Case Study: CDIO at the University of Hertfordshire

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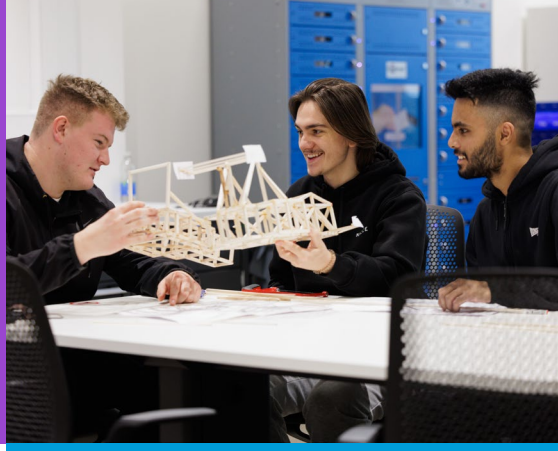


A journey beginning in 2018

Until 2018, the Engineering degrees at the University of Hertfordshire (UH) were typical of many traditional Engineering degrees. Subjects were taught in a traditional lecture-based format, with conventional assessments and a high proportion of exams.

However, the effects of this dated approach were being seen in dwindling student engagement and satisfaction rates. Failure and progression rates – especially in exam-based modules – become an increasing issue as increasing numbers of students joined the university from less exam-based school backgrounds.

Practicals sessions tended to be more experimental or observation based which did not mirror the industrial work environment, with students struggling to see the relevance of these activities.

Students complained about uninspiring teaching, large classes and assessments which seemed irrelevant to their careers.

Students also reported increasing levels of loneliness and isolation as the typical student social activities which traditionally happened on campus now moved online to social media.

Beginning with the Mechanical, Automotive and Aerospace Engineering degrees, a complete rewrite of the degrees started in 2018, based around CDIO principles, which launched in 2020. This coincided with the design and development of a new building, allowing bespoke CDIO spaces to be part of the new building.

Our first CDIO modules were in the 2020 COVID-19 lockdowns. Students were sent kits of materials in the post (including overseas students) to build at home. Students submitted pictures of their models (and testing) for grading!

CDIO at UH in Numbers:

3 Flexible CDIO spaces, adjacent to each other, capacity 64, 80 & 88 students or a combination of these, up to 232 if all combined.

34 Design, Build and Test modules, across

9 CDIO based Engineering Degree Programmes

42 Academics are on CDIO Module Teams

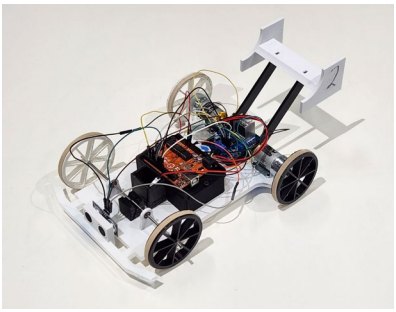
10 Dedicated CDIO Technical Team members

>800 STUDENTS ON CDIO PROGRAMS

Key Changes made:

- Modules on Design, Computer aided Design, Manufacturing Technology and Project Management in the 1st and 2nd year were replaced by 4 CDIO modules (one each semester) that combined these modules' material.
- Each CDIO project has a THEME. Other traditionally taught modules support this theme.

Example: Automotive Engineering



Project for Automotive Engineering:

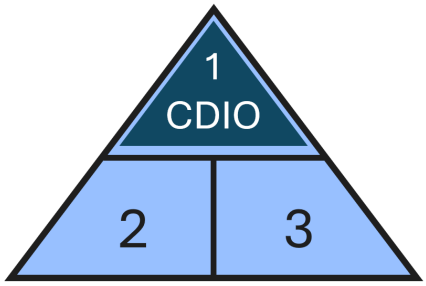
An Arduino controlled craft: "Introduction to Mechatronic Systems" Module

Automotive Engineering Example (cont.)

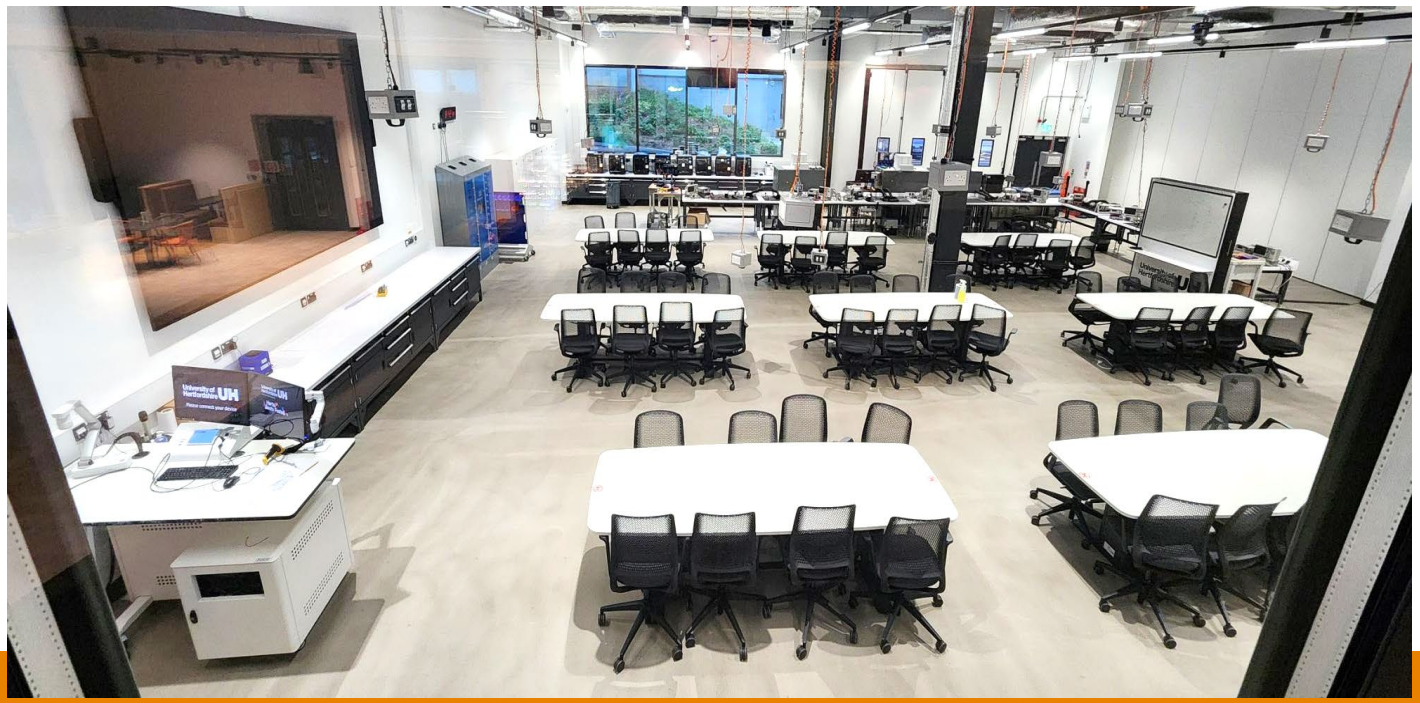
THEME – Electrical & programming

CDIO Module:
1. Introduction to Mechatronic Systems

Supported by:
2. Electrical Science
3. Programming for Engineers



Supporting modules (2 & 3) can be in the same or preceding semester.



A new building

The re-writing of the engineering degrees coincided with a new building for the School of Physics Engineering and Computer Science. This allowed the CDIO teams to collaborate with the architects to design three bespoke flexible CDIO spaces which occupy the ground floor.

CDIO at the University of Hertfordshire:

- Students have 4 CDIO project modules in their first 2 years, one each semester
- Each semester consists of 1 CDIO module and 3 “traditional" modules
- CDIO modules are timetabled from 10am-4pm, one day a week for each cohort. Other modules are timetabled on other days
- Lockers are provided for students to store their CDIO projects from one week to the next
- Laptops can be loaned from electronic lockers in the CDIO spaces for students who may not have their own laptops.
- Students work in groups of 4 to 8, depending on the module size
- To support the Teamwork and Employability learning outcomes, there is a minimum 70% attendance requirement at the CDIO modules for each student. Students not meeting this level have their mark for the module reduced to a “pass” to reflect that the above learning outcomes have not been met. This has met with widespread support from our Industrial stakeholders and employers.
- Student marks on the CDIO Module are weighted at 40% for the group work element (the overall project) and 60% for individual work (example: an (individual) software assignment).

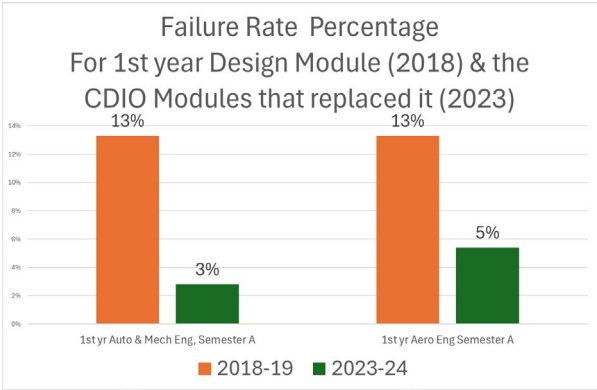
A day at the office…

Students have 1 day per week in the CDIO spaces for their CDIO Module. A day typically starts with the academic team directing the days’ activities or teaching some theory, followed by group work the rest of the day and computer labs as needed. All equipment needed to make the projects are in the CDIO spaces and all project manufacture and build is done in this time. Design activity occupies the start of the semester followed by manufacture and testing as the semester progresses.

Excellent Outcomes.

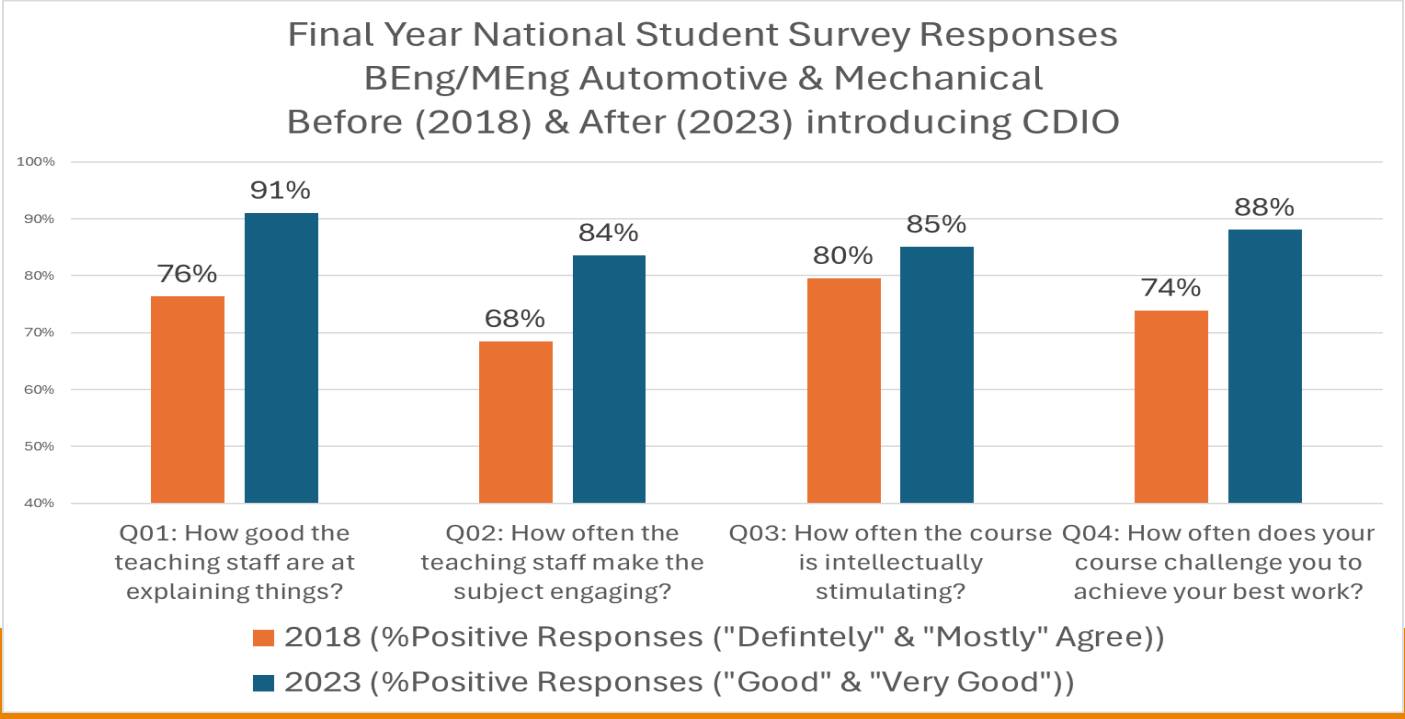
Moving to a CDIO based programme has had significant benefits*

- The number of “Good” (1st Class and Upper 2nd Class) degrees has increased by 15%
- Students securing industrial placements (a highly competitive optional year of industry employment after students’ 2nd year) have more than doubled.
- The number of students progressing to their second year without repeating has increased by 21%
- Attendance has improved dramatically: typically, only 1-3% of students have their mark affected due to the 70% attendance requirement. In 2017/18 half the class would typically have below 70% attendance.
- Failure on CDIO Modules is much lower than on the Design Modules they replaced:



- Although difficult to quantify, the engagement and enthusiasm in the CDIO spaces is unmistakeable, especially as the projects near completion.

*These numbers compare BEng Mechanical, Automotive & Aerospace 2017/18 classes (before CDIO & the Covid 19 lockdowns) and 2023-24 graduates who started CDIO programs after lockdowns ended.



NSS Success…

UK students are asked to complete the “National Student Survey” or NSS in their final year of studies. The introduction of a CDIO programs has led to significant improvements.