Teaching A Level Maths

by Rob Southern and Susan Whitehouse, pp 298, £25 (members £17.50),
ISBN 978-1-91161-637-5, The Mathematical Association (2024)

This is the book I wish I'd written. The subtitle is 'Content and Pedagogy' and it is packed with good advice and resources for teaching most parts of single-subject A level Mathematics. Written by two experienced teachers, it is resolutely focussed on lessons and teaching/learning approaches, aiming above all to show how to convey understanding rather than learn by rote. The arrangement is by broad topics, but the content is not that of a textbook; the emphasis is on the principle of using the best activities. Further, the authors see no reason not to mention common mistakes and misunderstandings that learners often exhibit, and they emphasise how to avoid or overcome these problems.

On almost every page I spotted something that I greatly liked. In the first chapter, Establishing a Mathematical Culture, the title itself promises well, and then we read:

> It is important that students view mathematics as a network of interconnected ideas rather than a series of separate topics … This results in a higher level of understanding of the underlying concepts.

How good it is, among everything else, to have it clearly implied that understanding is not just a binary yes/no thing but a continuum with different levels. Much later the first injunction is taken up at the start of the chapter in Functions:

> Functions should not be thought of as a discrete "topic" in the A level syllabus, but as a pervasive idea which underpins large portions of the content we study … If your scheme of work requires you to teach some or all of the content [in exponentials, logs, trigonometry, calculus and so on] before teaching the explicit functions content, you should spend some time discussing the notation and language of functions so that this will not become a barrier for your less confident students.

Naturally the greater part of the book is concerned with pure maths. The statistics section starts with discussion of an intriguing set of data about World War II fighter planes: which parts of the aircraft were damaged in combat. The data was obtained only from those aircraft that returned from missions, so the obvious inference (more armour is needed where there

was more damage) was wrong, as damage in these parts did not prevent the aircraft from returning. Subsequently there are valuable examples of how Venn diagrams and tree diagrams can be used in parallel, and good charts showing probability distributions. My one real complaint is that, although the modelling cycle is mentioned, there is no discussion of what constructing a model really involves; for instance, on page 231 there are several good discussion scenarios that may or may not involve a binomial distribution, but while most of them involve *conditions* (fixed number of trials, outcomes classified as success or failure), one or two involve *assumptions* (probability of a success is the same on each trial and the outcomes of individual trials are independent). This is of course a subtle issue, but I think a bit more care is needed at the start to select examples that are not potentially misleading. Some of the mechanics discussed goes a bit further than the core A level content (projectiles in 2D), and again I would have liked a little more discussion of modelling assumptions. I personally avoided like the plague the term 'normal reaction', as in my experience this tends to create creating confusion in the context of Newton's Third Law; instead I referred to the 'normal contact force', or just 'normal force', though it could be argued that learners are likely to come across this term in physics anyway. Throughout the book the authors are careful to relate their pedagogy to learners' likely prior knowledge.

The authors have raided a wide range of resources, and in each chapter they identify their own favourites. These include one or two surprisingly difficult problems (the length of a belt wound around two touching cylinders of radii R and r, or the area of the region between the curve $y = 4 – x^2$, the x-axis and a circle touching the origin and the parabola symmetrically), but many involve, for example, cards that offer various choices (true/false? and so on) and are admirably designed to improve the grasp of concepts.

New teachers will find that this book both gives them a substantial quantity of scaffolding for their lessons and inculcates the right approach to the subject for both teachers and learners. Who knows, it might even encourage those whose teaching has always been stubbornly algorithmic ("what do I have to do to get the right answer?") to bring an approach that is better suited for the more open-ended questions on current examinations, not to say better for the development of pupils' thinking and understanding.

Every teacher new to teaching mathematics A level should have a copy of this book, and so should every A level mathematics department in the country. Indeed, almost any teacher of A level mathematics, however experienced, would find much invaluable material here.

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