

## [P32] Threshold concepts, troublesome knowledge and knowledge gaps

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### Background

Within the science subjects, there are challenges that undergraduate students face. Science is often seen as difficult, but what are the reasons for this? Are there some concepts that most students find difficult because they are abstract and conceptually difficult or are their problems caused by a lack of prior knowledge (knowledge gaps)? Are there some key concepts which are fundamental to the understanding of the subject?

Meyer and Land call these key concepts, *Threshold concepts*, which they define as 'core concepts that once understood, transform perception of a given subject'. Once understood, these concepts are rarely forgotten and often have boundaries with other concepts leading to a greater overall understanding.

Meyer and Land also describe another problem, that of *Troublesome knowledge*. These are concepts that appear alien or counter-intuitive. Students are often able to perform mechanical tasks and techniques but fail to understand the underlying concepts and therefore the bigger picture. They are unable to apply their knowledge to new situations. Threshold concepts are often troublesome knowledge and cause major barriers to learning if not understood.

An additional factor is a lack of prior knowledge: Students enter degree programmes with a variety of backgrounds and qualifications, meaning that some students may have knowledge gaps. This can be due to either differences in syllabus content between qualifications e.g. Access and A-Level (A2) courses, or differences in how A2 courses are delivered in colleges. Further complications arise with Interdisciplinary courses (e.g. Sports and Forensic Science) which have students with mixed qualification profiles of AS Level and A2 Level in key subjects and therefore have knowledge gaps in key areas for their chosen course of study.

### Research methodology

CELS is conducting research with undergraduate students and academic staff at NTU across both pure and interdisciplinary science degree courses. Data is being captured through focus groups and questionnaires with the aim of identifying troublesome knowledge, threshold concepts and knowledge gaps.

Focus groups are being held with students from each year of a given course to capture in depth data about concepts within their course that they find difficult. The findings of this area

of the research are then used to create a questionnaire to be completed by all members of that course. This enables us to ascertain if the troublesome knowledge identified by the focus group participants is seen as troublesome by their peers. The questionnaire also captures data about the student's backgrounds to identify potential knowledge gaps. This allows us to distinguish between knowledge that is indeed troublesome, from that which students find difficult because of a lack of background knowledge.

### Research outcomes

The first focus group was run with Level 1 Forensic Science students who identified a number of chemistry concepts that they saw as being difficult. These were then compared with findings from a study carried out in 2006, which compared the chemistry content of science access courses with A2 Level Chemistry. The following concepts, identified as being covered briefly or not at all in the Science Access course, were also identified as causing difficulties for the 2005/2006 Level 1 Forensic Science students with Access entry level qualifications:

- Spectroscopy
- Chromatography
- Mole calculations
- Bond types
- Functional Groups

*'we have people who have done "A" levels here and I think they understood a lot more than we did'*

2005/2006 Level 1 Forensic Science student with Access to Forensic Science entry qualification.

A follow up questionnaire to be completed by all Level 1 Forensic Science students will seek to distinguish between knowledge that is difficult because it is troublesome knowledge from that which is difficult because of knowledge gaps.

New learning materials are being developed to address problems faced by students due to knowledge gaps and troublesome knowledge. E-learning materials for Mole calculations and Molecular geometry (which includes bond types) are currently under development.

For more information see [www.ntu.ac.uk/cels](http://www.ntu.ac.uk/cels)  
or email [cels@ntu.ac.uk](mailto:cels@ntu.ac.uk)

### References

Meyer, J. and Land, R. (2006) *Overcoming Barriers to Student Understanding*, Routledge Falmer.