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Book Review

Digital pedagogical media: Practical implications for the secondary classroom

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Johnston-Wilder, S. and Pimm, D. (Eds.) (2005).
Teaching secondary mathematics with ICT.
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The use of digital technologies is prevalent in most aspects of everyday life. In areas as diverse as shopping, communication, banking, travel, and entertainment, they thread operational processes from design, production, function, maintenance, to surveillance. The potential they have to revolutionise mathematics education and, in fact, the nature of mathematics itself, has been recognized from their early inception (e.g., Seymour Papert's Mindstorms: Children, computers and powerful ideas), yet only realised intermittently in mathematics classrooms. There is certainly superb practice occurring, but it doesn't permeate all feasible learning opportunities, and is often utilized to support traditional modes of learning. Progress is being made, momentum is gathering, and issues of equity and access are recognized. Perhaps education is an area that changes cautiously, where evidence of enhanced learning opportunities is pre-requisite, or teachers require easy access to effective approaches and resources to enable the space to explore change to their practice. From either of those perspectives this book is necessary reading.

It provides a rich, practical approach, that discusses theoretical aspects alongside affordances and constraints of particular software and digital pedagogical media, in relevant secondary mathematics contexts and content areas. The editors drew on substantial, predominantly British contributions, but the contributors' understanding and examples are highly relevant in the Australasian setting, and pertinent to more international situations generally. The editors introduced the book by describing a brief historical perspective of the relationships between ICT and British mathematics education. They situated their view of the present position within this perspective, while posing important questions regarding curriculum and "What is conceptually important in the teaching of mathematics at school?" (p. 15).

The second chapter began by introducing a range of tools available, including the internet and CD-ROMS, graph-plotting software, computer algebra systems (CAS), spreadsheets, interactive or dynamic geometry software

(DGS), Logo, and smaller more specific microworlds or 'small computer programmes'. The purpose of this was to give the relative novice access to the following, more detailed chapters on specific digital technologies and their application to content areas. The third section of this chapter is particularly important for all readers. It is a discussion of pedagogical issues that arise across the use of various software and tools, and it is the intention of the editors that readers frame their reflection on the subsequent chapters, through the entitlements afforded by learning mathematics with ICT. They used the notion of entitlement as the opportunities students can expect through engaging school mathematics through ICT media. They identified six major opportunities: learning from feedback; observing patterns; seeing connections; working with dynamic images; exploring data; and 'teaching' the computer, and illustrated each of these specific examples across a range of contexts. Two approaches; the *exploratory* mode with pre-planned documents, and the *expressive* mode where students create their own documents to express themselves mathematically, and the appropriateness of particular software to the learning experience, were also considered. The two central parts of the book focused on ICT and the school mathematics curriculum, and ICT and the mathematics classroom.

Part A: ICT and the school mathematics curriculum

Each of these five chapters was written by internationally recognized practitioners and researchers, with theoretical underpinnings and reporting of research seamlessly woven with practical classroom examples and related websites. There are chapters on thinking numerically, thinking algebraically, thinking geometrically, and thinking statistically, as well as a more generic discussion of the school mathematics curriculum in a technological age. Each of these illustrated up to date (in 2005) usage of a range of software and approaches, in those particular content areas, for secondary school mathematics. *Thinking Numerically* included explanation and discussion of place value as explored through parts of a software package, *Developing Number*. It considered not only how the software might shape the learning in intended ways, but also how the design includes inherent, internal structures that determine the nature of the interactions. It also highlighted the significant role of the teacher in ensuring the pedagogical experience is productive. *Thinking Algebraically* considered four general approaches to algebra: generalization, problem solving, modeling, and functional representation. It explored these approaches through a range of software with well-illustrated examples, and briefly discussed implications for teaching and learning.

Thinking Geometrically and *Thinking Statistically* both included appropriate clearly demonstrated examples of software used interactively in their respective areas. As expected, Cabri-geometry and The Geometer's Sketchpad (geometry), and Tinkerplots (for exploratory data analysis) and Excel (for simulations) were discussed, along with other applications (e.g., Fathom). An underlying theme of both was that while the exploration of ready-made documents is valuable, the expressive mode the software affords as students can choose and create their

own documents, is a desirable aim. The final chapter in part A of the book covered a broad range of the utilization of ICT, and included vignettes of particular secondary school mathematics situations and how they could be brought to life through the use of digital pedagogical media. The practical examples were accompanied by clear screen illustrations. The writer positioned these examples within the broader challenge of making the learning more stimulating and the teaching more effective.

Part B: ICT and the mathematics classroom

The chapters in part B continued with the blend of pedagogical considerations and practical examples, with the emphasis more deliberately on the use of ICT in the classroom. There are chapters on graphic calculators, interactive whiteboards, 'mathsalive'—a project on the use of ICT in the mathematics classroom, video-conferencing, and the use of the internet in mathematics teaching. While diverse in nature, each of these chapters offered clear explanation of their particular relationship with mathematics education, how they might enhance teaching and learning, and some of the constraints associated with their use. They each included insightful commentary on the use and potential of the particular aspect they were considering, while initiating reflection on how teachers might best engage the children. In general, what they offered in their brief but pertinent discussions were introductions, how their particular aspect contributed to understanding in mathematics (with specific exemplars), and an overall sense that it is a range of ICT, used with other pedagogical media where appropriate, coupled with the expertise and inclination of the teacher, that will lead to the most effective learning for the students. Secondary teachers won't in the future be expected to know the full range of use for all ICT software and approaches that are available, but an awareness of what is available and expertise in some of these should be part of their pedagogical knowledge.

The final two chapters extrapolated to possible future directions. *Summary and Vision* didn't attempt to predict the nature of software or learning in a futuristic manner, but considered both fresh perspectives of learning using ICT, and extensions of current trends. *Mediating mathematical thinking with e-screens* placed the emphasis clearly on the facility to enhance the thinking process and allowing opportunities to think in different ways, where "the aim is to bring forth a world of significance" (Mason, p. 233). *Understanding and projecting ICT trends in mathematics education* considered the impact of three waves of development with the future emphasis on relationships amongst learners, their immediate environment, and the world beyond the classroom. The writers contend that by attending to the roles future ICT might play in the relationships of those involved in individual and group learning situations, they will be more meaningfully integrated into classroom culture.

Conclusion

Teaching Secondary Mathematics with ICT is essential reading for secondary mathematics teachers and pre-service educators, but it is also a valuable read for mathematics educators in general, as many of the examples and discussion have relevance at primary and tertiary level. Just as, for example, using equipment or grouping needs to be considered by all mathematics educators, so too should the use of ICT and its integration with learning and teaching, especially in the context of the classroom. The text covered a broad expanse of software, tools and approaches, with excellent practical explanations and visual representations and referenced underpinning research where appropriate. These illustrations would be particularly useful for classroom teachers to access for using the technology with students, yet the book was simultaneously thought provoking and encouraged reflection. While its immediate context is the British situation, and perspectives on geometry and algebra from other European, American, and Asian viewpoints would have enhanced its content, all of it is pertinent to more global settings, and it certainly is highly relevant for the Australasian situation. Another endearing feature is the associated website and resources. Overall, I would highly recommend it for any collection of contemporary mathematics education literature, and have ordered copies for our library.

References

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