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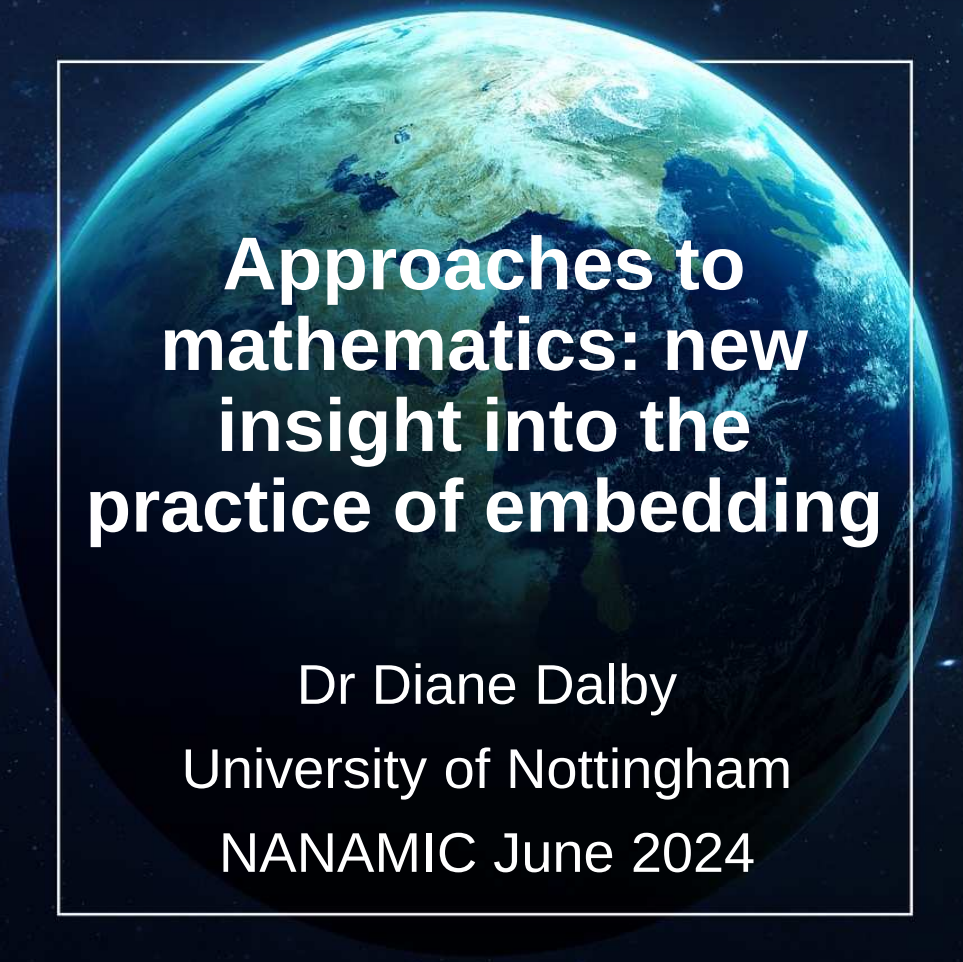


Approaches to mathematics: new insight into the practice of embedding

Dr Diane Dalby
University of Nottingham

NANAMIC June 2024

The context

- Technical qualifications (T levels), aimed at students aged 16 years and over;
- Phased introduction, with first T levels taught from September 2020;
- Offered by large Further Education colleges in England;
- Designed to be more ‘academic’ than other vocational or technical programmes;
- Maths is integrated into the programme (Dalby & Noyes, 2016)

A competency-based approach to maths

- Students engage with mathematics through applications in **authentic vocational contexts** (Royal Society, 2019).
- Competencies are demonstrated by an **activation of maths** to deal with problems within a given context (Niss & Hojgaard, 2019).
- The mathematics may be no more advanced than students have already learned but the emphasis is on the **application of maths** in work-related situations.

A competency approach (T levels)

The **General Mathematics Competency framework** focuses on the development of ten general mathematical competencies:

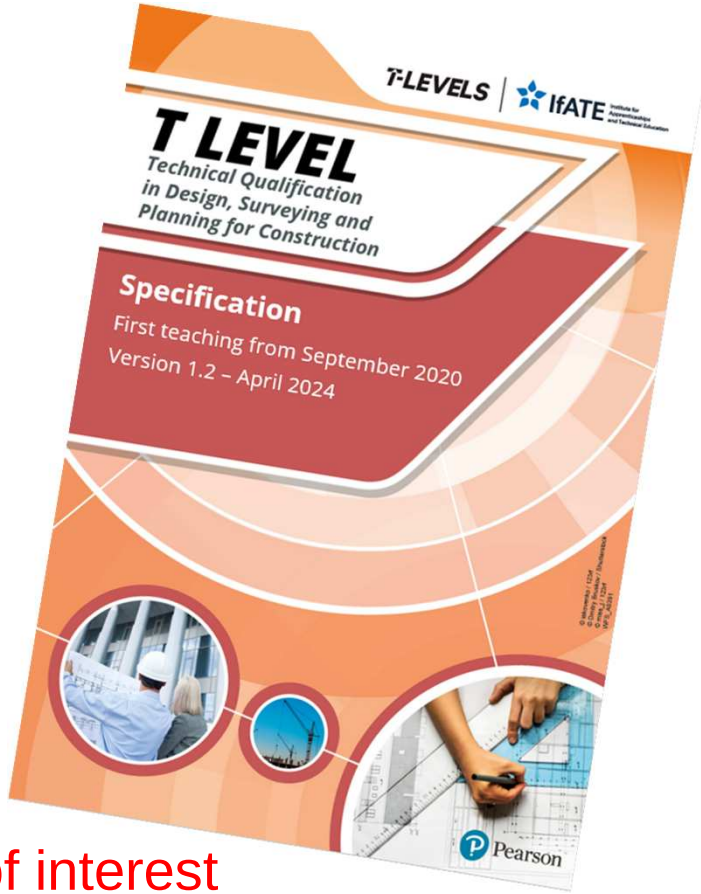
- Measuring with precision
- Estimating, calculating and error spotting
- Working with proportion
- Using rules and formulae
- Processing data
- Understanding data and risk
- Interpreting and representing with mathematical diagrams
- Communicating using mathematics
- Costing a project
- Optimising work processes

Research project

The research involved:

- a review of documentary evidence
- four college case studies
- ten different T level pathways.

Semi-structured interviews were carried out with T-level managers and teachers in each of the four colleges to inform the case studies, using a set of key questions about the way the GMC framework was used and the development of students' mathematical competencies.



Presentation aim: to explore three emerging areas of interest based on preliminary analysis, not confirmed findings.

Areas for discussion

Approaches to embedding maths

- How do vocational teachers embed mathematics into their programmes?
- What strategies do they use and why?

Teacher confidence and competence

- What issues might arise from any variations in vocational teachers' confidence and competence with maths?

Use of different 'authentic' contexts

- How do the contexts and learning environments for T levels affect students' understanding of and relationship with mathematics?

An embedded model

Opportunities to develop maths competencies are **embedded** into the vocational programme.

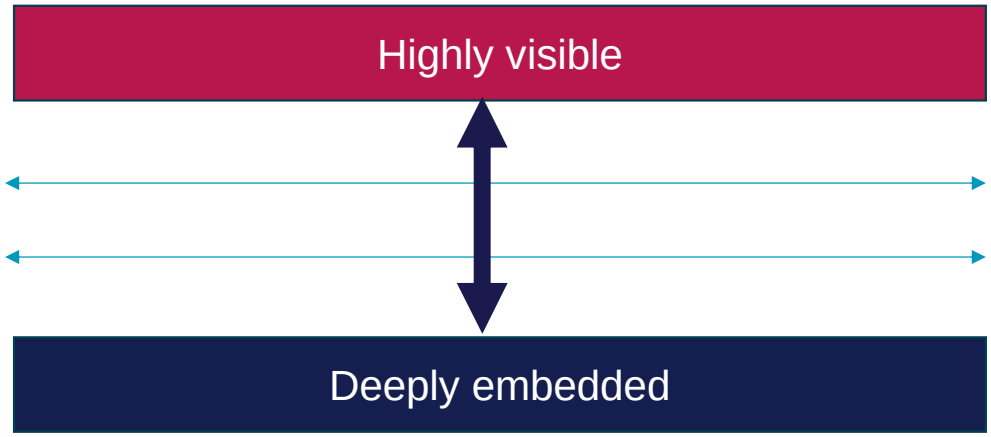
Vocational teachers are the main **policy actors** (Ball et al., 2012) with responsibility for maths in T levels.

The research study suggests:

- Almost all maths in T levels is taught by vocational teachers.
- There is little input or guidance from maths teachers.

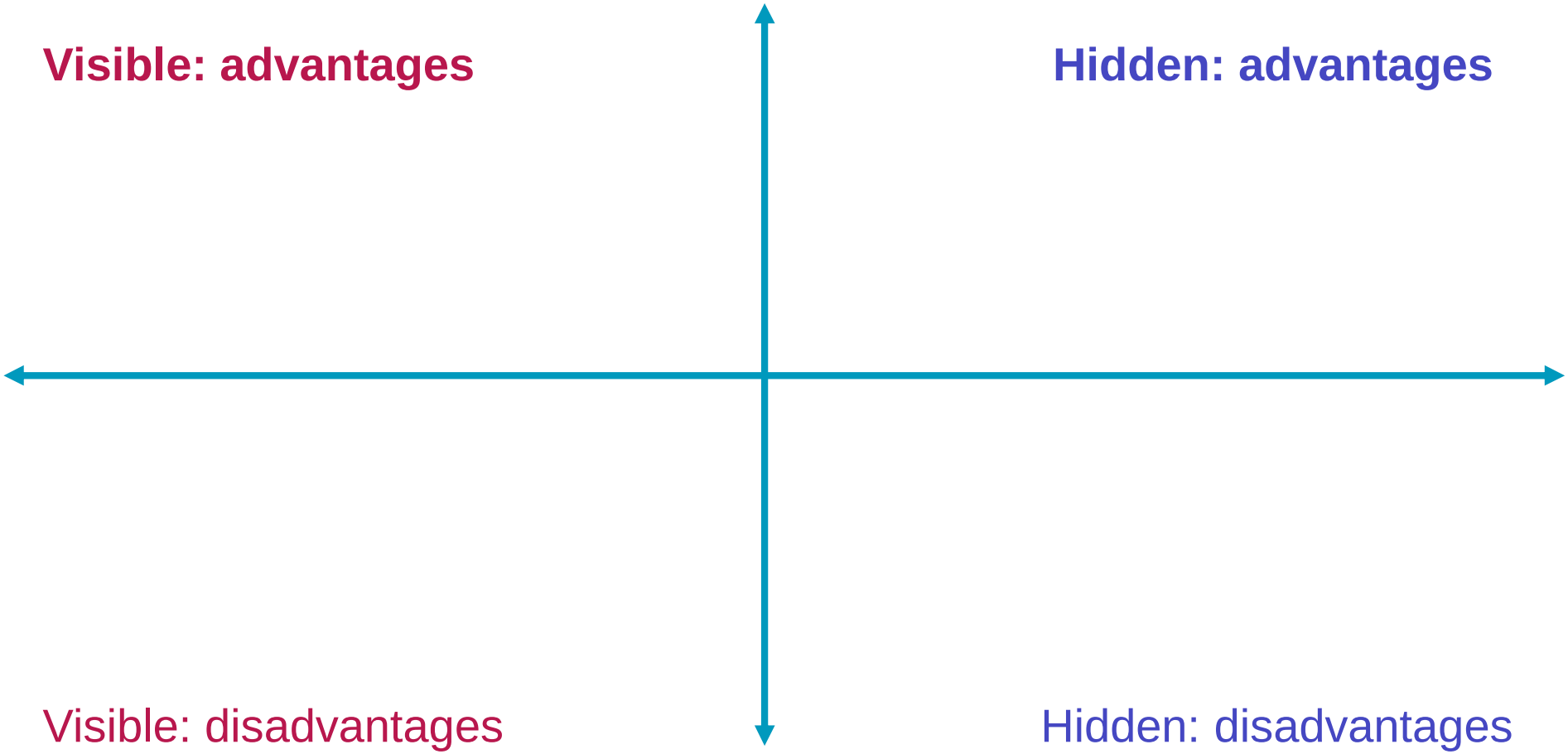
Approaches to embedding maths

- Variable use of the GMC framework
- Different levels of embedding



- Emphasis on a situated approach (Lave & Wenger, 1991)
- Highly influenced by vocational teachers' own preferences

Benefits and issues



Visible approaches

Visible

- Students see how maths is relevant to their studies and the workplace
- There are opportunities to make connections to maths in other contexts
- Problems with students' understanding of maths can be addressed

- Maths anxiety and negative attitudes are more likely to surface

Hidden approaches

Hidden

- Students are unaware that they are doing maths
- Attitudes are more positive and maths anxiety is minimised
- Students learn maths without realising it

- Opportunities to develop transferable maths skills are limited
- Weaknesses and misconceptions are less likely to be addressed
- Sometimes there is little actual maths

Teacher confidence and competence with maths

Confident and competent teachers seemed more likely to:

- highlight the maths in their vocational teaching
- make it visible in a range of different contexts
- use a range of approaches

Less confident and competent teachers tended to:

- favour deeply embedded approaches
- avoid identifying when maths was being used
- adopt a procedural approach

Implications for students

Visible maths

The visibility of maths in students' training and workplace means it is seen as an essential component of their work practices, with relevance and value in the workplace.

Deeply embedded maths

The apparent absence of maths from the technical pathway reinforces a view that maths is a subject associated predominantly with the past in school.

Benefits and issues: use of context

When maths taught in a meaningful context as part of another subject:

- Context can aid understanding (Dalby, 2014) but requires **accurate modelling** of the maths involved and **authentic contexts**;
- There is a danger of **“shoe-horning”** maths into places where it does not belong or using **unrealistic** contexts;
- Issues of **transferability** between contexts and different learning environments (e.g. classroom and workplace) can arise (Lave & Wenger, 1991).

Learning environments for T levels

- **Workplace –** a substantial amount of time in work placement
- **College training workshops**
- **College (vocational) classrooms**

Claims from teachers that learning maths in the combination of these three environments improves students' understanding. Is this because:

- Repetition aids recall?
- A shared work-related focus in all three environments makes knowledge transfer easier to achieve?

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Any questions?
diane.dalby@nottingham.ac.uk