Education Impact Case Study:
The University of Manchester

MANCHESTER 1824
The University of Manchester

Overview

Customer Profile
The University of Manchester is a public research university with a focus on advancing education and research by attracting and retaining high-quality students.

Challenge
The 2009 National Student Survey (NSS) gave the School of EEE alarmingly low marks. Improving student satisfaction would require engaging them with more practical course work.

Solution
Lab exercises with NI educational tools improved relevance for students through open-ended investigations on hardware and software.

Results
After one year, the 2010 NSS reflected the extensive School-wide effort: overall student satisfaction improved by 31percentage points.

National Instruments Tools Help Manchester Improve Student Satisfaction From 67% to 98%

Customer Profile

Founded in 1824, the University of Manchester is a public research university in the United Kingdom with a distinct focus on furthering higher education and research by attracting and retaining high-quality students. The university's commitment to providing an exceptional education to students of all backgrounds is critical to its position in the competitive academic environment of the UK, where the caliber of the student body directly impacts a school's research capability and quality.

The University ranked 38th in the world and 6th in Europe in the 2011 Shanghai Jiao Tong World Ranking. Within the University, the School of Electrical and Electronic Engineering (EEE) ranked 2nd in the UK's 2008 Research Assessment Exercise and 1st in the UK's 2011 National Student Survey (NSS). The School provides more than 570 undergraduate students a comprehensive foundation in core topics and practical project work to prepare them for industry and research.

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Challenge

The NSS is conducted annually to measure student satisfaction with degree programs across the UK. In 2009, the School of EEE received alarmingly low marks in categories including "satisfaction with the teaching of courses" and "learning resources." That year, the School ranked 34th out of 36 schools in the NSS.

The Head of School knew that if satisfaction ratings did not improve, the overall standing would decline. He identified a group of key academic staff to consult with students, the industry advisory board, and fellow academics to highlight major issues and propose plans for addressing them.

Evaluation

The team's research revealed that improving students' satisfaction would require engaging them with more practical course work. For this, Dr. Danielle George, a Senior Lecturer and enthusiastic champion for experiential learning within the School, focused on improving the laboratories by relying less upon computer simulations to do what hands-on experiments could accomplish in a more effective, engaging way. The new lab exercises had to improve relevance and understanding through open-ended investigations on both hardware and software across varying contexts. Since the changes needed to achieve immediate results while fitting within space, budget, and time constraints, any new equipment needed to integrate easily with existing tools, curriculum, and faculty expertise.

> *"Electronics used to seem so cryptic to me, but using NI tools in the new labs made everything so much more understandable. It's given me the confidence to experiment with electric circuits and to try out some of my own projects."*
>
> –Joshua Elijah
> **2nd Year Undergraduate Student**
> The University of Manchester

Dr. George began by evaluating the Electronic Circuit Design 1 course, one of the first laboratory courses that students encountered; creating a positive experience for the 160 enrollees in this course was critical. She knew that proven success in this course would be an indicator for the rest of the curriculum. Dr. George defined three requirements for new equipment: first, software needed to be useful for simulation, but not disconnected from the theory learned in lectures; second, the learning of the tools needed to be intuitive enough to not detract from the learning of the subject matter; and finally, the tools needed to be flexible enough to expand to other courses in the curriculum.

Solution

As she evaluated options, Dr. George found that most tools did not meet all of her requirements. Software options either did not convey the connection between the tool and the theory in textbooks, or did not visually represent the effects of tuning different parameters, largely mitigating the usefulness of simulation. Hardware options were either incompatible with software, which would require too much work to integrate and learn, or too rigid in functionality to scale across other courses.

Upon the recommendation of her local National Instruments academic field engineer, Dr. George evaluated the NI platform for teaching circuits. The platform consists of NI Multisim circuit simulation software and NI Educational Laboratory Virtual Instrumentation Suite (NI ELVIS) hardware. She found that students could intuitively use Multisim to visualize circuit diagrams and immediately transition to designing, prototyping, and testing circuits in real time on NI ELVIS hardware, bridging the gap between theory and experimentation. Because the NI software and hardware were integrated by design, students were able to stay within Multisim to compare their SPICE circuit simulations to real, acquired data from NI ELVIS.

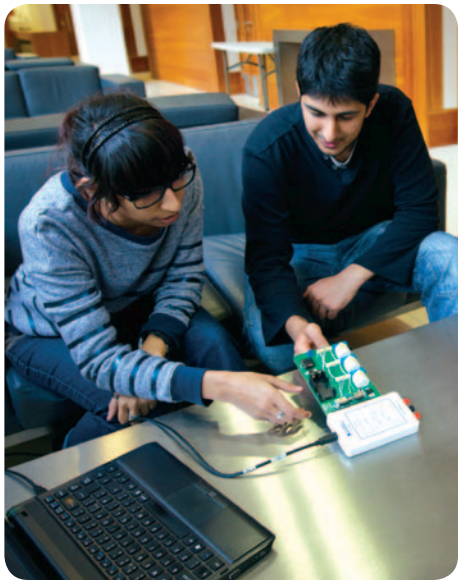
"To attract the most talented students, we must show them that the education they receive at Manchester will be relevant and fulfilling. The NI tools make it possible to do that."

– Andrew Gibson
Head of School
The University of Manchester

Students could use NI ELVIS, with its 12 integrated software instruments, including an oscilloscope, digital multimeter, and function generator, to perform multiple analyses on their circuits without having to jump from tool to tool. NI ELVIS was particularly unique because its integrated data acquisition hardware could be customized by interchanging the breadboard with the more than 20 other top boards, making it reusable in course applications such as measurements, instrumentation, and control design.

After incorporating Multisim and NI ELVIS into the course, Dr. George noticed immediate improvement in student engagement. The user-friendliness of NI hardware and software made students more comfortable with their first lab experience, enabling them to spend lab time focusing on applying the concepts they were learning in lecture rather than figuring out how to use the tools.

With the successful implementation of the NI platform for teaching circuits in Electronic Circuit Design 1, Dr. George worked with colleagues to introduce Multisim and NI ELVIS into the additional Year 1 courses of Digital System Design, Circuit Analysis, Electromagnetic Fields, and Energy Transport and Conversion. She also added NI LabVIEW system design software to the labs so that students could expand on fundamentals by prototyping, designing, and building complete applications. NI ELVIS could be further customized with LabVIEW to create instrumentation for application-specific uses.



Because it was founded on the graphical system design approach, the NI solution presented an unexpected benefit: the same hardware-software compatibility of NI ELVIS, Multisim, and LabVIEW was found across other NI platforms such as NI CompactRIO hardware for embedded control and monitoring and the NI USRP™ (Universal Software Radio Peripheral) for RF and communications system design. Thus, faculty, students, and researchers could apply their training and experience with the tools across advanced courses, projects, and research. The widespread use of LabVIEW in industry also meant that students could extend the application of that training into their careers.

Recommendations for Success

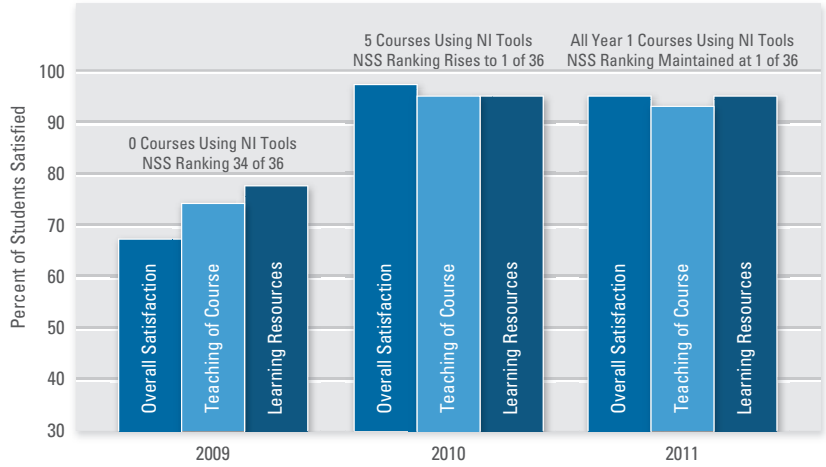
- **Identify a technical champion** to help drive course changes
- **Phase the introduction of updated labs** to build support by faculty through incremental change
- **Consult NI field engineers** to review which options best fit needs
- **Share one platform between multiple courses** to maximize space and equipment costs across labs
- **Use PC-based instruments and tools for flexibility** to expand both in and out of lab with software

"Teaching NI tools in our undergraduate courses is producing postgraduate research students who can deliver practical instrumentation, control, and communication solutions from day one. For them, the challenge is the research and not the tools that are needed to deliver it."

–Peter Green
Senior Lecturer
The University of Manchester

Results

After just one year, the 2010 NSS reflected the results of the extensive School-wide effort, including the changes to the laboratory experience: the overall student satisfaction score increased dramatically from 67 percent to 98 percent. Satisfaction with teaching of the courses went from 74 percent to 96 percent, and satisfaction with learning resources went from 78 percent to 95 percent. These results gave the team the proof they needed to extend the use of NI tools across the entire Year 1 curriculum and into more advanced courses. These high scores were maintained the next year, with an overall 2011 NSS satisfaction rating of 96 percent.



Looking Forward

Dr. George and her colleagues in the School have continued to expand practical course work using NI educational solutions throughout undergraduate courses, including Electronic Circuit Design II, Sensing and Imaging, Digital Image and Signal Processing, Advanced Control and Systems, and even into master's courses. In 2011, the School began issuing all incoming freshmen an NI myDAQ hardware device to use throughout their time at university. Based on the same technology as NI ELVIS, the NI myDAQ portable instrumentation and data acquisition device increases time for experimentation by equipping students to do practical course work at home. In 2012, the School became a LabVIEW Academy by adding a course dedicated to teaching best practices in LabVIEW. The course culminates in the opportunity for students to take the Certified LabVIEW Associate Developer (CLAD) exam. The School plans to continue integrating LabVIEW and NI tools into RF and communications, which further adds to the return on the graphical system design approach to attract, retain, and educate exceptional students for years to come.

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