# Textbooks for the teaching of computing

## Purpose

This discussion document, originally commissioned by the School Curriculum and Assessment Committee, is intended to promote a well-informed conversation in the computing education community about the following questions:

1. **To what extent would high-quality textbooks raise the quality of teaching and learning in computing at school?**
2. **Is it advantageous to have such books available in physical hard copy?**
3. **Is there a shortage of such textbooks?**
4. **Where would lack of textbooks sit in a priority list of obstacles to high quality computing education at school?**
5. **How can publishers be encouraged to produce materials for teaching computing?**

This report identifies the affordances and challenges associated with the use of textbooks for the teaching of Computing in key stage 3 and 4 and post-16.

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## Introduction and conclusions

The BCS School Curriculum and Assessment Committee (SCAC) was established in response to a major recommendation of the Royal Society's report 'After the Reboot'. It aims to offer thoughtful, well-evidenced scrutiny and review of the school curriculum in computing, how it is taught, and how it is assessed. This report is drawn up to reflect stakeholder opinion on the use of physical (hardcopy) textbooks in the teaching of computing. It was completed in March 2020.

A survey of current textbook resources was carried out https://tinyurl.com/draft-textbooks. Evidence and opinion has been drawn from teachers, authors, publishers, awarding organisations and teacher trainers. It cannot claim to be representative or proportional in the data but the range of issues and the nature of the conflicts would suggest that mainstream opinion has been voiced.

- The textbook is considered to be a high-value resource that supports the teaching of computing.
- Cost, availability and attitudes towards books are factors against their use.
- Structuring the curriculum (teaching) and professional development are clear advantages in their use.
- Textbooks can act as the focus/coordination of other non-book resources for teaching and learning.
- Equally, textbooks can be supplementary to other materials used to structure the programme of learning.
- CAS can support publishers in their endeavour to produce popular and successful textbooks.
- Careful consideration needs to be given to endorsement.
- Publishers need help to produce textbooks for courses where there are few candidates.
- The textbook survey shows there are sufficient to support examination specifications.
- The textbook survey found only one paper-based textbook for key stage 3 and none for key stage 4 pupils.
- The relationship between the textbook, other teaching and learning resources, the pedagogic practice and the curriculum content is important and a weakness in one aspect diminishes the value in all.

This report was generated through discussion and shared document writing with over 20 teachers and other educationalists including people from: awarding organisations, publishers, teacher training, university computing departments and commercial organisations. The following made a significant contribution:

John Woollard (editor), Phil Bagge, Hampshire HIAS; Rob Heathcote, publisher PG Online; Paul Long, author paul@gcsecs.org; Richard Pawson, author & A-level CS teacher; Cynthia Selby, University of Southampton; Matthew Wimpenny-Smith, subject lead and community hub leader, Headington School.

The individual views expressed in this document are not necessarily held by the named individuals or their affiliated organisations.

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## Why textbooks - some research

The evidence from professional practice and academic studies suggests that textbooks have a positive influence upon teaching and learning.

Cambridge Assessment (2016) has undertaken a wide-ranging analysis of textbooks and learning materials from a set of high-performing education systems around the world. Their analysis examined not only the form and features of the materials, but also their role in supporting effective learning and assessment. Their analysis shows the importance of textbooks as part of a large suite of materials including: a teacher handbook, a textbook, a student workbook, with linked online assessment and learning resources. But they also identify the importance of the underlying learning model. *It is not simply what but also how.* In contrast, they also identify apparently simple readers (selected texts in a discipline), with texts chosen by subject experts, to explain and illustrate core ideas in the discipline to provide a very clear and well-structured textbook covering essential concepts. *"The text is deliberately parsimonious – a selection of 'essential background reading' to underpin classroom and other learning activities."* Similarly, some textbooks and created with a sound pedagogic form but with material contextualised in everyday scenarios; these can be used by teachers, parents and learners.

The Cambridge Assessment analysis also identifies good practice in the use of textbooks through: providing a series of activities and content specifications which specify the sequence of learning and condition the learning activities; providing reference material and/or activities which can be used in a highly flexible way by teachers; providing structured activities which support or replace a very specific segment or segments of a learning programme; and extending/supplementing learning and be used outside contact time

A more recent analysis of the impact of textbooks on learner performance was the Select (2019) analysis of DfE published results compared with the use of Payne Gallway textbooks. The analysis indicated that, while taking account of a number of school background variables, schools purchasing one or more of PG Online's GCSE units tended to have higher average Computer Science GCSE point scores than other similar schools (statistically significant at the 5% level with a coefficient of 0.1225 of a GCSE grade).

An important systematic review of research on the use of textbooks has been conducted by Woodward et al (2013). It describes and discusses the general contribution of textbooks in society but identifies many issues relating specifically to school and student learning. However, current research is dominated by the availability and use of e-books and older research by singular issues such as gender or race representation, mis-representation, datedness, etc.

Anecdotal evidence from the teacher discussions and the online forum suggests that textbooks provide a scaffolded resource to support teaching and learning which is beneficial to less experienced teachers - textbooks have an important role to play in professional development. Further, textbooks can provide a "benchmark" basic standard curriculum on which to build a programme of learning. The teacher is able to take advantage of the author's interpretation of the subject specification.

Two higher education studies: Knight (2015) explored teachers' use of textbooks and Landrum, Gurung and Spann (2012) studied student textbook preferences. The former reports that textbooks are generally viewed as reliable tools which provide credible information that supports and enhances students' understanding of critical concepts, and that they present bite-size chunks of information to cement student learning. The other compared student preferences with learning- and grade-oriented attitudes and the relationship between pedagogical aids, percentage of textbook read, and actual course outcomes describing the potential benefits from continued study of textbook pedagogical aids and student performance.

## Views from the classroom

The values and challenges associated with the use of pupil textbooks in the teaching of computer science as presented by teachers in open forums. These comments are synthesised from discussions in face-to-face meetings with CAS members and others during January 2020.

**Overview of material** for the teacher to know what to cover and roughly when to cover it.

**Cognitive benefit** of tangible textbooks. Ability to flip back and forth between pages. Provides more mental clarity.

Textbooks act as **the programme of learning** and so reduce the workload associated with planning (long and medium term) and preparation of resources for individual lessons. They contribute to teacher professional development in that they represent an order and a level for the subject matter.

**Supportive** for non-specialist teachers and further ideas for experts. Great for cover work!

Textbooks authenticate/**makes authoritative** the content of the lesson, topic or subject as a whole (cf. value/role of textbooks in mathematics). They reinforce "computer science is not only working on a computer"; computer science is an academic pursuit as well as a practical/skills subject. Textbooks negate some of the impact of the internet-sourced curriculum has on teaching/curriculum focus.

Textbooks support **out-of-school learning**. They can be recommendations for parent purchase for activity that is supplementary to in-class teaching and learning. They support flipped learning activities. Can aid the depth of learning achieved through the ability to revisit material learnt during the formal lessons.

Some topics within textbooks **represent the principles** that are long-lasting and so, textbooks can provide appropriate material for teaching and learning.

The use of textbooks as an alternative learning activity can be used for **behaviour management**. They are an alternative to on-screen work and they can be used in "isolation" situations.

Textbooks enable a **tangible link to information** that can be comforting for both learners and teachers, albeit limited compared to the vastness of multimedia content offered by the internet. Often links on the internet can be lost.

Can enable **independent learning** of key aspects/concepts.

Textbooks complement the traffic lights approach (3 levels of engagement) basic/initial understanding, core/expected understanding and supplementary/extension material.

Textbooks usually are of a higher quality than materials produced in a less formal way. The process of getting a textbook to print ensures a **higher degree of quality assurance**.

Perhaps a **subscription model** of textbook ownership with automatic updates is possible?

Textbooks support inclusive practice and support for pupils with different learning needs. The teacher provides the basic curriculum through the text book and then there is more preparation time for modifying or re-presenting the materials for individuals or groups within the classroom.

How teachers use textbooks:

- A key stage programme of learning in a series of books/booklets each covering a topic or a coherent part of the whole curriculum.
- Most of the programme, but not all, uses paper-based resources. The role of a textbook is supplementary.
- The teacher's programme of learning uses some published materials
- Using published materials at particular points in the programme (eg revision guides, introduction to programming)
- A class set of text-books used during lessons for learners to work through activities either led by the teacher or the learner at their own pace.
- As a way to promote independent study away from the formal classroom, both pre and follow up learning after a formal lesson has taken place.
- Textbooks support co-create, co-comprehend activities - sharing a text book is not a bad thing! (Like, sharing a computer!)
- As a self study guide for support of formal examinations.

The nature of good textbooks that are designed to support the planning, preparation and assessment of teaching and learning - providing a programme of learning. A good textbook:

- Breaks the subject content into a linear sequence of topics that establishes a pedagogically sound path through the hierarchical structure of the subject.
- Presents the material in the form of essential matter, richer exemplification and then extension and supplementary material.
- Creates topics that can be taught within one lesson, in a full lesson or across 2 lessons.
- Helps to explain abstract concepts in a way that novices can understand.

## Views against

Some topics within textbooks can **become dated/incorrect**; they might no longer match the exact specification of the examination. For some, this is a critical factor why they do not advocate textbooks when the alternatives tend to be immune from this problem.

Hard copy textbooks have a **size/page number limitation** because of physical and cost issues.

There is a difficulty of establishing and maintaining **hypertext links** from a textbook to online and other resources.

For the learner, there is no **instant connectivity**. The learning activity is disrupted by the move from the textbook to another resource. (eBooks have direct linking with a range of other resources including multimedia.)

Most teachers (including those advocating textbooks) reported that their teaching is based on a **mixed economy** of hardcopy, online and own-developed resources.

Can be perceived as where the knowledge, skills and understanding starts and ends and **can limit the depth of learning**

Requires a **level of literacy** to have been achieved and therefore must be written to accommodate a wide range of abilities.

Teachers **can't easily edit** the content to adapt it for their learners and specific learner's needs. (A contrary opinion was expressed.)

Textbooks can be “riddled with quite serious errors... deeply off-putting in terms of their poor graphical design, density…”

The textbook is good for representing the underpinning information/principles and content (for example, word processing, spreadsheet applications. Textbooks are less good in representing the nature trending applications.

The upfront cost is an important factor for not adopting a textbook.

People hold views which seem immutable, “I have a very strong personal belief…” often based on personal learning or teaching style. This can be both strongly for and strongly against the use or value of textbooks.

## Publishers' and writers' views

An understanding of the process of publication will give an insight into how we can best prompt and support publishers to develop textbooks for computing.

A publisher's motivation to publish new books has a commercial imperative but is stimulated by changes in curriculum, pedagogy and assessment, the needs expressed by teachers and learners and the requirements of CPD and teacher support. Publishers gather data through conferences, exhibitions, surveys and school visits. They use market/sales statistics and author/expert reviewer feedback. Publishers liaise with: awarding organisations, multi-academy trusts, local authorities, education support services, universities and subject associations. It is those partnerships that can influence the decision to commission, develop and publish a particular book. Publications include student textbooks, e-textbooks, workbooks, revision materials, teacher guides, assessments, front-of-class presentations, animations and models, worksheets, readers, videos (CPD and pupil-facing), online activities, homework and podcasts. Producing textbooks for courses where there are a low number of candidates is challenging because of commercial viability and the commissioning authors. Publishers aim to have their textbooks in schools about a year before the specification is due for first teaching. This gives a commercial edge because schools can more easily make the decision to opt for a particular qualification if they have knowledge of the potential textbook. Some textbooks are developed to support the generic GCSE course (meeting the subject criteria) without gaining the specific approval of a particular or any Awarding Organisation. Some publishers add is that there is a coherence and logic to the package of resources. These all serve specific ends and work together to help teachers to teach and students to learn. We make it clear how all these things tie together, too.

CAS can support potential authors by forming development groups, reviewing and revising manuscripts and giving moral support. This can ensure more rapid publication of grounded material.

CAS could be influential through critical review and facilitating community forum discussion of newly published works.

CAS could facilitate publisher representation at conferences, community meetings and CPD sessions.

CAS can promote the value-added nature of textbooks.

CAS can be involved in approval, recommendation or endorsement. This engagement with publishers and audiences should take place at the earliest opportunity - even at the time of commissioning or before the publisher seeks approval of the Awarding Organisation.

[This final point needs careful consideration and, to avoid confusion, only one process/word be implemented. The vendor-neutrality of BCS and CAS needs respecting. CAS and BCS would need to set clear criteria and provide an open, transparent application by any publisher. The involvement of practising teachers who currently use the material in a classroom setting is essential. Statements of endorsement need consideration at CAS Board and/or BCS Academy Board level and in line with CAS Endorsement Policy and Procedure. This process has been considered previously and rejected on the basis of complexity, legal jeopardy, cost, capacity and conflict of interest issues.]

## Glossary of terms

**textbook -** a single, commercially publish, book that covers aspects of the computing curriculum including those that represent the body of knowledge, act as reference manuals or present content in a pedagogically structured manner.

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**activity book** - a textbook that contains instructions for the learner to follow The activities might be supported by information pages but this is essentially a programme of learning with reinforcement activities. Often works alongside a course book or scheme of work.

**content book (reference book) reference manual -** this is also called a glossary. It covers the subject matter of computing presenting the information as short, succinct paragraph descriptions of keywords or activities. The whole book might be a single alphabetical list or it might have a number of sections, each presenting the information alphabetically.

**content book (body of knowledge)** - this form of textbook is structured to reflect the content of the subject computing without any consideration of the order in which that body of knowledge might be taught.

**content book (pedagogically structured), also called student books -** the core book that covers the necessary content and learning. For Computing, it would be in the region of 300-400 pages. Those associated with particular qualifications can receive Awarding Organisation endorsement. They are usually supported by other resources online or on-screen.

**photocopiable/printable worksheets** - these are just enough, just in time consumables written on by the students.

**photocopiable/printable activity sheets** - these are just enough, just in time distributed to the class and collected afterward. They direct the students' learning activities. This approach is often instead of a conventional textbook.

**photocopiable/printable information sheets** - these are jejit consumables usually stored by the students for revision later. This approach is often instead of a conventional textbook.

**programme of learning (formerly, scheme of work) -** this is a series of detailed lesson plans and associated resources which are used by the teacher, course leader, facilitator to deliver the context of the curriculum.

**programming tutorials** - usually structured in terms of the programming constructs, for example, input output variables arrays iteration selection

**revision guides -** usually digests/abstracts of the full student book but some have spaces for students to make their notes

**revision notes** - usually made by the learner and based on what they have been taught and learned during the course.

**workbook** - a workbook is a book or booklet into which the pupil writes their responses and/or records their experience and answers to questions

## References

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