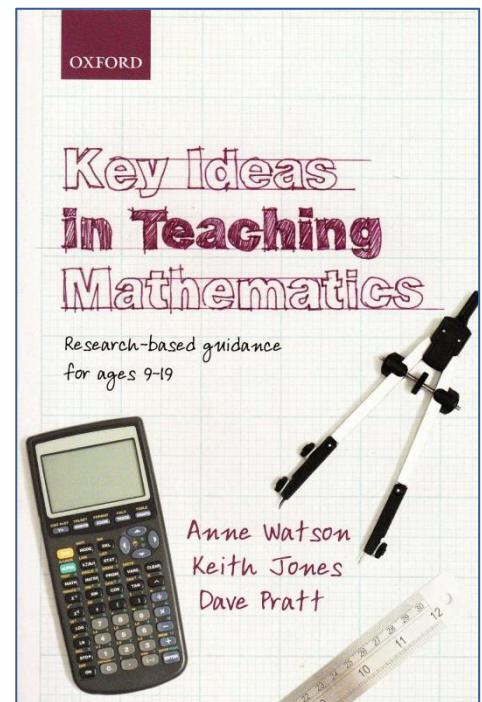


## Research Briefing N° 5

# Key ideas in teaching mathematics: research-based guidance for ages 9-19

This research is a review of mathematics education research resulting in a publication for teachers, teacher educators, textbook writers and curriculum policy makers at the secondary level.

**Key words:** mathematics education; evidence-based; research-informed



## Key findings

The review identifies the following recurrent themes:

- some ideas permeate the mathematics curriculum: ‘relations between quantities and properties is all pervasive’; ‘powerful implicit ideas characterise what makes mathematics mathematical’; ‘formalisation moves from a focus on what is explicit in the everyday to what is hard to see in everyday situations’;
- some issues around conceptual growth recur in all knowledge sub-domains: ‘sources of confusion’; ‘a range of experiences designed to be purposeful facilitate powerful mathematical thinking’; ‘representations are key tools for mathematical learning’; ‘proportional reasoning is central’; and
- in teaching approaches, the recurrent themes are: ‘concept definitions need to be introduced alongside non-examples and boundary cases’; ‘by exercising control over carefully designed software, students can ask new questions and engage more fully’; ‘graphical representation is a tool for learning and connecting representations in almost all knowledge sub-domains’.

## What we did

We review mathematics education research and report issues that we regard of special importance to practitioners and others interested in developing their understanding of teaching and learning mathematics.

This project, funded by the Nuffield Foundation from 2010-2012, draws together a wide-range of research into a publication for teachers, teacher educators, textbook writers and curriculum policy makers at the secondary level.

We have organised most of the book around seven key mathematical domains. These are: relations between quantities and algebraic expressions; ratio and proportional reasoning; connecting measurement and decimals; spatial and geometrical reasoning; reasoning about data; reasoning about uncertainty; and, relations between variables. Chapter 9, the last chapter, focuses primarily on some advanced aspects of mathematics which are rooted in teaching and learning at a younger level but are developed much further in higher education. The reasons for our choice of seven come from several directions: identifying threads in the curriculum; identifying mathematical concepts that permeate mathematics; identifying mathematical concepts that seem to present students with difficulties; and identifying mathematical concepts that have

strong implications for employment and citizenship.

## How we did it

We have approached the task through a systematic synthesis of relevant research about conceptual growth, through education, in key areas of the secondary curriculum, drawing on:

- theoretical explanations regarding how children learn mathematics which have been supported by research;
- research about learning mathematics at secondary level in relevant subject domains;
- relevant summary reports of research in particular areas;
- research on students' errors and teaching experiments, where these also illuminate ways of learning concepts successfully; and
- research about the advantages and disadvantages of particular teaching approaches.

We have focussed on research that can inform the teaching of mathematics in the ordinary schools with which we are familiar. In that respect, there is a degree of subjectivity in the process and it is entirely possible that different authors would have reported the research in an alternative way.

## Further information

The book is published by Oxford University Press as a collaborative exercise between Anne Watson (Oxford University), Keith Jones (Southampton University) and Dave Pratt (Institute of Education, University of London).

Watson, A., Jones, K. and Pratt, D. (2013). Key Ideas in Teaching Mathematics: Research-based Guidance for ages 9-19. Oxford: Oxford University Press

The book has an accompanying website, hosted by the Nuffield Foundation:

<http://www.nuffieldfoundation.org/key-ideas-teaching-mathematics>

The intention is that buyers of the book will find useful illustrative material in the website while some who find the website, perhaps as they search for useful teaching and learning tasks, will find the book explains and clarifies the underpinning rationale.

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