



CAMBRIDGE ASSESSMENT

Why textbooks count

A Policy Paper

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Foreword

When Tim Oates, one of the world's foremost experts on the school curriculum, was asked to lead the Government's review of the national curriculum in 2010, he emphasised the importance of "curriculum coherence". By this he meant that drafting a national curriculum was a necessary but not a sufficient condition for raising academic standards. Behind every short sentence setting out the content to be taught, there is inevitably scope for divergent interpretation.

In the Key Stage 2 Science Curriculum, for example, requiring 9-year-old pupils to be taught that "unsupported objects fall towards the Earth because of the force of gravity" could be taught superficially or in a way that conveys a genuine understanding of the science involved.

The international research work accompanying the curriculum review threw into sharp relief the role of high quality textbooks in realising the aims of national curricula and supporting effective teaching. The paper shows that the use of high quality textbooks is key to ensuring schools in England teach the National Curriculum to a standard that matches the education systems of the countries that top the international league tables. There should, he argues, be coherence between the National Curriculum, the content of textbooks and the approach to teaching in schools. It is the textbooks that provide the detailed knowledge implicit in the national curriculum programmes of study which, by their very nature, are succinct and broad descriptions of the content that needs to be taught.

Having seen the high quality of textbooks in key nations and examined the way in which they provide support to teachers, the paper concludes that the fact that in England only 10% of students' teachers use maths textbooks as the basis for their teaching compared to 70% in Singapore and 95% in Finland is a contributory factor in England's poor performance in maths compared to those countries.

Ideological hostility to the use of textbooks, particularly in primary schools, developed in the 1970s. Their replacement with work sheets and hundreds of thousands of bespoke written lesson plans has added to teacher workload, detracted from coherence and impacted on standards. This seminal paper will, I hope, lead to the renaissance of intellectually demanding and knowledge-rich textbooks in England's schools.



Nick Gibb MP

Minister of State for School Reform

November 2014

Why textbooks count

Acknowledgements

The role of textbooks in supporting national education policy and implementing the detail of national curricula emerged forcefully in the 2010 review of the National Curriculum. At that point, Professor Dame Celia Hoyles and Professor Jeremy Hodgen provided invaluable access to and insights into maths textbooks in Hong Kong and Singapore. Beyond this, I would like to thank Mark Neild and Debbie Morgan for their insights into Shanghai teaching; Sirkka Ahonen for her invaluable comments on the historical situation in Finland; Lee Fei Chen, Joy Tan and Mei Ling for their patient answers to my endless questions about the history of development of textbooks in Singapore; and again Debbie Morgan for our enjoyable joint work reviewing maths textbooks.

This paper represents the views of the author and is not a formal policy statement by Cambridge Assessment or any of its constituent bodies.

Tim Oates | Cambridge

We have known for some time that school mathematics textbooks are one element of the English mathematics ‘problem’. Compared to England, textbooks in high performing jurisdictions generally provide a more coherent approach to mathematics and better guidance to teachers.

But it hasn’t always been so. In the 1960s and 1970s, English mathematics textbooks produced by initiatives such as the School Mathematics Project were widely recognised as amongst the very best in the world. The development of these textbooks involved extended collaborations between educational researchers and teachers together with a rigorous and iterative process of design, trailing and feedback. As a result, many academics from the Pacific Rim and elsewhere have travelled to England to study our approach. Fong Ho Kheong, for example, the first lead author of the now renowned My Pals are Here Mathematics primary textbooks in Singapore, took his PhD at King’s College London.

This paper by Tim Oates is a welcome and timely contribution to the debate. He provides an insightful analysis of how other educational systems have developed textbooks as part of system-wide strategies to improve mathematics education and what can be done to improve textbooks in England. As Tim argues, textbooks are a key aspect of improving the enacted curriculum, the actual mathematics presented to students in classrooms. Tim rightly calls for a concerted effort by publishers, policy-makers, teachers and researchers to improve the quality of textbooks. I urge all those interested in mathematics education to consider how we can encourage this.

Professor Jeremy Hodgen | University of Nottingham, previously King’s College London

Thanks to Tim’s in-depth research and analysis one can be left in no doubt as to the importance of the effective use of text books. This marks a moment in time when we can all move away from the idea that has been promoted by some that using a text book as a central resource is unsound practice. The concept of teacher research groups contributing to future iterations of text books is one that will generate enthusiasm and trust. A highly developed text book is of central importance to the success of students and I welcome the findings in this paper.

Mark Neild | Head Teacher Sir Isaac Newton Sixth Form Norwich

Why textbooks count

Why, without realising it, England has fallen behind the times

Geologists have an interesting phrase: ‘...geological time is now...’. In other words, you may not see Himalayan mountains moving, but they are. Profound seismic forces are at work, lifting them by more than 1cm per year. Likewise, we may not have been conscious of the movement in England away from wide use of high quality textbooks, but it **has** happened. We may take the role of existing learning materials and textbooks for granted, but we have not kept an eye on our ‘direction of travel’. We’ve missed the fact that we have picked up some bad habits, and failed to notice the emergence, in other nations, of extremely well-theorised, well-designed, and carefully-implemented textbooks. We’ve also missed the fact that high quality textbooks **support** both teachers and pupils – they free teachers up to concentrate on refining pedagogy and developing engaging, effective learning. The critique of why we have moved to this position does not comprise an attack on teachers – far from it, the evidence suggests an unfortunate conjunction of influences affecting the overall context of schooling and teacher training. In this paper I include Marland’s interesting diagnosis of cause. Overall, this paper is intended to be highly supportive of teachers and recognises the pressures which exist in contemporary schooling in England.

This evidence of ‘falling behind the times’ is interesting in the light of some of the important innovations in textbook form, content and function which emerged in England during the 1960’s and 1970’s – such as SMP maths and Nuffield Science. Ironically, study of these by developers from some of the overseas jurisdictions examined in this paper served as stimulus for textbooks forms in their own context – for example, in Singapore. These latter now are beacons of high quality, throwing sharp relief on the inadequacies of many of the current textbooks used in England.

As part of the background work for this paper, over 200 teacher textbooks, teacher guides and student workbooks were studied, from Hong Kong, Singapore, Finland, Massachusetts, England, and Alberta. Maths was a key focus, but subjects included geography, physics, chemistry, biology, history, literature and first language learning. This paper covers textbooks used in both primary and secondary phases. It recognises the different issues and pressures which obtain in these phases. In particular, it recognises the influence of national qualifications on the form and content of textbooks for KS4. It acknowledges the fact that frequent change in the form and content of national qualifications poses considerable challenges to production of high quality textbooks, and militates against a rational process of evaluation and refinement of the kind seen in Shanghai and Singapore.

The scale of the problem is daunting. This paper traces some of the origins of low use and low quality, and argues that high quality textbooks have both played a role in system improvement in key jurisdictions and play a continuing role in stimulating and supporting high quality teaching and learning. My concerns are beginning to be echoed in some other country contexts – particularly in the USA (Tucker 2014).

To some, the phrase ‘textbooks’ will appear hopelessly arcane. However, in this paper is using the term to refer to rigorously-designed paper-based materials which can include textbooks for teachers’ use, textbooks for pupils, and pupil work-books – in many instances, carefully linked together. In the highest quality materials which were reviewed for this paper, the textbooks manifested a series of vital features:

underpinning by well-grounded learning theory and theory regarding subject-specific content

clear delineation of content – a precise focus on key concepts and knowledge

coherent learning progressions within the subject

stimulation and support of learner reflection

varied application of concepts and principles – ‘expansive application’

control of surface and structural features of texts to ensure consistency with underpinning learning theory

In line with the idea of England having moved imperceptibly but significantly out of sync with these kinds of materials, the narrow instrumentalism displayed by many textbooks in England and the neglect of structured materials in favour of the use of ‘worksheets’ stands in stark contrast to these high-quality materials and the manner in which they are used – by both teachers and pupils. But textbooks – and the way in which they are used - are a controversial issue in England. Why research and discuss textbooks? Surely this is ‘last century’ – surely the future is digital? Isn’t promotion of the use of textbooks a throwback to education of a hundred years’ ago, and undermines the professionalism of teachers?

Why on earth are we engaging with textbooks when ‘the future is digital’?

The move to on-line materials is of course a significant matter. But it would be naïve to ignore the way in which existing carefully-designed textbooks have played a crucial role in improving educational outcomes in key nations, and remain a vital part of maintaining quality within those nations. Being aware of the features and models in these existing materials is an important matter – there could be serious losses as well as gains in the move to digital materials. The textbooks have been developed to support highly effective pedagogic practices – the features of the textbooks have been subject to extremely careful development and refinement. The educationalists and publishers responsible for these textbooks are themselves concerned that while electronic delivery may hold promise, it is vital to understand whether the essential teaching and learning processes stimulated and supported by the existing paper-based materials will be guaranteed in any switch to digital. Yes, digital materials and ‘blended learning’ hold promise - exemplified by excellent materials such as Nrich and Cornerstone maths – but great care needs to be exercised, to ensure that carefully-won elements of learning, stimulated and supported by high quality textbooks, are not lost carelessly.

Surely textbooks which converge on common criteria are too prescriptive?

In Singapore, textbooks are State-approved, and although a number of publishers co-exist in the system, all must meet State criteria – criteria which were more restrictive when initially formulated, but have been successively relaxed as the really fundamental elements have become clear, through sound evaluation. This still sounds as if the model dictates teaching styles to an excessive level. Classroom observation shows that this is not the case. While textbooks are seen by teachers as extremely helpful in making clear the learning progressions within subjects, there remains plenty of ‘professional space’ for using the textbooks in very different ways. The texts encourage clarity regarding key concepts and core knowledge, provide clear learning progressions, include a wide range of examples and applications, support learner reflection, and yet can be used in different ways by different teachers. Some ask pupils to read and then discuss in groups the concept descriptions (e.g. the properties of circles), other teachers set this as individual reading to be done at home and then discussed as a whole class. Some focus in on the assessments included in the books, having used the text as a guide for structuring their lesson rather than following precisely the instructional material in the text. With the textbooks as a common reference point, they nonetheless can be used in very different ways by different teachers. One startling finding of Reynolds’ and Farrell’s large transnational study in 1996, and replicated in our recent comparisons, was that it is the highest-

performing teachers who are most supportive of the use of well-designed textbooks, citing as key reasons ‘coherence’ with curriculum aims, value of well-designed formative assessment items, and freeing-up of time to focus on learner progress rather than designing learning materials. It is interesting that the responses emphasised the extent to which using high-quality textbooks allowed enhanced responsiveness to individual learner need rather than detracted from it. Dependability and consistency with curriculum aims was a fundamental element of their views.

Cost

This paper will not explore in detail the various costing models which are associated with widespread textbook use in other national systems. In some systems, the learner workbooks in which pupils write, guarantee a certain volume of annual sales for publishers, supporting their investment in development processes – directly feeding the quality of the materials. This appears to represent a ‘fair deal’ for all parties. In some systems, textbooks are purchased by parents, which then tends to encourage pupils to value and care for the workbooks. But this paper does not explore different existing and possible purchasing/funding models. What is clear is that schools in England are perfectly prepared to double-enter large volumes of students for qualifications such as English and Maths GCSE, which costs significantly more than individual bulk-purchased textbooks, whilst complaining that textbooks are unaffordable. A more rational approach is needed urgently.

Is this paper suggesting State-approved textbooks for England?

Our analysis of the market in England suggests that there is chronic market failure. In KS4, teachers have been conditioned by performance tables into highly instrumental approaches to learning, oriented towards obtaining specific examination grades. This myopic focus has conditioned the market such that publishers efficiently are supplying the textbooks and materials which teachers are demanding. These instrumentally-oriented materials are ranked significantly behind other nations’ textbooks on a raft of quality-related criteria. In order to inject consideration of the characteristics of the highest quality materials around the world, I have in a series of meetings discussed quality criteria, production arrangements, and approval mechanisms with English publishers and international publishers – with the notion that enhanced competition on quality could be created through publisher awareness of quality criteria, and promotion of educational values. This consensual approach is the first step in addressing market failure. Whether it generates sufficient impetus towards quality, in a highly instrumental system context, is an empirical question - *further* measures may need to be considered by Government. But raising awareness of the problems and highlighting quality criteria are part of a possible solution – and this paper is designed to contribute to this process.

Looking at English arrangements

Over the period 1997 to the present, as a result of the focus on assessed outcomes in national accountability measures, assessment increasingly has dominated curriculum thinking in schools (Mansell 2008) with key ‘mediating instruments’ being ‘spent’ national assessment papers (used in the last segment of Primary education (Oates 2010) and public examination specifications (used in the second segment of 11-16 education) (House of Commons 2012). The narrowness of such mediating instruments appears to be a principal driver for undesirable narrowing in the school curriculum (Boyle & Bragg 2005; Mansell 2008; House of Commons 2012). Ironically, expansive approved textbooks – possessing high quality and exhibiting Schmidt’s ‘curriculum coherence’ (Schmidt & Prawat 2006) could be an antidote to such narrowing. Indeed, policy makers in England should attend to Reynolds’ and Farrell’s interesting finding (Reynolds & Farrell 1996) that, in key jurisdictions, high performing teachers are well-disposed and enthusiastic about textbooks. However, current sentiment in England amongst many educationalists is strongly opposed to approved textbooks; a sentiment which has arisen repeatedly whilst I have been researching the role of textbooks in system improvement strategy. The objections focus principally on concerns

regarding increased direct central direction of the curriculum ‘..so ministers will be choosing the textbooks now...’. This reaction confuses issues of *quality* with issues of *central control*. It fails to recognise even in those settings which DO have approved textbooks the variation in approval processes in different national settings, and the complex checks, balances and quality-creation processes associated with high quality textbooks.

The 2011 TIMSS survey included collection of data on countries’ use of textbooks and worksheets either as ‘a basis of instruction’ or to ‘supplement’ instruction:

Maths

Percentage of students whose teachers use

	England	Singapore	Finland
Textbooks as a basis for instruction	10	70	95
As a supplement	64	23	3
Workbooks or worksheets as a basis	11	71	37
As a supplement	78	29	61
Concrete objects or materials	39	34	15
As a supplement	59	66	83
Computer software as a basis	24	16	5
As a supplement	74	80	69

(Mullis et al 2012)

Science

Percentage of students whose teachers use

	England	Singapore	Finland
Textbooks as a basis for instruction	4	68	94
As a supplement	45	27	6
Workbooks or worksheets as a basis	4	69	40
As a supplement	82	31	54
Science equipment and materials as a basis	62	60	7
As a supplement	38	40	90
Computer software as a basis	15	19	1
As a supplement	74	78	61

(Martin et al 2011)

The contrasts in the first row, in both tables, confound many common assumptions about these three countries. In both maths and science, the figures for England regarding textbook use are extremely low, in comparison with Singapore and Finland. This paper examines later the situation in Finland – very high textbook use – which many outside Finland find very surprising, given the ‘high level’ messages regarding high school autonomy and learner-centred pupil support in that system.

In science in England, the figure is significantly lower than in maths (maths 10%, science 4%). This may appear to be offset by a high figure in use of science equipment and materials (62%) – conveying the notion that ‘active science’ is a key part of secondary science in England, in comparison with Singapore and Finland, with their high use of textbooks. However, the figures for Singapore also are high regarding use of science equipment and materials (60%) with Finland being interesting in its low level (7%).

In maths and science, row four regarding use of applications also shows interesting contrasts.

With levels of use lower than other jurisdictions, and very low levels assigned to ‘as a basis for instruction’ what is interesting in England is the existence of an underlying ‘anti-textbook ethos’, and its location in teacher training and educational research communities. Marsden’s comprehensive and penetrating 2001 analysis of textbook use in geography, history and social studies emphasised the pervasiveness of this ethos in teacher training. Marsden identifies an influence of post-modernist doctrine in the development of an ‘anti-textbook’ and ‘anti-subject’ ethos:

‘...textbook research has been given significantly lower priority in Britain than in mainland Europe and in North America. Attitudes in educational circles in this country towards textbooks have been more negative than in many other nations, to the extent that an anti-textbook ethos can fairly be postulated. It is important, however, not to take this generalisation too far, and to suggest that the ethos is everywhere present and that those who hold it do so equally strongly. It is probably just to surmise that it is more evident among education tutors and advisers than teachers; among primary teachers than secondary teachers; and, in the secondary sphere, among teachers in the humanities than in mathematics and the sciences. Supporting evidence is, however, more easily acquired informally, and often at an anecdotal level, than from the formal literature. Lidstone, for example, recalls that orally he was actively discouraged by university education department tutors from using textbooks during periods of teaching practice, even though experienced teachers in the schools regularly did so...’ (Marsden 2001, p55)...

‘...Post-modernism has inexorably infiltrated the thinking of educationists. Some post-modernists educational writers have recycled the long criticised linkage of subject-centred approaches with traditional textbooks, and this in turn with an outmoded ‘modernist’ agenda of ‘subject aggrandisement’ (Edwards, 1996, p.222). In Britain and the United States therefore, a simplistically polarised coupling of ‘modernism’ with anachronism, and of ‘post-modernism’ with progressivism, has emerged, even though child-centred approaches, as noted above, can be traced back at least to the late eighteenth century...’ (Marsden 2001, p65).

It is therefore interesting that work, by the 2010 Curriculum Review, on the role of approved textbooks in a range of high-performing systems attracted considerable criticism from prominent members of the research community in England.

However, underpinned by the concept of ‘curriculum coherence’, recognition of the importance of not merely comparing top level curriculum specifications but also the detail contained in other instruments, was a key element of the comparative method deployed in the 2010 review. Schmidt’s concept of ‘curriculum coherence’ relates to (i) material in curriculum frameworks, textbooks etc being in an appropriate age-related sequence; and (ii) that all elements in a system should ‘line up’, so that contradictions are not set up in the different elements, and professionals are not subject to contradictory incentives and targets (Schmidt & Prawat 2006).

A framework was developed in Cambridge (Oates 2010) to further elaborate Schmidt's concept of 'curriculum coherence', consisting of a listing of system elements which should sit in coherent relation:

- 1 curriculum content (nc specifications, support materials, etc)
- 2 assessment and qualifications
- 3 national framework for qualifications
- 4 inspection
- 5 pedagogy
- 6 professional development
- 7 institutional development
- 8 institutional forms and structures (e.g. size of schools, education phases)
- 9 allied social measures (linking social care, health care and education)
- 10 funding
- 11 governance (autonomy versus direct control)
- 12 accountability arrangements
- 13 labour market/professional licensing
- 14 allied labour market regulation

(Oates 2010)

This framework is predicated on the notion that these elements interact in complex patterns of dependency and cause (Morris P & Auld E 2013). This in turn suggests that no national curriculum specification can be considered in isolation from other elements of the system – such as learning resources, inspection, etc.

The Review explicitly addressed the question: if a National Curriculum can be considered as statement of intended outcomes in the enacted curriculum, what instruments transmit and mediate that intention – and what is their status and form?

The 'form' issue relates particularly to granularity and detail – and affects decisions regarding the necessary form of the National Curriculum in a specific national setting. Because of the importance of mediating instruments (guidance, training support, textbooks, etc), more detailed instruments lower in the system can allow more generic statements in a jurisdiction's topline national curriculum specification. Conversely, in the absence of more detailed mediating instruments, a national curriculum may need to contain more granular, detailed statements.

The 'status' issue also affects granularity and detail in the topline National Curriculum statements in England. If mediating instruments are not statutory or use is not universal, then the intentions embodied in a highly-generic set of National Curriculum statements may not be realised in the enacted curriculum.

Note that this is NOT arguing that a National Curriculum in England should, or can, determine every aspect and element of the enacted curriculum. What I AM saying is that if the National Curriculum has a set of specific aims and intentions associated with it, the form of the National Curriculum – and its ability to realise these aims - is partly determined by the form of mediating instruments and their status. Additionally, in line with Schmidt's concept of 'curriculum coherence' the mere existence of mediating instruments is not enough: they must 'cohere' – they must 'line up' with the aims and intentions of the overall curricular and strategic aims. For example, the topline curriculum statements in Singapore are relatively parsimonious. However, the existence of state-approved textbooks which schools are required to use if they choose to use textbooks (almost all do) means

that systematic detailed interpretation of the topline statements is provided to teachers (and to pupils and parents).

Key jurisdictions in the 2010 review have the following textbook/resource approval policies in place:

Alberta

'Authorised' texts in core subjects (eg maths, English), approved by Alberta Learning (province administration) under the authority of the Minister of Learning. A range of alternative texts and resources are available in the approved lists, enabling a degree of school/teacher choice.

Massachusetts

Massachusetts is an open territory state with no centralised textbook acquisition. The selection and purchase of textbooks and instructional materials is a local district activity. However, there exist centres such as AIM whose objectives are to identify and make accessible materials which meet certain criteria (National Center on accessible instructional materials 2014).

Hong Kong

Textbooks are approved, by the Hong Kong Education Bureau, on the basis of alignment with the Hong Kong curriculum and formal quality criteria: 'The major role of the Government in textbook supply is to review the textbooks submitted by publishers and include those textbooks which meet the requirements of the relevant curriculum guides and the required standard in the "Recommended Textbook List" (RTL) for schools' selection' (ref Education Bureau circular memorandum 42/2013). Schools are able to choose from a range of approved resources, developed by private providers. Specific, carefully-limited developments in electronic resources as analogues and developments of existing textbooks have been put in place within the approved system (the Education Bureau of Hong Kong E-Textbook Market Development Scheme 2012).

Singapore

The Ministry of Education is vested with the power of approval: '...MOE engages publishers to develop instructional materials based on the syllabuses. The quality of the instructional materials is maintained through a textbook review process whereby the materials are reviewed by a panel of professionals, including curriculum specialists, teachers and academics from the universities. There are several iterations to the process before the materials are approved and listed on MOE's Approved Textbook List for selection by the schools...' (MOE 2012). Schools are not legally obliged to use textbooks, but if they do, they must use an approved textbook. As in Hong Kong, specific, carefully-limited developments in electronic resources as analogues and developments of existing textbooks have been put in place within the approved system.

Finland

Currently, there are no explicit processes of State approval, but this follows a period of tight regulation of textbook form and content. Textbooks were approved by the Examining Office of the National Board of Education, throughout the period of implementation of 1968 education reform act, until the early 1990's. This was a significant part of educational reform. The important legacy effect of this raises a question mark over the conclusions of Wilkens (Wilkens 2011) who places Finland in the 'no State influence on textbooks' category – which ignores the powerful influence of prior history of State approval processes in Finland.

England

There has been no tradition of direct State approval of textbooks in England, and currently there are no processes in place. However, two instances of central control are worthy of note. The first is the implementation of the Literacy and Numeracy Strategies (1998-2011) in primary education (DfE

2012). These were non-statutory but assumed a quasi-statutory place, adopted in the majority of schools; with rafts of centrally-produced materials. The second is the existence of 'endorsed textbooks' which are endorsed by organisations offering State-approved examinations (at age 16 and 18). Again, the textbooks are not statutory, but the link to high-stakes assessment (critical in national accountability measures) makes their use compelling amongst some schools, and choice of textbook strongly linked to choice of specific examination.

Again, note that I am NOT arguing that central/State approval of textbooks is uniquely associated with high performing jurisdictions. There are high performing jurisdictions which do not use central approval processes (eg Massachusetts) and low ranked jurisdictions that do. However, close scrutiny shows that approved resources carry specific and important functions in a range of high-performing jurisdictions, with the processes for approval meeting Schmidt's criterion of 'curriculum coherence' (Schmidt & Prawat 2006). The quality and characteristics of resources in selected high performing jurisdictions are analysed in further detail in the final section of this paper.

In using the terms 'transmission of curriculum intent' and 'instruments of enactment' in this paper, I do not naively assume that 'perfect transmission' is either possible or desirable. Paul Norris' analysis of the context in Hong Kong provides a clear outline of the process of mediation and adjustment that can occur in real arrangements:

'...Educational Publishers: This group has an influence on the curriculum which is very variable. After a syllabus or curriculum guide has been produced, the textbooks and related resources will determine how the topics are explained and the depth of coverage. This can be a very strong influence as teachers and pupils rely heavily on these resources in most classrooms. For subjects studied by a large number of pupils, many resources will be available and these might have slightly different emphases and approaches which teachers can choose from. However, in the long run, because published resources are economic commodities, the important influences on contents are teachers and schools, because they decide which resources will be adopted, and publishers are very cautious of producing resources which are very different from those with which teachers are familiar. One consequence of this is a tendency over time for resources from different publishers to become similar, as they follow the market leader. There is also the possibility that publishers will engage in self-censorship as they anticipate what they think the government wants.

Schools and Teachers: Schools and teachers have a strong influence on the implemented curriculum because they decide what methods of teaching are used, the styles of learning that are encouraged, and the textbooks which the pupils will use. Consequently, many innovations designed to reduce the strong influence of academic rationalism...on the curriculum have failed simply because they were not adopted in schools.

(Morris & Adamson 2010 p38)

Although extremely valuable in reflecting on processes of mediation, this in some ways underrepresents the high quality of the textbooks in Hong Kong in comparison to the quality of textbooks in England – as the empirical analysis of content later in this paper suggests.

The analysis for this paper, while highlighting the importance of textbooks in mediating curriculum intent, also highlighted the importance of professional development associated with specific textbooks. This is a key commitment of textbook producers in Singapore, and assumed to be essential by Ministry officials there. The current collaborative developments between Singapore and English publishers includes vital exchange and development of appropriate professional development to accompany curriculum innovation led by textbook adoption.

The critical role of textbooks in maths pedagogy in Shanghai

The role of textbooks in contemporary practice in mathematics education in Shanghai reinforces the 'lessons' emerging from Hong Kong and Singapore. As with Singapore, the focus is deep understanding of mathematical concepts and relations, leading to high fluency in operations and high facility in problem-solving. The textbooks are intimately linked to pedagogy, with contact-time typically assuming the following form:

Apparently narrow and deep focus in short 35-minute maths lessons focusing on very specific aspects of mathematical concepts and operations – such as examining the impact of changing the value of one digit in a calculation. This attention to deep understanding of specific relations is seen as vital to developing extensive understanding of fundamental mathematical relations.

A pedagogy based on challenging questions, encouraging rich exchange which involves all members of a class. The model of differentiation and ability is entirely different to that typical in England. All children are assumed to be capable of understanding, and ideas are elaborated in different ways in order to encourage individual understanding. All children study the same topic and progression is managed on a whole-group basis. (I will not here document the approach in Singapore, Shanghai, Japan and Finland to pupils who are grasping material more rapidly or require additional support. The precise approach differs in each setting, but all support a central model of ability and progression which contrasts sharply with the dominant model of individual and group differentiation present in the English system).

As in Japan, 'model lessons' are highly respected, and are demonstrated to large number of teachers.

Textbooks link tightly to this curriculum approach. They are used extensively and provide structure to lessons and to pupil progression. In Shanghai, there appears to be less variation in patterns of teacher-use than in Singapore. Pupil workbooks are important in providing carefully-structured and extensive practice – as in Singapore, this is not narrow repetition, but well-theorised application for the development of understanding (Sun 2011).

The Shanghai textbooks are based on accumulated theory in maths education, are written and edited by expert authors, and constantly are supplemented by 'adjustments' from teacher-research groups. These teacher-research groups exist across the school system. Competitions are held, whereby 'top' adjustments are routinely fed through into the texts.

The textbook 'set' includes teacher texts and pupil texts. The pupil texts include well-theorised elaboration of concepts and of application, and allow teachers to depend on children 'thinking mathematically' outside contact time (there remain some interesting points of comparison between Shanghai and Singapore in the precise form of the examples included on specific topics, and the way in which sets of related problems are 'elaborated'; this is being examined in detail by Debbie Morgan at NCETM).

There are some important assets of the approach:

The complexity of lesson preparation is greatly reduced. Teachers can focus on refining and polishing lessons, rather than originating novel materials which focus on high level of differentiation within learner groups.

Teacher collaboration and sharing of material is enhanced.

Textbooks are dependable and respected, since they are based on developed theory, are authored by specialists and refined through active research. The ‘writing frames’ and design elements of the texts are tightly focused on key concepts. Both practice and text embody and reinforce shared beliefs and assumptions regarding ability and conceptual development.

The texts encourage effective conceptual progression through the subject, convey clearly ideas about standards, and posit a unitary expectation of outcome – that all children in a group will come to a working understanding of the specific concept and/or operation being studied.

Study of contemporary maths textbooks and their management cannot be separated from the deep historical traditions which underpin the pedagogic approach and the assumptions regarding learners – the Confucian tradition regarding ability (Nisbet 2013; Hoyles Morgan & Woodhouse 1999) and specific theory on deep learning of mathematical. Some of this theory has extraordinary historical pedigree (eg Daoist teaching of the first century BC (Sun X op cit)). Obviously, historical pedigree does not assure technical and scientific credentials, however, the theory directly influences the form of maths problems and practice – giving highly distinctive problems focusing on underlying mathematical relations rather than surface features of operations. The ‘modern proof’ of the historical basis of the pedagogy emerges through high performance on contemporary international measures of performance. Additionally, the examples and problems tackled by pupils present no tensions between use of efficient algorithms – eg for long division – and deep mathematical understanding. Students use the algorithms and are encouraged in their use – but by virtue of understanding the relations beneath the algorithms:

‘...In a study conducted by Ma (Ma 1999) Chinese teachers happened to have a better understanding of fraction division than American teachers. More specially, Ma found that Chinese teachers have a deeper understanding of the rationale of the algorithm, a solidier knowledge of abundant connections and much more flexible way to solve problems than their American colleagues...’

(Sun op cit p69).

By including carefully selected and presented examples and problems, the textbooks condition both learning sequences, practice, and continuous formative assessment. Their role in conditioning underlying models of ability and progression were particularly evident in the transformation of the Finnish system, and it is to that which I now turn.

The errors of ‘ahistorical analysis’ – the issue of state-approved textbooks in Finland during its period of fundamental transformation

Finland leapt to international attention following its performance in PISA 2000. This resulted in high levels of ‘educational tourism’, with extraordinary scrutiny of the nature of the Finnish system. Prominent commentary (Hancock 2011; Partanen A 2011; Guardian 2014) has focused on the current form of the Finnish system, associating elements of its current form with its success. But to do this is to commit an error. Many analyses have not followed the methodological tenets adopted at the outset of the 2010 curriculum review in England (Oates 2010) – particularly, for any given system which has enjoyed a period of improvement, what form did arrangements take **prior to and during** its period of improvement? This is a more robust approach than naively attributing the cause of improvement to the **current form** of the system – ie asking ‘...what does the system look like now, now that it has achieved high performance?’. To adopt this second stance is to commit an error of chronology and thus an error of causation (Oates 2010).

The current form of Finland's system – manifest from the very late 90's to the present day - is characterised by relatively high school autonomy (by OECD's international measures: low levels of central inspection and low levels of external testing (Sahlberg 2011)). The system is characterised by 'front end restriction' associated with highly selective, long duration initial teaching training. This contrasts with systems focusing on 'back end restriction' – ie a strong emphasis on inspection and target-based accountability arrangements. Many accounts of Finland omit acknowledgment of problems currently manifest in the system – continued disparity of performance between boys and girls; rising tensions in urban areas regarding social mix in schools; issues of choice and quality following large scale closures of small schools; continued complaints of poor maths attainment in first year undergraduates; and declining performance at age 15 in some localities (Rinne & Tikkanen 2011; Goldstein D 2008; Autti O & Hyry-Beihammer 2014; Askew et al 2010). None of these problems are a denigration of Finland's outstanding achievement in so substantially raising its performance in the period 1970-1999. But a key question is whether the current form of the system was also the case during the time of Finland's transformation from a relatively moribund system to a high-performing one. The historical record suggests that the answer to this is a resounding 'no'. The system as it appears now is not the form of arrangements during Finland's period of dramatic improvement. More thorough historical analysis of the form of the system, the nature of policy, and the conditions in the system preceding, and at the time of, rapid improvement suggests that state-approved textbooks were an important part of the mix at that time. Finnish teachers' own testimony helps to understand the role which they assumed during the move to fully-comprehensive education – namely as 'part of the steering mechanisms of the system' (Vitikka, Krokfors & Hurmerinta 2012). Key Finnish educational analysts concur:

'...The Basic Education (9 grades, 7-16 yrs) Act in Finland was accepted 1968, implemented starting 1972 and covering all Finland by 1976. From 1972 to 1985, the system was strongly state controlled, all teachers were requested to participate extensive in-service training, where the obligatory contents were delivered. The school inspection was active, nationally through National Board of Education (NBE) and locally through provincial school inspections. All textbooks were pre-examined and approved by NBE: all the teaching materials were to be aligned to the 1970 Framework Curriculum for the Comprehensive School. The curriculum was very detailed (2 large volumes, pages over 600) and the same for all municipalities. There were no state-level assessments in any school subjects, not even at the end of basic education (9th grade, 15-16 year-old students). However, the national comparability of school marks, given by teachers, was ensured by the detailed curriculum, intensive in-service training, but also by developing standardised tests in major school subjects, for public, non-profit use, by educational researchers under the order of NBE...'

(Hautamäki 2014)

As outlined above, the precise sequence of development in Finland is important. Consideration of the necessary time-lags and genuine phasing of transformation of the system leads to a conclusion that textbook quality has been used as a policy instrument and has been an important factor (naturally, one amongst many of the 'control factors' presented above) in system improvement in Finland.

Following Sahlberg and others, I see the following major phases in the development of modern Finnish arrangements:

Phase 1 - foundations

Following Cygneus' transnational comparative work, development (in 1861) of a distinctive model of general education, following centuries of commitment to personal learning, particularly in

respect of literacy. A distinctive emphasis in general education of education of women, civic participation and vocational education was accompanied by development of high quality teacher preparation. Concern, from Finnish independence (1917) onwards, to establish the foundations of universal education was followed by concerns (late 1950s onwards) regarding high spread of attainment.

Phase 2 - enactment

Systemwide reform policy established in the reform act of 1968 - movement to a fully comprehensive system effected during the 1970s. Foundations established, of the system which gave rise to high performance in the late 90's. Values, aims and practices laid down through widespread social and political discussion, streaming discontinued in 1985. High levels of legal prescription to implement change, accompanied by highly active, centralised inspection of classroom teaching and learning. Textbooks centrally approved by National Board of Education; in 1975 this Board ordered all teaching materials books maps and tapes to be checked by the official examiners' office in order to ensure that they were consistent with full comprehensivisation of the system. Inspection heavily deployed in order to ensure that classroom practice corresponded with the aims of reformed, comprehensive education and were not subverting it.

Phase 3 - consolidation

Strategic move to higher levels of school autonomy. Low levels of central inspection. Focus on teacher quality through long duration, high level, 'twin track' (pedagogy and specialism) ITT. Deregulation and decentralisation in the 1980s, the examining office of the National Board of Education (responsible for central approval of textbooks) was closed in 1990. There is some disagreement about exactly when approval of textbooks ended – Krokfors & Hurmerinta (Krokfors & Hurmerinta 2012) give the date as 1994 ('...abandonment of centralised control of textbooks and school inspection...'). In my interviews with current Finnish teachers and educationalists, the most common response to the question '...what is essential to quality in the Finnish system...?' is '...high quality teachers and high quality materials...' (Oates 2013). No longer State-approved, but still considered as a very important factor in system quality.

It is on Phase 3 that most international interest has focused, frequently committing the 'error of ahistorical analysis' which either explicitly or implicitly associates the current form of the system with the period of its transformation and substantial improvement – a period (phase 2) in which arrangements were very different. Phase 2 was characterised by very high levels of centralised prescription and control, and was designed to ensure thorough 're-conditioning' of the system around the principles of fully comprehensive education. This phase is not well-recognised outside of Finland; it jars with many contemporary non-Finnish accounts of the system– it may indeed be an 'inconvenient truth' at odds with the 'desired' wider narrative regarding autonomy (Alexander 2012; Benton 2014).

An important note: it is vital to recognise that I am NOT advocating the Phase 2 approach in Finland as a general system improvement strategy, to be unreflectively applied to any other system in other circumstances and at another time. Rather, I am trying to correct the misrepresentation of the character of the initial modern improvement phase in Finland. Using the 'control factors' analysis, we can see that specific factors assumed an interesting form during this phase, with some factors playing a greater role than they play in phase 3. A more accurate reading of the initial modern improvement phase highlights textbooks as an important factor, another 'inconvenient truth' for some analysts. I am not advocating that all systems need state-approved textbooks, but I AM highlighting their importance in the transformation effected in Phase 2 in Finland.

In Phase 2, many factors – widespread social discussion of the purpose and form of education, further development of teacher training, etc interacted to create improvement and effective implementation of the Finnish model of comprehensive education. But within this, textbook control appears to be an important element of the switch to the fully comprehensive system. They were a vehicle of transmission, and of consolidation of the new values and practices of the reformed system.

Textbook research in Finland has been analysed (Ahonen undated) and this notes the way in which textbooks have been viewed as instruments of control and social reproduction – and, indeed, subject to important critique by student organisations, an interesting element of Finnish history highlighting both the importance of textbooks and the negotiated or allowed influence of learners within the system (Ahonen op cit). The history of Finnish research on textbooks includes 1970s work using Wiio's instrument to measure the legibility of texts – authors were then 'asked to comply with the indicators'. Interestingly, the appropriate weight of schoolbags was introduced as a constraint in textbook writing. '...Textbooks became light, richly illustrated and simple to read. Appearance and motivational power of books (was) surveyed...' (Ahonen op cit p3).

Overall, the system reforms moved the system from moribund performance in the late 1960's to high performance, as measured in PISA 2000. These dates are important in respect of the key dates regarding patterns of control in textbooks in Finland. The high levels of control – including control of textbooks - played a part in the initial, coherent transformation of the system to being a comprehensive one, and ensured alignment in the new system arrangements. The subsequent interventions on textbooks enhanced quality. Looking at timelags in the system, the impact of approved books (and more importantly the common criteria around them) are unlikely suddenly to cease in the early 1990s. Approval may have ceased but use of the approved books (and the impact on the shape and content of the school curriculum) did not cease overnight, on the date that textbook approval ended. The children who did so well in the first PISA survey were 15 years of age. They progressed through a system which was continuing to be conditioned by the textbook forms which had been established during the period of approval and intensive research – ie these children may have been measured in 2000 but they were educated in the mid-90s, and in a system with many quality features established during the late 1980s. As stated above, Finnish teachers continue to highlight 'high quality materials' as a key feature of the system – even if the mode of production and application of quality criteria has evolved (Tero 2010; Kuismanen & Holopainen 2014).

The Finnish system now has many features associated with relatively high autonomy. But this is the system now. And the route to high levels of autonomy is paved with interesting movement from central control and regulation to devolved arrangements.

It is clear from the literature and from discussions with Finnish educationalists that approval of textbooks was a control element in the transformation of the system to a comprehensive system. Once the system values and 'acceptable' practices were established, relaxation of high levels of wide-ranging central control began (ie movement towards the current pattern of autonomy) but it is vital to recognise the quality criteria already established and communicated during the control phase was a vital element of system transformation, and contemporary system performance.

As an addendum, it is important to note that Vitikka Krokfors and Hurmerinta 2012 theorise educational resources as part of the 'steering system' of basic education. In the current system in Finland they see the function of these resources as 'independently interpret curricula' and thus have a significant role in the enacted curriculum. They note that, now, '...this is the only aspect of the educational steering system which is not governed or financed by a public organization...' (Vitikka Krokfors & Hurmerinta 2012 p87).

For this paper, this section will conclude on two key points:

1

the drive to a specific form of comprehensive education was a key part of the enhancement of the Finnish education system – and textbook approval played a strategic rather than contingent role in that change. They were aligned with and communicated the values and practices associated with comprehensive education.

2

using the ‘control factors’ perspective, recognising that textbooks assumed an important role in system transformation suggests that if they are NOT being used by a jurisdiction in supporting that jurisdiction’s specific system improvement strategy, then the function that they carry must be discharged through other factors or means.

Textbook qualities – case studies

The theoretical framework for the 2010 review of the National Curriculum (Oates T 2010) saw approved textbooks as part of the instruments for explicating the content of a National Curriculum and essential for international comparative work on the form and content of national curricula in other jurisdictions. As a result, over 200 textbooks were collected from target jurisdictions and used as part of the transnational curriculum content mappings. This curation of textbooks allowed further analysis of the qualities of the textbooks themselves. The case studies below were the result of ‘elements’ and ‘model’ analysis. Each textbook was documented for the different kinds of information elements which it contained and the manner in which it presented these elements. An overall assessment was made of the coherence of the text, based on either correspondence to a stated model (eg spiral curriculum) or to an obvious form adopted in the text.

What emerged was a fascinating set of contrasts. A class of textbooks can be summarised as ‘traditional’ – often excellent and simple, laying out specific concepts and content in a discipline but not using a specific model of learning to present or structure the material. A second class explicitly embodied specific models of learning – for example, a review activity to establish whether pupils are ready for a new activity, blocks of learning content focused tightly on a concept, assessment and rehearsal activities, extension activities. A third class was also evident – highly instrumental texts linked to examinations, heavily lead by the structure of the examination and loaded with assessment identical to the examination.

This has led to a difficult policy context in England. In 2012 the Education and Skills Select Committee considered evidence on textbooks and considered the apparent emergence of an inappropriately close and constrained relationship between specific examinations and ‘awarding body endorsed’ textbooks. It was suggested that these flagged elements relating to specific grades in examinations too explicitly, and restricted school choice of material. Initial discussion in the Select Committee suggested that there should be dislocation and gross separation of exams and textbooks, a sentiment which currently has been adopted in the policy of the national regulator, Ofqual. However, evidence submitted to the Select Committee by Cambridge Assessment suggested that while it may well be the case that the current close relationship between textbooks and examinations is wrong (and the quality of textbooks too low) this does not legitimate the proposition that there should be a very weak relation or no relation **at all** between textbooks and examinations. Using Schmidt’s concept of ‘curriculum coherence’, Cambridge Assessment argued that the two should relate, and in a coherent relation. Transnational comparison shows that textbooks need not be dominated by narrow instrumental preparation for exams, but can support rich, immersive learning leading to higher attainment in examinations.

The instrumental character of textbooks in England was highlighted in transnational comparison of textbook form and content, with contrasts highlighted in the sample case studies which now follow.

Case study texts extracted from the textbook analysis

Hong Kong – secondary maths textbook

Elements

Statement of Pre-requisites

Review activity to determine whether pupil is ready for the chapter

Different forms of the equations of circles

Features of circles from the equations

Equations of circles from the different given conditions

Intersection of a straight line and a circle

Inclusion of a series of problems

Check through assessment: 6 problems, 1 practice exam Q, 1 lively maths problem

Key features

Important evaluation of student readiness at the outset of each section

Extremely clear statement of concepts/constructs

Good elaboration through application

Checking of understanding at key points

Spiral curriculum model

Singapore – secondary maths textbook

Elements

Chapter overview – narrative regarding concepts and ideas – engagement

Discover – learning outcomes

Use of diagrams explained

Key ideas – concepts/constructs – margin notes – focus on concepts

Worked examples

Did you know – interesting facts

Guidance on the use of a calculator

Exercises

'Time out activity'

Journal writing task

Summary – recap and revision – checking main concepts

Revision paper

Ten-minute concept check

Review paper

Enrichment maths

Key features

Extremely clear statement of concepts/constructs

Constant re-inforcement of concepts/constructs

Good elaboration through extended application

Requirement for self-reflection through use of journal task

Checking of understanding at key points

Extension of application and understanding through enrichment element

Structured use of calculator accords with King's College research
Worked examples to clearly show concept and operations

England - International General Certificate of Education (IGCSE) textbook

Elements

Clear statements of mathematical ideas
Clear statements of operations
Some sample activities

Key features

Highly traditional form
High expectations
Very flexible resource
Succinct and clear on both concepts and operations
Does not prescribe pedagogy to any significant extent
Presupposes high quality teaching unlike Hong Kong and Singapore texts which include a clear learning model

England - General Certificate of Secondary Education (GCSE) textbook KS4

Elements

Extremely diverse content within diverse structure – complex
Divided into Higher Tier and Lower Tier elements to match examination
299 pages long
Sample full GCSE exam paper very early in the text: p11

Key features

Rather incoherent presentation with little signposting of key concepts
Highly instrumental text
No extension activities
Formative assessment defined entirely by the form of end-assessment
Presupposes high quality teaching unlike Hong Kong and Singapore texts which include a clear learning model

These case studies demonstrate some clear features of high quality in the Singapore and Hong Kong texts, such as the extended application of maths and reflective activities in the Singapore texts, the 'readiness' assessment in the Hong Kong texts, and the extremely clear presentation, explanation and reinforcement of key concepts and ideas in both. The coherence with the national curricula in each setting, and the strength of the pedagogic model promoted by the text, is impressive. The narrow instrumentalism, poor organisation and poor theoretical underpinning, of the (entirely typical) GCSE textbook is extraordinary by comparison.

Conclusion

Textbooks and resources should be considered as an integral part of establishing, within education arrangements, the policy intentions of a national curriculum. While precise approval mechanisms differ around the world, the majority of high-performing jurisdictions locate textbooks as part of the set of 'control factors' determining the form and quality of arrangements.

High quality textbooks are not antithetical to high quality pedagogy – they are supportive of sensitive and effective approaches to high attainment, high equity and high enjoyment of learning. A

failure to recognise this may be impeding improvement of education in England. A supply of high quality textbooks may provide considerable support to both teachers and pupils.

The analysis of Finland shows that the historical role of textbooks in system improvement has been misrepresented in some of the important contemporary analyses of that country.

The technical comparison of textbooks indicates the emergence of innovative and well-theorised textbook forms, meeting Schmidt's criterion regarding 'curriculum coherence', and assuming an extremely important role in improvement strategies.

This provides significant impetus to self-searching criticism of the status-quo in England, and to concerted effort by publishers, the State, researchers and educationalists in order to align more with emerging international standards of excellence – both in the form of textbooks and the patterns of their use.

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