys student team program is successful in helping FSAE teams complete their competition objectives. The specific mention of the AICs and ALH being of value was a particular highlight for us. The specificity of the feedback on how we can approve was appreciated, as this gives us items to act on going forward.

The comments on the impact learning simulation skills and how they assisted in both improving problem-solving skills as well as improved job prospects, were a welcome surprise that was the focus of much of the narrative. A reminder that student teams, such as FSAE, are there to help students gain skills that will help them seek employment upon graduation. Ensuring that our software support program not only aids in preparing students for competition, but as well as for their future careers, is an important consideration.

Limitations

As industry, we do not have a formal Institution Review Board (IRB) like universities do. This has led to limitations in the type of research we can conduct. While the information gathered during this discussion is invaluable to Ansys in terms of how we can continue to grow our program, we acknowledge there are areas of improvement for our data gathering methods. Specifically, there is a need for more formal research questions and rigorous qualitative interview analysis techniques. We hope to explore collaborations with HEIs in the future to conduct more rigorous research in this space.

Another limitation is that this is the perspective of only one team from one university. While we make the claim that the Ansys student team program successfully helps FSAE achieve their competition objectives, that claim needs additional data to support it before we can consider this to be true. For future studies, more teams from around the world need to be included.

Ansys Next Steps

There are clear next steps, both short and long term, based on this exploration. The students from Panther Racing gave clear suggestions on how our program can be improved in the short-term, such as specific training modules targeted to student teams that we are developing in collaboration with the students at Pitt. We hope to continue collaborations like this to ensure the program changes we are making have user input from the development stage.

A more long term next step for the Ansys Academic Program is establishing an IRB to conduct a more widespread official study of the Ansys program. The questions and trends identified during this case study will be invaluable as we develop our research questions, surveys, and more going forward.

Conclusion

It is clear from literature and reports like the WEF Future of Jobs 2023 that the skillset required by today's workforce is ever evolving and traditional education is struggling to keep up. A question is posed of how industry and academia can work together to support the next generation of engineers in being prepared for the workforce. Increasing student engagement across multiple areas is a space where industry can be more active in shaping the learner's experience during higher education. For this paper, we explore how industry support could improve student engagement outside the classroom via student teams. For this case, a single Formula SAE team at University of Pittsburgh was informally interviewed. The narratives shared by current students and alumni underscore the pivotal role of Ansys support in shaping the educational experiences and career trajectories of engineering students. While Ansys software has proven invaluable in fostering competition success and preparing students for the workforce, there remains a clear need for targeted training, mentorship, and resources to maximize its impact. By addressing these challenges, Ansys can continue to empower the next generation of engineers and innovators, driving innovation and excellence in the field of engineering. We hope that by sharing this work, we encourage more industry/academia collaborations in this space.

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Appendix: Interview Questions

1. What Ansys tools do you use?
2. How has Ansys helped you succeed in the competition?
3. Did you learn to use Ansys software in any of your university courses or on your own or both?
4. How suitable did you find the following resources for your learning and design needs?
    1. Ansys Innovation Courses (AICs)
    2. Ansys Learning Hub (ALH)
    3. Ansys Learning Forum
    4. Any live (or recorded) training sessions
    5. Direct support from Ansys reps
5. How and why is the experience you received from FSAE **and/or** Ansys important?
6. Have you seen companies intentionally seeking out your students because of their real-world experience?
7. Was that experience heavily discussed/of interest in job interviews?
8. Were they hired mainly because of that experience?
9. How did this help with your skills compare to the University classes, including senior design?
10. How has Ansys helped you to get better prepared for the workforce?
11. For alumni or those with internships: What skills from Ansys did you use in your career?

References

[1] World Economic Forum (WEF), "The Future of Jobs Report 2023," Apr. 2023.

[2] D. I. Spang, "Curriculum design and assessment to address the industry skills gap," in *2014 ASEE Annual Conference & Exposition*, 2014, pp. 24–345.

[3] Hart Research Associates, "It takes more than a major: Employer priorities for college learning and student success," 2013.

[4] R. Korte, S. Sheppard, and W. Jordan, "A Qualitative Study Of The Early Work Experiences Of Recent Graduates In Engineering.," in *2008 Annual Conference & Exposition*, 2008, pp. 13–94.

[5] E. Goold, "Engineering students' perceptions of their preparation for engineering practice," in *The 6th Research in Engineering Education Symposium*, 2015.

[6] E. F. Crawley, D. R. Brodeur, and D. H. Soderholm, "The education of future aeronautical engineers: conceiving, designing, implementing and operating," *J Sci Educ Technol*, vol. 17, no. 2, pp. 138–151, 2008.

[7] D. Heaslip, "Bridging The Gap Between Post Graduate Engineering Education And Industry Needs," in *2004 Annual Conference*, 2004, pp. 9–264.

[8] P. Trowler and V. Trowler, "Student engagement evidence summary." The Higher Education Academy, 2010.

[9] "National Survey of Student Engagement." Accessed: Feb. 02, 2022. [Online]. Available: https://nsse.indiana.edu/nsse/index.html

[10] S. J. Quaye, S. R. Harper, and S. L. Pendakur, *Student engagement in higher education: Theoretical perspectives and practical approaches for diverse populations*. Routledge, 2019.

[11] K. Krause and H. Coates, "Students' engagement in first-year university," *Assess Eval High Educ*, vol. 33, no. 5, pp. 493–505, 2008.

[12] F. Martin and D. U. Bolliger, "Engagement matters: Student perceptions on the importance of engagement strategies in the online learning environment.," *Online Learning*, vol. 22, no. 1, pp. 205–222, 2018.

[13] NSEE Annual Report, "Engagement Insights: Survey Findings on the Quality of Undergraduate Education," 2019.

[14] B. Ogwezi, K. Tyler, N. Manai, and C. L. Penny, "Closing the gap between industry and academia via student teams support," in *2023 ASEE Annual Conference & Exposition*, 2023.