

Book Review

Teaching STEM in the Secondary School: Helping teachers meet the challenge

Banks, F. & Barlex, D. (2021) Teaching STEM in the secondary school: Helping teachers meet the challenge

Reviewed by Andy Mitchell, Independent Consultant, UK

This book explores the purpose and pedagogy of STEM (Science, Technology, Engineering and Mathematics) teaching and the ways in which STEM subjects can interact in the curriculum, to enhance student understanding, achievement and motivation. Publication of this second edition is particularly apposite, considering the current world under COVID 19. As reported daily in the media, STEM is at the heart of providing the solution to the pandemic. Perhaps this represents the most significant ever worldwide bringing together of the individual elements of the construct to address a common goal. In terms of education, this should only serve to promote further the benefits of cross curricular study, working in teams and the benefits to learning in terms of knowledge application not simply acquisition.

Cross curricular working, continues to be an elusive objective in many schools, not helped by the strictures of public examination systems. But the authors argue there has never been a better time to consider new ways of constructing a relevant curriculum. Not least as it this best reflects the world beyond education. 'With regard to interaction between the subjects, it is becoming increasingly clear that the problems now facing the world will need robust interdisciplinary teams for their solution hence an interaction at school level might be a useful precursor. (p.53)

But the book's publication is pertinent for a second reason. From at least a UK perspective of design and technology (D&T) education, coping with the persistent challenge of employing sufficient subject trained specialists, extending design and technology teaching teams to include teacher colleagues with non-D&T backgrounds but related expertise may offer a solution. At a time when D&T is perhaps experiencing its lowest status in its history, the opportunity to use creative timetabling and collaboration with computing, science but also art and design, to revitalise both its teaching and perception, could offers interesting possibilities. Whether or not this way of working adopts the acronym STEM (the use of which is contested in some quarters), securing the fundamental of D&T teaching that makes more formal use of shared knowledge skills and understanding can only be of benefit to learners.

Central to the books purpose, is the proposal that teachers need to look beyond their own subject, to create teaching and learning experiences that make sense of and enrich science, technology and mathematics. Indeed, the problems of siloed organisation of learning which fails to exploit the relationship between different subjects, one could argue has long held back

learning. Chapter 2 refers to this as 'Looking sideways'. But key is the consideration of the silent 'D' for design and the vital role that design and technology plays, not least in providing meaning, context and purpose. Throughout, concepts are explored through each contributory subject. Too often the label STEM is applied incorrectly and frequently describes work that is much narrower in nature than the construct implies and is restricted to mathematics and science. The book provides an excellent justification for STEM but also defines it in much more inclusive terms.

Those who found useful the first edition of the book published in 2014, will not be disappointed by this revision. It has been significantly updated and contains a good deal of additional content.

This book will be particularly useful to schoolteachers, interested in both curriculum development in their workplace and their own personal development. It provides an accessible source to inform their thinking and draws together perspectives from the contributing disciplines, key authors and initiatives that underpin STEM education. It should also feature in indicative reading lists for initial teacher education (ITE), assisting student's development of their ability to draw links between subjects and understand better their own subject's contribution.

The authors share considerable experience of working in various fields, including science, design and technology, teaching in schools but significantly providing teacher education. Barlex in particular has a considerable reputation for his contribution to D&T curriculum development and the publication of resources to support teaching and learning. Perhaps the best known of which is the Nuffield Design and Technology Project (2000); and also, the Young Foresight resource (2000), a 12-week programme for 14-year-olds, making use of industry links and designed to stimulate creativity by challenging orthodox practise in design and technology. The contents of both are referred to for illustrative purposes.

As a text, it also provides a very useful reader for senior leaders and curriculum planners in school, looking for ways to managing and sustain STEM approaches. Even if coming from one of the STEM subjects, it will help them become more conversant with each subject's potential contribution. If a school were to embark on developing STEM an initiative, not least those that have already taken the decision not to include D&T in the curriculum, then this book would provide an excellent introduction to promoting discussion and ensuring a common understanding.

The scenario of entering the post pandemic world to which we hope to return, adds further weight. Even when we return to life more similar to pre-March 2000, the education world will never be the same again. Addressing D&T's precarious position in many schools will depend entirely on its community being proactive, rising to the challenge and embracing the opportunities presented. Whenever we overcome Covid-19 and its variants, we cannot expect a massive investment in education to follow. Many countries including the UK will be financially challenged. Certainly, it is unlikely that D&T will be prioritised. However, in some situation, STEM might be.

The book is helpfully laid out, each chapter encouraging further exploration with the inclusion of extensive and useful recommended reading lists. This alone, serves as a very useful

bibliography for scholars, not least those undertaking courses in ITE. Most chapters also contain a short conclusion and additional reading list. This may help the reader to 'dip into' the book, quickly identify issues of immediate interest to them.

The book is well illustrated contributing to its accessibility. However, the range of figures is largely restricted to diagrams and resources. Difficult though it often is to collect actual examples of STEM outcomes emanating from schools, considering the practical nature and physical outcomes of the type of activity advocated, it is perhaps disappointing these are under-represented. Chapter 9: Computing, digital competence, computer science, TEL and STEM is a case in point. The section: Computing in design & technology and engineering lesson (p.193) provides a comprehensive list of the ways in which IT has massively extended the range and capability of young people working in D&T and in STEM contexts. If photographs of student's application of microprocessors or CAD and additive manufacture, harnessed to facilitate outcomes, until recently beyond the capability of schools had been included, it would have been compelling. This would also have provided opportunity to include contemporary, different and perhaps more imaginative examples of D&T and engineering, the type of which we should be promoting today.

Including separate chapters to consider STEM from the standpoint of each subject specialism may well provide an 'in' for the reader, eager to understand first, how their own specialism is represented. For example, Chapter 7: 'Enabling the 'E' in STEM'.

A welcome new addition is provided by Chapter 11: Looking at STEM education in different countries. In this section authors from Australia, Belgium, Brazil, China, Israel, Russia, Taiwan, and the USA write about STEM education in their particular countries. Each piece has been extracted from a longer piece, all of which can be found at the website <https://dandtfordandt.wordpress.com>.

What follows are fascinating examples of how STEM education has been approached in each country, which add to the ideas throughout the book, that will provide stimulus for teachers to develop their own activity. The overcoming of challenges reported in scenarios is interesting but also the conveying of a sense of the opportunities created.

In Belgium (p. 240), we read of 'the pedagogical adjustments required to implement the STEM projects imparting a new instructional paradigm on teachers where their concept of learning progression evolved from teaching maths first, using that acquired in science, followed by application in technology, to a more integrative view where interdisciplinary interactions occur in a more natural way (Thibaut et al., 2018).

In China, (p.247) we learn how the Ministry of Education has implemented various educational reform strategies, including practical STEM activity. The scale of the 'China STEM Education 2029 Innovation Action Plan' launched in May of 2018, opens the systematic development of STEM education in China. This is enviable. It will undoubtedly provide useful experience with which to compare practise elsewhere. Although unconnected, since 2014, the D&T Association has been involved in supporting the Ministry of Education's development of design and technology in Shanghai schools, so is very familiar with the interest in and rapid development of design and STEM in parts of China.

Not only is each description supported by an example, but each study includes a section on the future development of STEM education in secondary schools again making for useful comparisons with what could be developed in a teacher's home country, region or individual school.

The final chapter builds on the examples of STEM education illustrated in chapter 11. It is divided into three sections 'Big issues and STEM education', 'STEM education and disruptive technologies' and the final part, 'Your vision' which considers four possible scenarios for the future of STEM. The latter depicts four scenarios from 'axis of uncertainty' described by two crossing continuums: one being isolation/collaboration, the other vocational/general. The authors claim these 'provide an opportunity to explore possible futures from various perspectives and consider the consequences of such futures for STEM education'. At a time when there is a need for design and technology education to consider its own future and the value of its unique contribution to the broader curriculum, this serves as a timely reminder of the dangers of being reduced in some schools, to a subject taught 'in isolation, with vocational education intent'. Not a scenario advocates of D&T would welcome.

Footnote

In the absence of a printed copy, this book was reviewed in E-book form, using the VitalSource Bookshelf computer app. This provides some useful features common with virtual book software including searching, book marking and note making. However prospective readers may wish to wait until paper copy is available. Whilst I would recommend a school owning several copies for its staff development library, for sharing and discussion purposes, a decision needs to be made in the workplace, whether E-book or print copy is the most suitable.

References

Thibaut, L., Ceuppens, S., De Loof, H., De Meester, J., Goovaerts, L., Struyf, A., Boeve-De Pauw, J., Dehaene, W., Deprez, J., De Cock, M., Hellinckx, L., Knipprath, H., Langie, G., Struyven, K., Van de Velde, D., Van Petegem, P., & Depaepe, F. (2018) Integrated STEM education: Conceptualizing an instructional approach for secondary education. *European Journal of STEM Education*, 3(1), 02. <https://doi.org/10.20897/ejsteme/85525>