Education Impact Case Study

The University of Leeds

Leeds Grows Mechanical Engineering Student Employability by 19% Through Curriculum Reform

Customer Profile
The University of Leeds in the United Kingdom works to maintain its position as one of the top universities in the world through its distinctive ability to integrate world-class research and education. To achieve this goal, Leeds focuses on delivering outstanding teaching to more than 33,000 students from 145 countries. In 2012, Leeds was one of only three institutions to receive a commendation for enhancement of student learning opportunities, the highest honor from the UK Quality Assurance Agency. The university has been awarded 17 National Teaching Fellowships for its imaginative and innovative teaching methods, which is more than any other higher education institution in England, Northern Ireland, and Wales.

Within the university, the School of Mechanical Engineering strives to give graduates an advantage in the job market through access to industrial collaborations. In particular, students work closely with industrial partners such as BP, Rolls-Royce, Shell, and Surgical Innovations to deliver real engineering solutions in their fourth-year term projects. These efforts have made the school one of the leading mechanical engineering programs in the UK, according to the UK Research Assessment Exercise.

Overview

Customer Profile
The University of Leeds is a top-ranked university in the world focused on integrating world-class research and education.

Challenge
Graduating unprepared students from the School of Mechanical Engineering into industry jobs.

Solution
A reconfigurable and durable hardware-software platform that scales from first-year teaching to research.

Implementation
Complete curriculum reform that integrates practical work into an entire degree program.

Results
After four years, the employability of students rose 19% and the university received positive feedback from students and industry.
Challenge

In 2009, the school’s newly appointed director of Student Education, Dr. Martin Levesley, analyzed the curriculum and the feedback from industry. He found that the school was graduating students who had never designed, built, or tested physical systems. “Before the reform, I could simply look at their designs and realize that if I pushed on the structure at all, it would collapse,” Levesley said.

Thinking back to when he worked with industry during his postdoctoral research for Rolls-Royce, Levesley remembered how his knowledge of theoretical concepts was solidified when he was given situations with real-world constraints. He hypothesized that by giving students the experience of completing practical, industry-based projects with the time constraints of a semester, they would be better prepared for their future jobs.

However, before he could feel comfortable implementing a large-scale curriculum reform, he wanted to test his hypothesis. The school sets aside £10,000 each year for curriculum improvements through its Think-tank for Initiative in Learning and Teaching (TILT) program, and with this money, Levesley sought to equip the students in his newly assigned second-year classes to design, build, and test physical systems.

Evaluation

Head of School Dave Barton agreed with Levesley’s approach. “If students could use the same tools on their projects that they would use on the job, they would be more attractive to hire. Employers would value the training time and cost savings, making the school more appealing to students and industry alike.”

Levesley identified several tool requirements for this course. First, because students are not advanced programmers, they need software that can abstract low-level programming and match how they are being taught to design systems. Additionally, since experimentation is a valuable part of the learning experience, the tools have to allow students to rapidly test and iterate on their designs. Finally, the tools have to be durable enough to not be damaged in these experiments.

Solution

Levesley found that many options fell short of his requirements. While some were used in industry, they were too difficult or low-level for students to learn in a short amount of time and too inflexible to allow students to rapidly prototype. Other tools that allowed for quick iteration were not tough enough to withstand the rigor of the projects and student experiments, nor could they be scaled to project adjustments or advances.

The solution came from Levesley’s work with researchers Pete Culmer, Andrew Jackson, and Dave Keeling, who were delivering robotic physiotherapy to stroke patients. The project had strict safety requirements because the robot was attached directly to the patient’s arm. They brought their search for tools to NIWeek, the annual conference hosted by National
Instruments, where they saw examples of cutting-edge research projects with similar requirements for high sampling rates and scalability that used NI LabVIEW system design software and NI CompactRIO hardware. The durability and safety of the platform made it a perfect fit, and the ability to transfer LabVIEW code across various hardware targets meant their research could easily scale.

As the group members developed their research, they realized that in addition to being powerful and complex, LabVIEW abstracted VHDL programming for the FPGA on CompactRIO. As a result, they were able to quickly prototype and iterate on their research. Seeing the scalability of the hardware and software platform, they recommended these tools for the second-year student projects.

Implementation

As the project gained momentum, the group helped Levesley revise the second-year classes to focus on an autonomous ground vehicle project that culminated in a competition among the students called the Daring Dash. Because the students used LabVIEW and CompactRIO as the standard tools for the “brains” of their vehicles, they could be judged fairly on their mechanical design and their vehicle’s agility and speed navigating the terrain.

The group saw that students began to understand the subject matter better by applying it to practical projects. Students were excited about what they were learning and wanted to be successful in the competition. Some even put in extra time outside classes working on their designs. Industry partners helped judge the competition and were impressed by the high standard of design they saw. The year-end survey provided the proof Levesley was looking for. For many of the 25 survey questions, student approval rose by more than 20 percent. Most notably, the positive responses to the statements “As a result of the course, I feel confident in tackling unfamiliar problems” and “The programme is intellectually stimulating” were up 16 percent and 21 percent, respectively. Levesley believed that if first-year students were given the opportunity to participate in project work, overall satisfaction would improve even more.

Thus, the group redesigned the first-year computing module with design, build, and test challenges and tailored it to particular groups. This again proved extremely popular, with approval ratings for the first-year computing course rising by 75 percentage points in a single year.

As an added benefit, standardizing on LabVIEW meant that each stage of the curriculum could lead to the next while helping students become more proficient in programming by the time they use it in industry. In addition, the first LabVIEW academy in the UK was established at Leeds to prepare students to become Certified LabVIEW Associate Developers (CLADs).

Results

Based on prior success, the team continued the reform into third-year and team-based fourth-year projects with consistent results. Feedback from the industry advisers was positive, and employers began to seek out the

“My practical experience at Leeds marked me out as a rarity among the other engineering graduates applying to Jaguar Land Rover’s graduate scheme.”

—Sian Owens, Leeds Mechanical Engineering School Graduate, Jaguar Land Rover Engineer
students who were graduating with the CLAD. Additionally, the school’s position in the National League Tables, which rank universities based on data in various categories relevant to each degree plan, rose significantly.

Prior to the curriculum reforms, the school was ranked in the lower quartile of the Russell Group, which consists of 24 UK universities committed to the highest levels of academic excellence in both teaching and research. “This academic year, in the three League Tables released so far, our school is clearly at the top of the Russell Group for Student Satisfaction and Teaching Excellence, and the employability of its graduates has improved significantly,” Levesley said. “Data from The Guardian and the Complete University Guide (CUG) tables, both free to students, clearly shows the progress made from 2010 to 2013.”

The research quality at the School of Mechanical Engineering has also improved. In 2012, Keeling and Levesley’s research team won Application of the Year in the NI Graphical System Design Achievement Awards for a mechanical heart simulator that removed the need for animal testing. This generated international attention for them and the school.

Looking Forward

Propelled by his success in the School of Mechanical Engineering, Levesley plans to share his solution of applying theoretical concepts to relevant practical work with other faculties and schools. He plans to continue collaborating with key industry partners that are equally passionate about the collaboration between students and industry such as Dr. Bipin Bhakta, a local medical professional, who said, “Engineers who have not interacted with the end users of their products are designing in a vacuum.”

The curriculum reform has also had a dramatic effect on student recruitment. Dr. Mark Wilson, school admissions officer, said, “There has been a recent increase in the number of students selecting Leeds as their first choice, and the quality of students coming to Leeds is improving year on year.”

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