# The research experience from part A to D:
## Implementing research education to support effective teaching in higher education

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## Introduction

Over the past few decades, the concept of the research-teaching nexus has become established as a core principle of UK policy in higher education, as evidenced by the 1997 Dearing Report[1] and the Government's 2003 White Paper.[2] The concept draws together the two main functions of higher education, namely research and teaching, arguing that they should be closely associated. However, there are potential pitfalls to the implementation of research-based teaching at the undergraduate level. In particular there is an unwelcome perception that academics care more about their research than their teaching, a theme that was highlighted by the then Universities minister, Jo Johnson, during his 2015 speech to the Universities UK Conference.[3] Current thinking on approaches to the research-teaching nexus are often expressed according to a framework designed by Healey,[4] which defined four themes of research-led, research-orientated, research-tutored and research-based teaching. Here we present an overview of how we engage with these themes various stages of our degree programmes, drawing on examples from our disciplines.

## Part A

**In Part A the curriculum is generally teacher focussed, with the students as participants. A large proportion of this involves research-led teaching.**

**In research-led teaching the curriculum is focussed on teaching the underpinning subject content, which is required for the remainder of the course.**

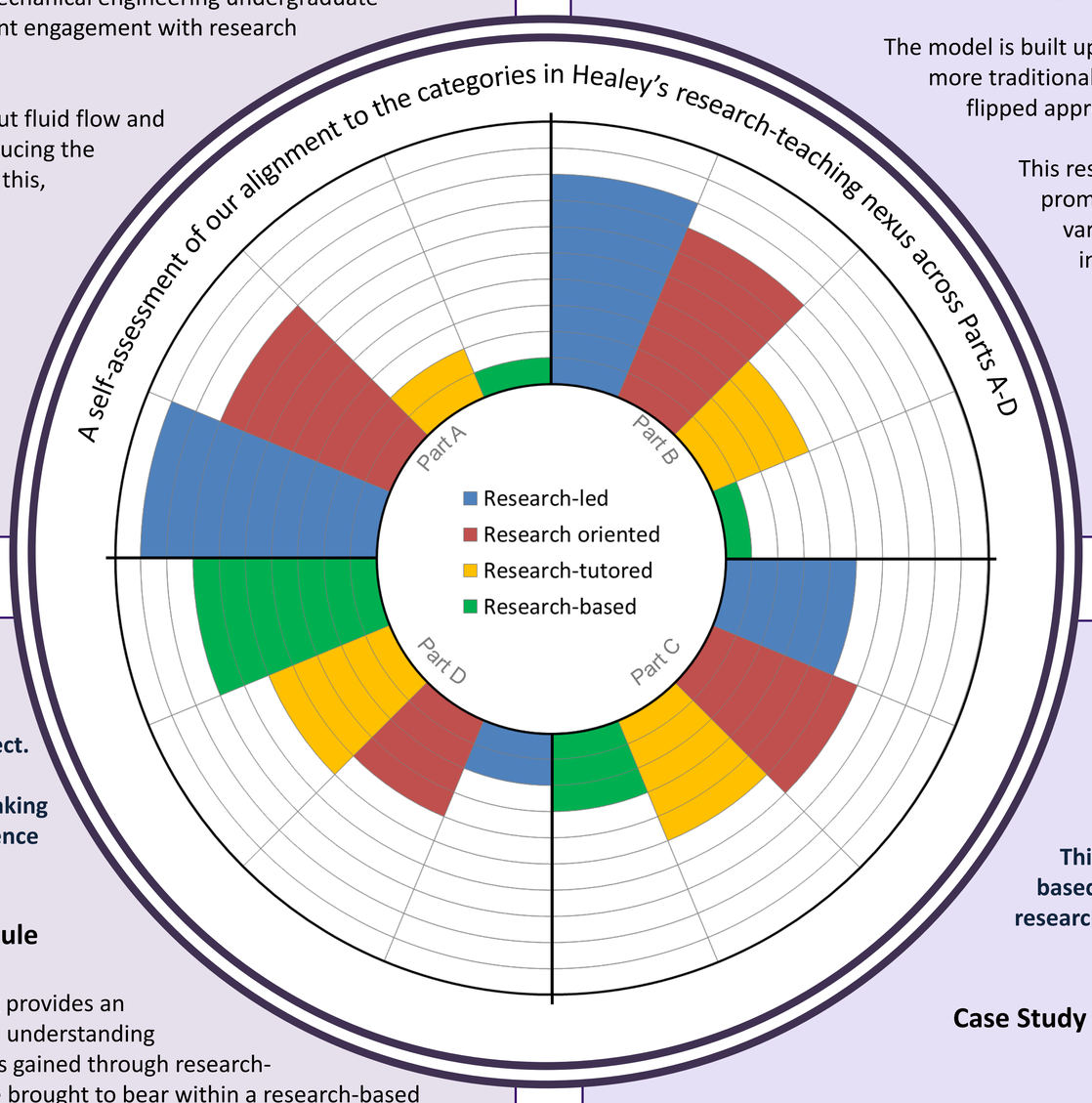
### Case Study – MMA800 'Thermofluids' module

Part A engineering modules typically focus on foundational learning, incorporating concepts and capabilities which are built upon during the remainder of the course. However, incorporating current research right at the start of a students education experience can significantly aid their perception of the research-teaching nexus, exposing them to both application and purpose.

The part A module on *Thermofluids*, taught as part of the mechanical engineering undergraduate program, provides an excellent opportunity to initiate student engagement with research through a ***research-led*** approach.

During the 1st semester laboratory work, students learn about fluid flow and measurement techniques through practical exercises; introducing the relevance of this is vital for student engagement. To achieve this, current research activities are introduced to the students, indicating how correct measurement and understanding of fluid flows is critical in understanding processes and Interactions.

By analysing the accuracy and value of their measurements, Students begin to appreciate limitations of techniques and the value of research.




## Part B

**In Part B the curriculum still contains a large proportion research-led teaching, but begins to incorporate more aspects of research-oriented teaching.**

**Research-oriented teaching places emphasis on the understanding of the processes of inquiry *per se*, and on the learning of the specific content achieved through that process. It is an intermediate step between a research-led approach and a research-based approach.[5]**

### Case Study – DSB112 'Research Methods' module

This module provided active opportunities to experience the processes of inquiry/conducting research *per se,* and to learn about its core principles, via a modified "flipped classroom" model.[6]

During lectures, students are tasked with developing meaningful ergonomics research questions, to collect some specific group data of interest, and following a brief creation of graphs, to present this to the rest of their colleagues.

The model is built upon a brief delivery (10-20min) of some key concepts in a more traditional way followed by the "go and use the knowledge" flipped approach.

This research-oriented approach has been successful in promoting critical knowledge acquisition and in developing a variety of skills (e.g. critical thinking, problem solving, immediacy and effective delivery of content to peers) that are essential to support the intellectual growth of part B students. An interesting outcome of such approach has been in the "heated debates" between peers that have regularly occurred during lectures, and which students now appreciate being an integral part of the research process.

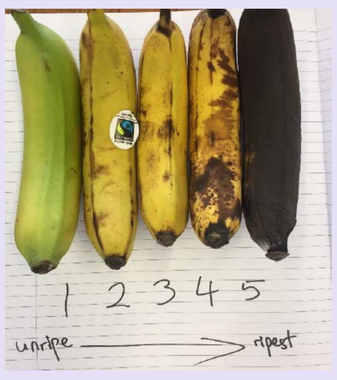
## Part C

**In Part C the emphasis shifts from a predominantly teacher focussed curriculum to students becoming active participants in research learning.**

**This may involve research-tutored teaching, where skills based on students writing and critically evaluating other's research e.g. in published data or literature, are developed.**

### Case Study - CMC026 'Extended Experiments' module

This module draws together several research aspects and develops a range of problem solving, teamwork and presentational skills.




Students perform a literature review on a research area of their choice, with findings presented to their peers in the form of a poster and an oral presentation. Here the students are mainly working within the research-tutored category, but also experience research-based teaching during a 2 week research project.

In one option students initially work in a small group to develop and validate a method for the analysis of potassium in bananas. They then work individually to investigate an aspect of their choice in detail e.g. the effect of ripeness on potassium content (photo courtesy of J.W. Tan, BSc in Chemistry 2017), producing a report in the style of an RSC journal article.

## Part D

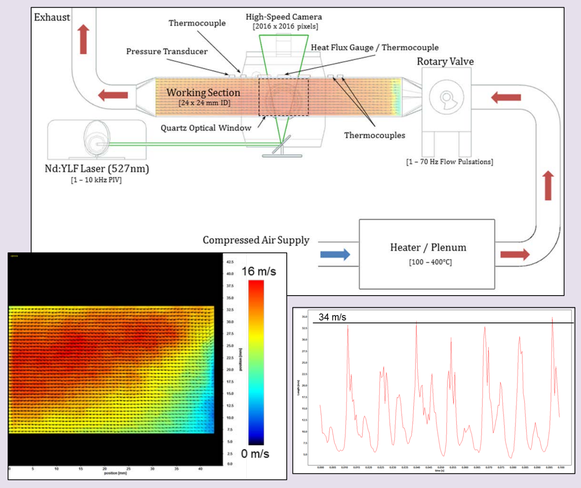
**In Part D the curriculum is strongly research focussed and typically includes a large individual or group research project.**

**This research-based teaching emphasises students undertaking enquiry-based learning and requires aspects of independence and originality.**

### Case Study – MMD503 'Project engineering' module

The product engineering module of mechanical engineering provides an opportunity for part D students to apply the techniques and understanding developed through the parts A to C to new project. The skills gained through research-oriented and research-tutored sections of the course can be brought to bear within a research-based context where students take responsibility for the direction and success of the work.

Students work together in teams of 5 in this module, working for an industrial company who provide the real-world problem. Students must conduct their own research in order to develop a viable solution within the specified constraints. They must define their objectives, conduct a suitable review of literature, conduct their own investigations and produce a solution that meets the clients needs. In carrying out this work, students must take responsibility for identifying the solution and perform a critical evaluation of their work. This process of self-reflect helps develop deeper learning in the students and reinforce understanding of concepts introduced theoretically during their prior studies.




## Conclusion

Our case studies provide an overview of how the **teaching-research nexus** is incorporated at different stages of higher education learning (see central Figure). While multi-disciplinary, the practice presented in those cases studies highlights a common goal, that is, to support the student transition from an **active recipient of knowledge**, to a **proactive producer of knowledge**.

This is achieved with the incorporation/transition from research-led teaching to research-based teaching, where the understanding, acquisition, and first-hand experience of the process of research and inquiry, is made integral part of the student's experience. The themes and practice above align to activities A1,A2,A4, knowledge K2, and values V3, of the UKPSF.

## References

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