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A Literature Review on Textbook Use and Links to L

Final Report

for the Publishers Association and the British Educational  
Suppliers Association

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# A Literature Review on Textbook Use and Links to Educational Standards

## Final Report

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## 2 Executive Summary

### Introduction

This review was commissioned from AlphaPlus by the Publishers Association and the British Educational Suppliers Association in response to the current debate about the role of textbooks in schools in England. The aim of the review was to collect together the evidence that links textbook use to high educational outcomes, and to seek evidence of causality in this relationship. The review also sought evidence about specific features of textbooks and wider contributing factors that are linked to high educational outcomes.

### Methodology

The review adopted a *synthetic* methodology: that is, it is a review designed to produce a set of concrete conclusions and recommendations for action based on sound evidence. Literature searching was carried out at NFER, in their Centre for Information and Reviews. The Centre's staff devised the search strategy in discussion with AlphaPlus and the client, defining the parameters and search terms/keywords. The team at NFER also conducted the searches and documented the process to ensure transparency and replicability.

The date parameters were limited to the last ten years: 2005–2015. NFER searched a range of bibliographic databases, hand searched the tables of contents in the Curriculum Journal and the Journal of Curriculum Studies, and reviewed a number of UK and international websites.

AlphaPlus then followed a three-stage process to filter and review the search results before drafting the report. The three stages were: i) coding; ii) appraising; and iii) synthesising.

### Textbook Use and Evidence of Links to High Educational Standards

The first stage of the research was to collect evidence about the links between textbook use and high educational outcomes. The evidence found is very limited. In addition, we did not find any evidence of a causal link between textbook use and high outcomes.

Askew *et al.* (2010) considered a range of factors, including textbook use, and their impact on outcomes in mathematics. They found little evidence to suggest that any of the factors impact on outcomes, rather that cultural factors seem to be having a more significant impact. The review also included three high quality meta-analyses which consider a range of different factors that might have an impact on educational standards, including textbooks: Slavin *et al.*, 2008; Slavin *et al.*, 2009 and Slavin and Lake, 2009. The studies found that programmes that affect daily teaching practices and student interactions have larger impacts on achievement measures than those emphasising textbooks or technology alone. Fan *et al.* (2013) summarise the research evidence about textbook use in mathematics over the last 60 years. They find that there is limited evidence that links textbook use to outcomes, and that the evidence they do find is weak and inconclusive. Glewwe *et al.* (2009) distribute textbooks to rural schools in Kenya, specifically with the intention of raising standards. However, in their research they find that the textbook use does not lead to better outcomes. Finally, Ofqual (2012) investigated the links between textbook use and standards in examinations in England. They found that some textbook development is too closely aligned to examination development and may lead to predictability in exam questions.

### Qualities of Effective Textbooks and their Contribution to High Standards

The second stage of the research aimed to identify features of effective textbooks, where effective means that the qualities can be linked to high outcomes. As with the previous sections, direct evidence in response to the question is limited.

Vincent and Stacey (2008) researched the features of Australian textbooks that might be linked to high standards, including a review of problems involving high procedural complexity. They found that not all the textbooks develop these skills effectively and teachers may not be well-equipped to select the best ones without training. Macintyre and Hamilton (2010) suggest that there is a link between further study in mathematics and enjoyment and engagement. They suggest that this in turn is linked to the student identities and how they relate to the mathematics curriculum. The findings of the study imply that the limited opportunities for students to identify with the content in these mathematics textbooks may reduce their engagement with mathematics. Weinberg and Wiesner (2011) present a framework that can be used to analyse factors that impact the ways students read and engage with textbooks. They suggest that rather than having students use the textbook as a source of mathematical exposition (and thus as a teacher stand-in), teachers should more actively mediate students' textbook use. Kablan *et al.* (2013) concluded that the use of educational materials in classroom instruction has a strong positive contribution to academic success, where materials include computer presentations, hands-on-materials, cartoons, concept maps and a combination where more than one material was used.

Two articles focus on frameworks that can be used to select appropriate resources or textbooks. Leifer and Udall (2014) describe the criteria used in the *Educators Evaluating Quality Instructional Products* (EQuIP) framework. These are: alignment to the depth of the standards; key shifts required by the standards; instructional supports, and assessments. Charalambos *et al.* (2010) conclude that an evaluation of textbooks should consider both vertical and horizontal features, that it should consider how students are expected to understand the content, and the analysis should also be based on the specific features of the textbooks being considered.

## Other Supporting Features

This section contains a diverse range of articles each considering textbook use in a wider context and suggesting wider contributing factors to effective use of textbooks.

OECD have found in PISA studies that the link between resource allocation (including textbooks) and high standards is weak. However, in their 2014 paper (OECD, 2014) they find that the more important consideration is how equitably resources are allocated, so whereas overall spend links weakly to standards, if the resource is allocated evenly then this can have an impact on disadvantaged schools. Wilkens (2011) also uses PISA data to look at links between state influence and textbook approval systems, and educational outcomes. The article found that the mean PISA scores for all subjects were higher for countries with no or weak state influence on the textbook approval system. However, they then argue that *high quality* textbooks (paper and digital) are important to teachers and education and therefore approval systems are necessary. Askew *et al.* (2010) review evidence from a wide range of sources and conclude that the frequent and extensive curriculum change in England has led to limited time for developing and trialling textbooks, which has, in turn, led to a reduction in their quality. Tesfaye and White (2014) report on the results of an on-going survey in the US into the use of textbooks in physics lessons. They find that a common barrier to textbook use was funding. Finally, Guthrie and Klauda (2012) report on a four year survey to learn about student motivation and engagement in reading. They suggest that students may be reluctant to engage with texts and identify five crucial practices that motivate adolescents to read informational texts.

## E-Books

Although not the focus specifically of the research questions, some relevant research on the use of e-Books was included in the review. Fan *et al.* (2013) conclude that there is limited research in the area of e-Books. However, Felvégi and Matthew (2012) present a review of literature from multiple disciplines pertaining to using e-Books in the classroom and found that the enhancements embedded in e-Books can help students comprehend what they are reading, develop reading fluency, increase their vocabulary, and have the potential to motivate students to read. However, the enhancements can also hinder students from developing their reading skills, can interfere with comprehension, and can result in passive rather than active

reading. Kim and Jung (2010) report on a study from South Korea in which e-resources were introduced to schools. The authors conclude that digital textbooks allow students to learn content that is tailored to their abilities and interests. They also offer many advantages over paper-based textbooks, however, they quote related evidence from the same project that found that the academic effectiveness of digital textbooks has not been proven (KERIS, 2008, cited in Kim and Jung, 2010).

## Conclusions

The suggestion that providing a good quality textbook for all subjects in all schools sounds like a reasonable suggestion when considering options that will lead to high educational outcomes. Similarly, the list of features that Oates (2014) suggests in his article as typifying high quality textbooks sound sensible. However, the research evidence does not seem to exist to support these assumptions (nor does it exist to suggest that these assumptions are not correct). The mismatch between what ‘feels’ right and the evidence that exists may reflect the complexity of the questions underlying the assumptions being made and the classroom context. A number of factors need to be constrained in order for the impact of the textbook, or particular features of the textbook, to be measured. This is methodologically complex and time consuming.

The articles reviewed here do give some indications of the features that may be important when developing high quality textbooks. However, again the evidence is inclusive. The extensive and high quality work conducted by Slavin and his team suggests that those interventions that result in changing teaching practices are most likely to have an impact, and these may be supported by textbook use.

It is clear that a number of other factors are important for textbooks to be used appropriately: teachers who understand the underpinning principles and can apply them effectively (i.e. change their teaching practice as suggested by the Slavin work); training for less experienced teachers; curriculum stability; and funding, to name a few.

## Recommendations

To sum up the recommendations from the review, much more evidence is needed if we are to be sure about the role of textbooks in developing high educational outcomes, and the key features of textbooks that would ensure that these high outcomes are achieved. Evidence is also required about the wider contributing factors that need to be put in place to ensure that the higher outcomes are achieved. This research should be carried out systematically, firstly to agree the features that are required, and then to select or develop textbooks that incorporate these features. Research then needs to be carried out, possibly in the form of randomised control trials, to measure if the desired outcomes are really being achieved. To conduct this research is no small task, but it is necessary before we can be fully confident in the assumptions that we make about textbook use and its link to high educational outcomes.

## 3 Introduction

There is much debate in England at the moment about the use of textbooks in schools and whether the use of the ‘right’ textbooks could lead to an improvement in educational standards. The debate stems in part from England’s performance in international testing programmes such as TIMSS (Trends in International Mathematics and Science Survey) and PISA (Programme for International Student Assessment). OECD (the Organisation for Economic Co-operation and Development) has stated that England’s performance in PISA is stagnating at best. This relatively poor performance has led to a review of what ‘high performing’ jurisdictions are doing in their systems, that might give an indication of what England can do to improve. One development stemming from this is two studies currently underway in England piloting curricula resources or textbooks from Singapore (Vignoles *et al.*, 2015; Jerrim *et al.*, 2015) and from Shanghai (Hodgen *et al.*, 2014) in a number of schools.

The debate about the use of textbooks also stems, in part, from a paper written by Tim Oates in 2010, arguing for better ‘curriculum coherence’ as a means of improving education standards. In the paper he states that: *‘A system is regarded as ‘coherent’ when the national curriculum content, textbooks, teaching content, pedagogy, assessment and drivers and incentives all are aligned and reinforce one another’*. (p. 13)

More recently Oates, who led the latest curriculum review in England, has written a policy paper specifically about textbook use (Oates, 2014). In this he argues that *‘Textbooks and resources should be considered as an integral part of establishing, within education arrangements, the policy intentions of a national curriculum’* (p. 19). Whereas the detail within a national curriculum, in order for the curriculum documents to be manageable, must be fairly limited, it is possible, using textbooks, to more clearly exemplify what is intended by the different curriculum statements. In addition to this clarification of the intended curriculum, Oates argues that textbooks can support effective teaching by providing *‘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’* (p. 5).

Oates (2014) summarises the key features of the best textbooks as follows:

‘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’.

Nick Gibb, Minister of State for Schools, has also argued in favour of textbook use in schools. He also provided a supporting foreword in Oates’ 2014 paper. In a speech to educational publishers in November 2014, he argues that *‘In the controversial search for the reasons why a range of key nations have improved their systems so dramatically and so quickly, the role of high-quality textbooks has been seriously neglected. Well-focused, forensic study of these nations highlights the extent to which good teaching and high academic standards are strongly associated with adequate provision and widespread use of high-quality textbooks’* (Gibb, 2014).

This literature review has been commissioned by the Publishers Association and British Education Suppliers Association in order to collect evidence around the debate about textbook use and design. The review aims

to systematically collect together the best evidence about textbook use and draw conclusions about the links between textbook use and high educational standards, and to investigate this in more detail to collect evidence about any features of the textbooks which are key in leading to those high standards.

## 4 Methodology

### 4.1 The Research Questions

The aim of the project is to review existing research on the impact of textbooks in order to answer the following research questions:

1. Is there evidence of a correlation between high educational performance and textbook use? If so, what form does that evidence take?
2. What evidence is there for the causality of the relationship between textbook use and effective education?
3. What are the qualities of effective textbooks? (e.g. clear pedagogical underpinning, clear learning progressions, repetition, attractiveness, inclusion of workbooks or other resources)
4. Where textbooks succeed, what are the contributory factors? (e.g. alignment with curriculum and assessment, teacher training, separation of curriculum and assessment, long term or short term curriculum planning)

### 4.2 Conducting the Searches

The review adopted a *synthetic* methodology: that is, a review designed to produce a set of concrete conclusions and recommendations for action based on sound evidence, rather than a *systematic* review, which seeks to quantify the entire extent of literature written over a particular time period.

Literature searching for the review of international literature on textbooks was carried out at NFER (the National Foundation for Educational Research), in their Centre for Information and Reviews, which provides international perspectives as an integral element of many of NFER's research projects. The Centre's staff devised the search strategy in discussion with AlphaPlus and the client, defining the parameters and search terms/keywords. The team at NFER also conducted the searches; and documented the process to ensure transparency and replicability.

The literature search was designed to identify the most pertinent UK and international research evidence on textbook use in schools and its relation to high quality educational outcomes. The date parameters were limited to the last ten years: 2005–2015.

A range of bibliographic databases was searched (the Australian Education Index, the British Education Index, the Education Resources Information Center (ERIC) and the Idox Information Service) using 'textbook' terms combined with 'educational outcomes' terms tailored to the specific search capability of each database.

In addition we 'hand searched' the tables of contents in volumes of the following journals published between 2005 and 2015:

- Curriculum Journal
- Journal of Curriculum Studies.

We also reviewed the publications/research/policy sections of the following websites:

UK

Cambridge Assessment; Centre for Evaluation and Monitoring (CEM); Institute of Education; National Literacy Trust; NFER; Nuffield Foundation; Pearson; Sutton Trust; Teaching and Learning Research Programme (TLRP); University of Durham (School of Education); University of Southampton (School of Education).

### International

Australian Council for Educational Research (ACER); Education GPS (OECD); Eurydice (European Commission); OECD (Education); International Association for the Evaluation of Educational Achievement (IEA); International Association for Research on Textbooks and Education Media; McKinsey & Co; National Educational Research Center (Institute of Education Sciences, US Education Department); What Works Clearing House (Institute of Education Sciences, US Education Department).

The searches brought up **77 articles** for possible inclusion in the review.

## 4.3 Selecting and Reviewing the Literature

AlphaPlus followed a three-stage process to filter and review the search results, so that the most relevant and best quality studies are included within the review. The three stages were: i) coding; ii) appraising; and iii) synthesising. These are explained below.

### Stage i) Coding the literature

The review team screened all the articles that were identified by the searches. The screening was undertaken based on a thorough analysis of the abstracts provided for each item, seeking to exclude all sources that did not meet our inclusion criteria. The coding used the following criteria:

- Does the article provide evidence about textbook use and educational standards?
- Does the article provide information about the key features of the textbooks that contribute to high standards?
- Does the article provide other supporting evidence about textbook use and standards, such as other contributory factors?
- Is the article about school level education? If yes, primary or secondary?
- Is the report based on high quality of evidence<sup>1</sup>?
- Is the report useful to include in final report?

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#### <sup>1</sup> Quality of Literature Coding

- High (3 marks): authoritative, independent study/research paper/systematic literature review, or review of reviews including some quantitative information or case studies covering a range of settings and stakeholders.
- Medium high (2 marks): independent study, research paper or research/literature review (non-systematic), or official documentation, not covering as much quantitative information, and based on fewer case studies, settings and stakeholders, but based on sound theory.
- Medium low (1 mark): study, research paper, research review (non-systematic) or official documentation authored by organisation or individual involved in e-testing.
- Low (0 marks): observation or opinion piece, based on one case study or views of one person.

Once coded every positive response was allocated one mark, except the quality question which was given up to 3 marks where high quality evidence is allocated 3 and low quality evidence is allocated 0. This resulted in an initial rank order for the selection of articles. Professional judgement was then used to check the coding and select the most useful articles in terms of variety and quality of evidence for appraisal and synthesis.

The coding resulted in **24 articles** being selected for probable inclusion in the final report.

### Stage ii) Appraising the literature

In order to ensure a systematic approach to the appraisal of all literature sources, the research team used an appraisal template to extract the key research findings from each study, as well as (again) assessing the strength of the evidence base and the quality of each item. Appraisal took place on the full article in order to tease out the key ideas that should be included in the final report.

Articles were appraised against the following areas:

- Jurisdiction in which the evidence was collected
- School subjects which were being investigated
- School grade or years to which the evidence pertained
- Year in which the evidence was collected
- Brief outline of the evidence collected/ study
- Key findings from the study
- Evidence about causality of textbook quality and high standards
- Evidence about features of textbooks that are important
- Evidence about other supporting features that are important
- Appraiser's view on the quality of the study and the evidence
- Whether, on review of the full article, it should be included in the final report
- Useful quotes or extracts for inclusion in the final report.

At the appraisal stage it was concluded that one of the articles was not of high enough quality to include in the final report, and two of the articles did not include detail about textbook use. All three articles were excluded. A total of **21 articles** were used for the final report writing.

### Stage iii) Synthesising the literature

Having appraised the key literature items, the team then synthesised the findings to produce the literature review draft report. This involved analysing the reviewed evidence to draw out emerging themes, patterns and key messages based on the outlined review questions.

The draft literature review report was submitted to the client for comment. A final report was then produced.

## 5 Discussion of Key Literature

### 5.1 Textbook Use and Evidence of Links to High Educational Standards

The first research question in this project focuses on the link between textbook use and high educational standards, with the second research question focusing on whether there is a causal link between these two things. A key element of the review is therefore to collect together evidence, if this is available, about this link between textbook use and high educational outcomes. One source of evidence cited in this debate is the results from international surveys such as TIMSS and PISA. Askew *et al.* (2010) review evidence from both international surveys, TIMSS and PISA, to answer the research questions:

- What is the range and type of research evidence from countries with high performance in mathematics that gives insights into the reasons for their relatively high position?
- What constitutes high performance in mathematics learning and what factors appear to contribute most to achieving it?

These questions are clearly broader than the use of textbooks, but do include textbook use, and helpfully set this against a number of other potential factors. The authors selected a number of factors to focus on and selected a number of countries to include: China, Chinese Taipei (Taiwan), Finland, Hong Kong, Japan, Singapore and South Korea. They then sourced literature to inform their understanding of the contribution of the different factors to overall performance in mathematics.

The authors conclude that high educational outcomes may be more a feature of cultural values than specific teaching practices (in this case in mathematics). They state that many of the studies they review show that countries that do well do not use innovative approaches to teaching, and they quickly go on to emphasise that this does not prove that the traditional approaches that are used lead to the high outcomes:

*'study after study shows that countries ranked highly on international studies – Finland, Flemish Belgium, Singapore, Korea – do not have particularly innovative teaching approaches. Lest this observation be picked up as ammunition for arguing for a 'back-to-basics' style of teaching, we hasten to add that such traditional approaches only appear to succeed because of cultural conditions that support them, particularly through parental expectations and relatively homogeneous populations.'* (p. 12)

It can be extrapolated from this finding that textbook use, among the other themes considered, did not stand out as having a strong effect on outcomes.

As in the Askew *et al.* (2010) study discussed above, a number of other articles considered the relative impact of textbooks compared to other possible interventions. The following three articles provide high quality examples of this strand of research.

Slavin *et al.* (2008) reviewed research on the achievement outcomes of mathematics programmes for middle and high schools. Amongst other criteria, in order to be included studies had to have:

- used a randomised or matched control group;
- a study duration of at least twelve weeks; and
- equality at pre-test.

There were 102 qualifying studies, 28 of which used random assignment to treatments.

The intention of the review was to place all types of programmes intended to enhance the mathematics achievement of middle and high school students on a common scale; and to provide educators with meaningful, unbiased information that they can use to select programmes most likely to make a difference for their students' standardized test scores. It also sought to identify common characteristics of programmes likely to make a difference in students' mathematics achievement. The various approaches to mathematics were grouped into three categories:

- **Mathematics curricula** with a focus primarily on textbooks
- **Computer-assisted instruction (CAI)** referred to programmes that use technology to enhance mathematics achievement
- The third category, **instructional process programmes**, was the most diverse. All programmes in this category rely primarily on professional development to give teachers effective strategies for teaching mathematics.

Much of the debate in mathematics instruction, the review suggests, revolves around the use of innovative textbooks or curricula. The curricula that were evaluated fell into three distinct categories:

- Innovative strategies based on the National Council of Teachers of Mathematics (NCTM) Standards, which focus on problem-solving, alternative solutions, and conceptual understanding
- Traditional commercial textbooks, also based on NCTM Standards but have a more traditional balance between algorithms, concepts, and problem solving
- *Saxon Math*, a back-to-the-basics textbook that emphasizes a step-by-step approach to mathematics.

The authors concluded that effect sizes were very small (weighted mean effect size =+0.03 in 40 studies) for mathematics curricula, and for computer-assisted instruction (effect size=+0.10 in 38 studies). There were larger (weighted mean effect size=+0.18 in 22 studies) for instructional process programmes, especially cooperative learning (weighted mean effect size=+0.42 in 9 studies). The article concluded that programmes that affect daily teaching practices and student interactions have larger impacts on achievement measures than those emphasising textbooks or technology alone.

The reviewers stress that it is important to note that the three types of approaches to mathematics instruction reviewed here do not conflict with each other, and may have additive effects if used together, and the effects may be greater than those of any of these programmes by themselves. However, the findings suggest that educators as well as researchers might do well to focus more on how the classroom is organised to maximise student engagement and motivation, rather than expecting that choosing one or another textbook by itself will move students forward.

*'... there were several interesting patterns in the research on middle and high school mathematics programs. One surprising observation is the lack of evidence that it matters very much which textbook schools choose.'* (Slavin *et al.*, 2008, p. 44)

The programmes that produce consistently positive effects on achievement are those that fundamentally change what students do every day in their core mathematics classes.

*'The debate about mathematics reform has focused primarily on curriculum, not on professional development or instruction ... Yet this review, in agreement with the review of elementary math programs by Slavin & Lake (2008), suggests that in terms of outcomes on traditional measures, such as standardized tests and state accountability assessments, curriculum differences appear to be less consequential than instructional differences.'* (p. 45)

In a similar study considering reading programmes rather than mathematics programmes, Slavin *et al.* (2009) review research on the achievement outcomes of three types of classroom approaches to improving the reading achievement of students in grades 2-5:

- reading curricula and core reading textbooks,
- computer-assisted instruction (CAI), and
- instructional process programmes.

The criteria for including studies in the review were:

- They evaluated programmes for upper elementary reading. Studies of variables, such as use of ability grouping, block scheduling, or single-sex classrooms, were not reviewed.
- They involved approaches that began when children were in grades 2-5, plus sixth graders if they were in elementary schools.
- They evaluated reading programs intended for all children.
- They compared children taught in classes using a given reading programme with those in control classes using an alternative programmes or standard methods.
- They could have taken place in any country, but the report had to be available in English.
- Random assignment or matching with appropriate adjustments for any pre-test differences (e.g., analyses of covariance) had to be used. Studies without control groups, such as pre-post comparisons and comparisons to “expected” scores, were excluded.
- Pre-test data had to be provided, unless studies used random assignment of at least 30 units (individuals, classes, or schools) and there were no indications of initial inequality. Studies with pre-test differences of more than 50% of a standard deviation were excluded because, even with analyses of covariance, large pre-test differences cannot be adequately controlled for as underlying distributions may be fundamentally different.
- The dependent measures included quantitative measures of reading performance, such as standardized reading measures. Experimenter-made measures were accepted if they were comprehensive measures of reading, which would be fair to the control groups, but measures of reading objectives inherent to the programmes (but unlikely to be emphasised in control groups) were excluded.
- A minimum study duration of 12 weeks was required. This requirement was introduced to focus the review on practical programmes intended for use for the whole year, rather than brief investigations.
- They had to have at least two teachers and 15 students in each treatment group.

A total of 80 studies met these criteria. The reading curricula category included seven qualifying studies of core basal textbooks and nine studies of supplementary texts used as initial instruction with all students.

The authors conclude that both core and supplemental reading curricula for the upper-elementary grades have been studied in high-quality evaluations. Among 16 studies, there were six randomized experiments as well as four randomized quasi-experiments, involving more than 10,000 students. These studies found few effects on student reading achievement. The review concluded that programmes designed to change daily teaching practices have greater research support than those that focus on curriculum or technology alone.

*‘In particular, positive achievement effects were found for cooperative learning programs and for same-age and cross-age tutoring programs. The effective approaches provided extensive professional development intended to significantly affect teaching practices. In contrast, studies of reading textbooks and of computer-assisted instruction found small effects on reading outcomes.’* (Slavin *et al.*, 2009, p. 2)

The same research team, Slavin and Lake (2009), conducted a synthesis of both the substantive and the methodological findings across the five main Best Evidence Encyclopedia reviews (involving over 400 studies) of reading and mathematics programmes in grades K-12.

The “meta-findings” across the five Best Evidence Synthesis reviews suggest that strategies likely to improve student learning are those that improve the quality of daily instruction, increase students’ active participation in the classroom, and help students learn metacognitive skills. Consistently successful programmes, such as cooperative learning, teaching of metacognitive skills, and improved management and motivation approaches, as well as comprehensive programmes such as *Success for All* and *Direct Instruction*, all emphasise extensive professional development, typically including multi-day workshops, in-class follow-up, and clear guidance and extensive supportive materials for teachers. Technology can be effective to the degree that it also supports active instruction, cooperative learning, and improving classroom instruction.

Changing curriculum or textbooks is rarely an effective strategy in itself, but may be an important element of comprehensive approaches that also incorporate instructional processes.

Methodological patterns were also consistent across subjects and grade levels. Surprisingly, random assignment never made an important difference in effect sizes. Far more important were sample size, duration, and use of measures not inherent to treatments.

*‘Studies comparing alternative core and supplemental textbooks ... find near-zero effect sizes at all grade levels and in both subjects. On measures not inherent to the curricula themselves, reform-oriented textbooks (such as math texts supported by the National Science Foundation), traditional texts, and back-to-basics texts (e.g., Saxon Math) have rarely been found to differ from control groups in student outcomes.’* (Slavin and Lake, 2009, p. 5)

Fan *et al.* (2013) again take a broad perspective and summarise research into mathematics textbook use over the last 60 years. This research covers various aspects of textbook use, including its impact on outcomes. It includes findings from 111 research articles which it categorises by date and by type of research. The classification of the research it uses is:

- Role of textbooks (29% of the literature)
- Textbook analysis and comparison (34% of the literature)
- Textbook use (25% of the literature)
- Other areas (12% of the literature, which includes research into e-textbooks and the relationship between textbook use and outcomes).

They find that research over the last 30 years in particular has been valuable and has developed a much better understanding of the role that textbooks play in teaching and learning.

*‘In general, researchers have developed better understanding of the role of textbooks in mathematics curriculum, teaching and learning. Many and major research studies have been conducted in the area of textbook analysis, textbook comparison and the use of textbooks.’* (p. 643)

They find that textbooks play an important role in mediating between the intended curriculum and the implemented curriculum.

*‘Researchers have generally agreed that textbooks as a major conveyor of the curriculum play a dominant role in modern education scenes across different school subjects.’* (p. 635)

However, the link between textbook use and outcomes is not evidenced in a large proportion of the literature, with it making up the smallest category, grouped with other elements under the ‘other areas’ heading. Perhaps most importantly for this review, they find that *‘the research evidence for a positive correlation between textbooks and students’ learning outcome is weak and inconclusive.’* (p. 643)

A further paper offering evidence in response to this research question about the link between textbook use and standards, investigated this question specifically. Glewwe *et al.* (2007) carried out a randomised evaluation involving 100 schools, of a programme that provided textbooks to rural Kenyan primary schools. They suggest that providing textbooks to schools where few students have them seems to be an obvious way to raise students' educational performance in developing countries. Textbook provision is almost universally accepted, even by those who doubt the effectiveness of increased school spending. However, the results of the study indicated that providing textbooks in Kenya did not increase average test scores, although it did increase the scores of students with high initial achievement.

The study used three different estimates of the effect of textbooks on average test scores:

- a levels estimator
- a difference-in-differences estimator; and
- a differences-in-differences subject-based estimator that compares the difference between test scores in textbook schools in subject-grade combinations in which textbooks were and were not given to the same difference in comparison schools.

All methods showed little effect of textbooks on average test scores. All three estimates showed that the impact of textbooks was close to zero. In addition, there was no evidence that the impact of textbooks rose over time.

These findings were in contrast to a retrospective analysis the authors conducted of textbook use that did seem to suggest that their use led to higher educational standards. The authors offer a number of possible reasons to explain the lack of an impact of textbooks on test scores in their data and why retrospective estimates were positive. The reasons for the not having an impact may be due to the quality of the textbooks, or the extent to which the textbooks were appropriate to the typical student. The authors suggest that the retrospective analysis may have been more positive as the textbooks involved were bought by the parents, and it may be that these were, therefore, more appropriate for the students.

The authors did find that the textbooks had a greater positive impact on higher ability students and suggest that some less able students were just not able to read the books, which were written in English (the third language of many of the students).

Finally, in this section, we have included a study conducted by Ofqual (2012) which collected evidence about textbook development and use, and the apparent impact on standards, predictability of assessments, conflicts of interests, and quality of learning. Ofqual gave their reason for conducting the research as the disquiet that had been expressed about the impact of endorsed textbooks on GCSE and A Level results by a number of stakeholders. They also expressed concern that conflict of interest by awarding organisations with a strong link to publishers producing endorsed textbooks is having an impact on market forces and inhibiting innovation and improvement. The underlying implication of the research is that attainment may have increased due to the use of textbooks, although this may not be due to increased learning, rather the predictability of the exams and links being too close between the textbooks and the exam questions.

Ofqual collected evidence using five approaches: a public call for evidence; a survey and case studies with schools researching their purchasing choices; an analysis of published responses to the Select Committee Inquiry; an analysis of previous written reports on the topic of endorsed textbooks; and a review of textbook to investigate if they are a factor in the predictability of assessment.

The report found that the evidence about the impact of increased use of endorsed textbooks on school standards is mixed. *'Overall, the evidence collected suggests there are pros and cons with current endorsement processes. The relationship between curriculum and resources has changed over time in a climate of increasing use of exam results for accountability, resulting in a very formulaic approach to textbook*

*development supported by current endorsement processes and market pressures.*' (p. 13). They also found that the published resources are a key element of a school's decision about what syllabus to follow. However, endorsed textbooks are not the only resource that impacts on the decision or that teachers use.

Ofqual conclude that there are some current practices which have too much impact on the predictability of exams. These include:

- 'the use of questions, contexts and case studies in examination papers which are very similar to those in textbooks
- The style and construction of questions in the exam being replicated in the textbooks so students become familiar with these
- worked examples in textbooks illustrating how particular styles of questions should be answered to gain maximum marks.'

These findings would suggest that the use of endorsed textbooks in this way would have a positive impact on outcomes, but that this would not be based on genuine learning gains. Their findings suggest that too close a link between the publisher and the examination provider may lead to unrealistic attainment measures. However, they do support Oates' (2014) arguments around curriculum coherence and its role in raising standards: 'there is a strong defence of the principle of alignment of textbooks to exams on the basis of curriculum coherence and its role in high-performing countries'. This last point raises an interesting question about the concept of curriculum coherence, and where this does lead to improved outcomes, and where, in contrast, this leads to shallow learning or too much predictability in the outcome measures. We will come back to this point in the Conclusions section below.

### 5.1.1 Section summary

The evidence considered in this section specifically regards evidence about the links between textbook use and high educational standards. The evidence found is very limited with regards to a link between textbook use and high outcomes. We did not find any evidence of a causal link between textbook use and high outcomes. Askew *et al.* (2010) considered a range of factors, including textbook use, and their impact on outcomes in mathematics. They found little evidence to suggest that any of the factors impact on outcomes, rather that cultural factors seem to be having a more significant impact.

The review included three high quality meta-analyses which consider a range of different factors that might have an impact on educational standards, including textbooks. The first study, Slavin *et al.* (2008), considers mathematics programmes, and the impact of mathematics curricula, computer assisted instruction, and instructional process programmes. From the 40 qualifying studies the authors conclude that textbooks themselves have little effect on the outcomes. The second study, Slavin *et al.* (2009), reviews evidence about factors that affect performance in reading, again considering curricula, computer assisted instruction, and instructional process programmes. 80 studies were included in the review. The authors again conclude that programmes designed to change daily teaching practices have greater research support than those that focus on curriculum or technology alone. The final study, Slavin and Lake 2009, summarises findings across five Best Evidence Syntheses. As in the two previous studies, the synthesis finds that changing curriculum or textbooks is rarely an effective strategy in itself, but may be an important element of comprehensive approaches that also incorporate instructional processes. They find that strategies likely to improve student learning are those that improve the quality of daily instruction, increase students' active participation in the classroom, and help students learn metacognitive skills.

Fan *et al.* (2013) again take a broad perspective and summarise the research evidence about textbook use in mathematics over the last 60 years. They find that there is limited evidence that links textbook use to outcomes, and that the evidence they do find is weak and inconclusive. Glewwe *et al.* (2009) distribute

textbooks to rural schools in Kenya, specifically with the intention of raising standards. However, in their research they find that the textbook use does not lead to better outcomes.

Finally, Ofqual (2012) investigated the links between textbook use and standards in examinations in England. They found that some textbook development is too closely aligned to examination development and may lead to predictability (and therefore, likely to impact on examination success), although this success may not reflect a genuine improvement in standards.

## 5.2 Qualities of Effective Textbooks and their Contribution to High Standards

The third research question being addressed in this review considers the evidence related to the qualities of textbooks that lead to high standards. Given the limited evidence described above about links between high standards and textbook use, and the lack of evidence about causality in this relationship, it could be assumed that there will be little evidence that specifically links particular features in textbooks to high educational standards. This was found to be the case. However, there are a number of articles that do research whether particular features exist in textbooks or not. These articles carry the underlying assumption that the features being researched are important in the target subject, and are therefore linked to high standards in that subject. This section will consider these articles and the features being considered, if the textbooks include the target features, and if there is any evidence of this being linked to high educational outcomes. When selecting literature for use in this review, articles that describe frameworks for evaluating textbooks, were also selected as best evidencing the features that are considered to be important.

Vincent and Stacey (2008) researched the features of Australian textbooks that might be linked to high standards, building on evidence collected in the 1999 TIMSS Video Study. It was found in this Video Study that lessons in Australia had some positive and some negative characteristics. On the plus side they included a relatively high proportion of problems set in real-life contexts, and on the negative side three quarters of the problems presented in the lessons were repetitions of previously presented, similar problems. The Australian lessons also included a relatively high proportion of problems with low procedural complexity and few examples which required proof by logical reasoning. (Hiebert *et al.*, 2003).

This study investigated whether similar patterns would be seen if the teachers were using a number of selected textbooks currently being used, including the most popular textbook from four Australian states. The states to be investigated were chosen due to accessibility of the textbooks. Three topics from the mathematics curriculum were selected to investigate in detail. 3687 problems from across the three curriculum areas included in the selected textbooks were reviewed.

Each of the selected textbook problems was classified according to five of the Video Study criteria: procedural complexity, type of solving processes, degree of repetition, proportion of 'application' problems and proportion of problems requiring deductive reasoning. The authors found that the majority of the problems in all of the textbooks were of low procedural complexity. Problems of high procedural complexity were rare (0-4%) in all the textbooks. Over the three topics, in the majority of books and including three of the four best-selling textbooks, less than 15% of problems required students to make connections.

Overall, there was a broad similarity in the proportions of problems in each category in the textbooks and the Australian Video Study lessons, although considerable variation existed between textbooks and topics. None of the textbooks had a higher percentage of problems of high or moderate procedural complexity than those documented in the Video study. Although not specifically linked to the achieved outcomes, the study

does demonstrate that the profile of performance on international surveys, is similar to that which would be expected based on the textbooks in use in the country. In this case, the preponderance of problems of low procedural complexity could be considered to result in lower outcomes than would be achieved if the problems in the textbooks develop higher order skills.

In a similar way to the previous study, Newton and Newton (2008) investigated whether a number of geography textbooks would support non-specialist teachers in primary schools to develop higher order thinking skills, particularly causal understanding, in geography lessons. The authors suggest that some teachers place too much emphasis on the acquisition of facts and that this may be due to their limited geography subject content knowledge. The authors quote Rymarz and Engebretson (2005) who studied textbooks in religious studies and found that ‘the textbook helped by enabling and enhancing the teaching, letting teachers see what to teach and what mattered most, helping them teach it in more depth, and by guiding their assessment of learning’.

The authors go on to say ‘As Rymarz and Engebretson (2005) found out, a non-specialist with a book is often better than one without. This depends, however, on there being books that address the problem’.

The study investigated whether 29 textbooks in use in schools in England would support the development of such skills. They suggest that an in-depth analysis of the text itself is required to identify the kinds of understanding that the book might develop.

The authors found a wide variety in the way in which the books provided causal explanations, and that ‘many books provided relatively few or none at all’. They did find that some books provided a significant amount of causal explanation but that this was limited to particular aspects of the national curriculum for geography. They conclude that teachers need training, not just in geography subject content knowledge, but also in the kinds of understanding that are important, so that they can select the most appropriate textbooks. They also need training in how to use the textbooks effectively.

*‘Teachers who are unclear about the kinds of understanding that should be supported may be unable to choose a book that points them in the right direction. They may, in practice, choose one that reinforces their existing teaching.’ (p. 37)*

Again, the study suggests that the inclusion of the right skills within a textbook, would lead to the development of these skills in pupils. If these skills are linked to high educational outcomes, then the textbook use could lead to higher outcomes.

Macintyre and Hamilton (2010) set their study in the context of a policy desire for wider participation in higher level mathematics courses. The authors suggest that this is linked to enjoyment and engagement with mathematics, and that this in turn is linked to the student identities and how they relate to the mathematics curriculum.

This is a relatively small study, in which two textbook schemes were reviewed and four focus groups were conducted with learners. The authors aim to report on how textbooks contribute to patterns of inclusion and exclusion in mathematics education.

The study focuses on Standard Grade mathematics in Scotland and the curriculum for this is set out in detailed contents lists. The authors suggest it is difficult to argue with the curriculum documents and there is little apparent bias. They go on to look at how the curriculum is presented in more detail via the textbooks. They select two textbooks to review, which have a large and increasing market share, although more are available in Scotland and teachers are free to use whichever they choose.

The focus of the study is on the relationship between perceptions of the mathematics curriculum and perceptions of identity. The aim is to investigate what effect, if any, the curriculum has on learners’

relationships with mathematics, and how such relationships influence their participation and achievement in the subject.

The authors examined each of the selected textbook sections for its presentation (e.g. pictures, the presentation of the text on the page); the messages portrayed; the style and language adopted; and evidence of any stereotypical representations. They then recorded a rough tally of the incidence of male and female names used in the questions (for gender and ethnic balance) as well as any job descriptions (for indicators of social class).

The basic quantitative assessment of the incidence of use of names highlights differences in gender and ethnicity, more so for ethnicity. The content analysis also highlights an imbalance in the type of job used. There are very few professional careers or management posts presented. Correspondingly, there are many manual and service positions cited.

The authors suggest that learners cannot identify with a person in every example, but the contexts used across the examples will have a bearing on their engagement and identity with the subject. There is a wide variety of contexts provided for young people with examples of the everyday, sports, science, nature and practical applications in the functional sections.

As with the mathematics and geography examples described above the link between the research and educational outcomes is not explicit. However, it is implied that the limited opportunities for students to identify with the content in these mathematics textbooks may reduce their engagement with mathematics and therefore their likelihood to achieve high outcomes or progress to further study.

Similar to the above study, Weinberg and Wiesner (2010) present a framework that can be used to analyse factors that impact the ways students read and engage with textbooks. It adapts ideas from reader-oriented theory and applies them to the domain of mathematics textbooks. The central tenet of reader-oriented theory is that the meaning of a text does not reside in the text itself, but rather is generated through a transaction between the text and the reader as the reader reads and responds to the text.

The framework described in this paper focuses on three concepts from reader-oriented theory:

- the intended reader: the image of the reader that the author forms in his or her mind
- the implied reader: the collection of qualities required of the empirical reader in order to correctly interpret the text. For mathematical texts, the implied reader is defined as the embodiment of the behaviours, codes, and competences that are required for an empirical reader to respond to the text in a way that is both meaningful and accurate
- the empirical reader: the person who actually reads the text.

To illustrate these ideas, the paper uses examples from an introductory section of Calculus: Single Variable (Hughes-Hallett *et al.*, 2009, cited in Weinberg and Wiesner, 2010).

In terms of determining the impact of the textbook, the focus is necessarily on the empirical reader. Here the authors see readers as being on a continuum between adopting a ‘reader-centred’ (i.e. viewing reading as a **transactional** process of generating meaning); and a ‘text-centred’ (i.e. viewing reading as a **transmission** process in which “meaning is transmitted directly from the author to the reader”) model towards the textbook.

There is substantial evidence that reader-centred models support productive reading strategies; and that successful mathematics majors were more likely than non-successful majors to use reading strategies that reflected a reader-centred model, such as reformulating definitions and reflecting on statements before they were proved.

If an author is successful in constructing the textbook for his or her intended reader, the intended and implied readers coincide. Similarly, the success of a textbook as a pedagogical tool is dependent on the extent to which the empirical reader matches the implied reader.

Teachers often implicitly endorse a text-centred reading model. However, endorsing a text-centred model may lead to pedagogy that constrains students' ability to use text materials to learn mathematics in a meaningful way. One possible solution is to reconceptualise the role of a textbook while simultaneously strengthening the role of the teacher: rather than having students use the textbook as a source of mathematical exposition (and thus as a teacher stand-in), teachers can more actively mediate students' textbook use.

Kablan *et al.* (2013) took a slightly different perspective, and reviewed certain materials and the links to high standards. Although not textbooks specifically, many of the materials studied could be elements of textbooks, so the information may be of value here. The authors conducted a meta-analysis, combining and analysing statistical data from 57 experimental studies. Their key research question is: 'whether the use of educational materials affect students' achievement or not?'

Studies included were:

- Conducted and published in Turkey between 2000 and 2012
- Quasi-experimental and experimental studies that used educational materials in the experiment groups
- Studies that reported sufficient statistical information to calculate effect size.

The study looked at different educational levels and subjects. It considered the effects of different types of educational material – defined as computer presentations, e.g. PowerPoint, hands-on-materials (materials that can be touched and moved around by students), cartoons (for specific content and reveal important information), concept maps (showing relationships between concepts), and a combination where more than one material was used.

The paper concluded that the use of educational materials in classroom instruction has a strong positive contribution to academic success. This is the only article included in the review with this finding. It found no significant differences between educational levels, subjects or by different types of materials. The paper, however, did not include any analysis or understanding of the interventions or the attainment outcomes from the individual studies. The study also did not explain how the quality of the research papers that were included was determined.

The next two articles have a slightly different focus to the articles included above looking at specific skill, features or content areas. These articles describe frameworks that teachers can use to select textbooks for use. The implication in these articles is that the criteria used in the selection frameworks would lead to the teachers using high quality resources. It could be extrapolated from this that these are therefore considered to be features of textbooks that would lead to high educational standards.

Leifer and Udall (2014) discuss ways of selecting appropriate resources for supporting the newly introduced Common Core in the US. They describe how many existing resources do not cover the Common Core appropriately, even if they claim to do so, and cite two models that teachers can use to select appropriate resources. They describe the criteria that the models set for selection. One model they include, *Educators Evaluating Quality Instructional Products* (EQulP), has four dimensions:

- alignment to the depth of the standards
- key shifts required by the standards
- instructional supports, and
- assessments.

When resources are scored for each dimension they are classified as exemplar, exemplar if improved, revision needed, or not ready.

They suggest that such tools allow teachers and school leaders to be able to spot high quality resources and encourage publishers to develop them. The authors suggest that the tools are used most effectively when the teachers are given training. Resources that do not fully meet the criteria can be adapted by teachers to meet their requirements.

The authors conclude that teachers and resources are crucial to success in implementing a new curriculum. However, teachers need support in selecting and implementing the right resources.

Charalambos *et al.* (2010) used a framework developed specifically for this purpose to compare the way in which the addition and subtraction of fractions is taught in three countries – Cyprus, Ireland and Taiwan. The framework was developed based on a review of previous frameworks described in the literature. The authors conclude that it is important to consider both the breadth and content of the curriculum and the way in which individual topics are taught and developed across the curriculum, they call this a horizontal and vertical analysis. The authors state that studying textbooks is important as it gives an indication of the ‘intended’ curriculum, even if it is not possible in this way to research the ‘implemented’ curriculum.

The authors use the topic of addition and subtraction of fractions as a case study through which the wider area of textbook comparative research can be explored. They suggest it is important to consider features such as page size, number of pages, topics, and topic sequences to give an initial impression of the appropriateness of the textbook. However they point out that this does not give an idea about how the content is dealt with. In this case they considered the content in terms of ‘communicated to students’, ‘required of students’ and ‘connections’. They suggest, in addition, that researchers need to consider content areas in specific detail. Finally, they suggest that these reviews may give a fragmented view and so it is necessary to group the criteria into categories.

The authors listed the topics presented in the books and their sequencing. They then looked at worked examples, fraction constructs, potential cognitive demands, and type of answers. The authors present a number of specific findings related to the way that fractions are taught in the three countries researched.

*‘These findings suggest that choices made about topics and sequencing, but most importantly, the diversity of constructs and worked examples impose different demands on students who use the textbooks in these countries.’* (p. 143)

More generally they conclude that an evaluation of textbooks should consider both vertical and horizontal features, that it should consider how students are expected to understand the content, and the analysis should also be based on the specific features of the textbooks being considered.

They found that textbooks within countries are more similar than textbooks between countries and that ‘this dissimilar textbook variability across rather than within countries might be rooted in cultural differences, because the respective curricula do not specify features such as the nature of worked examples to be included in textbooks or the relative proportion of more or less cognitively demanding tasks’.

## 5.2.1 Section Summary

This section focuses on the research that identifies qualities of effective textbooks, where effective means that the qualities can be linked to high outcomes. As with the previous sections, direct evidence in response to the question is limited. Articles have been selected that research specific features of textbooks, or frameworks for selecting effective resources or textbooks, as the underlying implications of such research is that the qualities being researched are critical, and are likely to lead to improved outcomes.

Vincent and Stacey (2008) researched the features of Australian textbooks that might be linked to high standards. The video study had found that Australian lessons included a relatively high proportion of problems with low procedural complexity. A review of the textbooks used in four states found that the problems included in the textbooks also demanded low procedural complexity. The implication of the study is that Australian students may achieve better outcomes if the textbooks included more demanding problems, although this is not explicitly stated. Newton and Newton (2008) investigated whether a number of geography textbooks would support non-specialist teachers in primary schools to develop higher order thinking skills, particularly causal understanding, in geography lessons. The authors found that not all the textbooks develop these skills effectively and teachers may not be well-equipped to select the best ones without training. Again the implication is that textbooks that develop these skills well could lead to higher educational outcomes.

Macintyre and Hamilton (2010) suggest that there is a link between further study in mathematics and enjoyment and engagement. They suggest that this in turn is linked to the student identities and how they relate to the mathematics curriculum. The findings of the study imply that the limited opportunities for students to identify with the content in these mathematics textbooks may reduce their engagement with mathematics and therefore their likelihood of achieving high outcomes or progress to further study. Similarly to the Macintyre and Hamilton study, Weinberg and Wiesner (2011) present a framework that can be used to analyse factors that impact the ways students read and engage with textbooks. They find teachers often implicitly endorse a text-centred reading model and suggest that endorsing a text-centred model may lead to pedagogy that constrains students' ability to use text materials to learn mathematics in a meaningful way. As a solution they suggest that rather than having students use the textbook as a source of mathematical exposition (and thus as a teacher stand-in), teachers can more actively mediate students' textbook use.

In contrast to other articles discussed in this review, Kablan *et al.* (2013) concluded that the use of educational materials in classroom instruction has a strong positive contribution to academic success. Their review covers a large range of features, subject areas and age groups.

Two articles reviewed in this section focus on frameworks that can be used to select appropriate resources or textbooks. The implications of such frameworks is that the features included are those that would lead to the selection of effective textbooks. Leifer and Udall (2014) describe, as one example, the criteria used in the *Educators Evaluating Quality Instructional Products* (EQuIP) framework. These are: alignment to the depth of the standards; key shifts required by the standards; instructional supports, and assessments. Charalambos *et al.* (2010) conclude that an evaluation of textbooks should consider both vertical and horizontal features, that it should consider how students are expected to understand the content, and the analysis should also be based on the specific features of the textbooks being considered.

In sum, the articles reviewed in this section suggest that qualities of effective textbooks include:

- The inclusion of problems that include high procedural complexity
- That can support non-specialist primary teachers to develop children's higher order thinking skills e.g. in geography
- Those that can develop enjoyment and engagement with mathematics by including contexts and examples that pupils can relate to
- Those that exemplify the depth of standards well and changes from existing schemes, as well as appropriate instructional support and assessment
- Demonstration of how students are expected to understand the content.

## 5.3 Other Supporting Features

The fourth and final research question asks about the contributing factors that are helpful in ensuring that high quality textbooks can have the desired and potential impact. The articles relating to this question are described below.

### Equity of Resource Allocation

OECD published a report in 2014 looking at the extent to which equity in resource allocation is a predictor of student performance in the PISA survey (OECD, 2014). In this context, the term resources is used to cover a range of inputs, including textbooks and also science equipment. Evidence is taken from PISA 2012 data. The report cites previous evidence that suggests that the amount of resources spent on education is only weakly related to student performance in the PISA assessments. They explore this in more detail by exploring equity of distribution.

They use the following variables:

- PISA mathematics score points as the outcome student performance measure
- Cumulative expenditure per student (ages 6 – 15) – after accounting for *per capita* GDP
- Equity in resource allocation – difference in the *index of quality of schools' educational resources*<sup>2</sup> between socio-economically advantaged and disadvantaged schools
- Quality of resources – mean *index of quality of schools' educational resources*.

The paper concludes that fairness in resource allocation (across disadvantaged and advantaged schools – where 'disadvantaged' is defined by the socio-economic background of its students) is related to the performance of the education system as a whole. Not all students benefit from adequate resources:

- After accounting for per capita GDP, 19% of the variation in mathematics performance between countries and economies participating in PISA can be explained by adequacy of resources<sup>3</sup>
- 30% of the variation in mathematics performance across OECD countries can be explained by how equitably resources are allocated across schools.

Overall, it can be seen that the adequacy of resources, including textbooks, has a relatively low impact on outcomes, whereas the equity of resources has a greater impact. However, this does support the idea that textbook use in part contributes to high educational standards, and can lead to improvements in disadvantaged schools if the resources are distributed fairly. The report concludes: '*The bottom line: Higher-performing school systems allocate resources more equitably among socio-economically advantaged and disadvantaged schools. Supporting disadvantaged schools does not necessarily mean providing them with more resources, but rather with high-quality human and material resources.*' (OECD, 2014, p. 4)

### Textbook Approval Systems

The third study in this review conducting research on the PISA data is by Wilkens (2011). Wilkens looks at the textbook approval systems in relation to educational outcomes. The aim of the research was to gain an

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<sup>2</sup> Constructed index based on school principals' responses about their perceptions about educational resources in their school. They were asked to report whether their school's capacity to provide instruction was hindered by a shortage or inadequacy of: science laboratory equipment, instructional materials (e.g. textbooks), computers for instruction, Internet connectivity, computer software for instruction, and library materials. (Definitions, PISA 2012: OECD)

<sup>3</sup> Principals' responses to questions about the adequacy of science laboratory equipment, instructional materials, such as textbooks, computers for instruction, Internet connectivity, computer software for instruction, and library materials.

overview of textbook approval systems in use across the world, and any relationship between state influence, as reflected in textbook approval systems, and educational outcomes.

The study included:

- **A review of the literature which focused on** the role of textbooks in resource ‘construction’ within schools and the role of the teacher and other variables on pedagogic practice; the role of approval systems (existing literature, it was concluded, suggests strong state influence may hamper learning); and approval systems in different countries
- **An online questionnaire** to a representative (unspecified) in ten countries re approval system/ level of state influence
- **PISA outcome data for approximately half the PISA participating countries.** Countries were categorised as model A, B, C, D or E based on Repoussi and Tutiaux-Guillon (2010) typology for degree of state influence in textbook approval systems, where A is no state influence, B strong influence, C moderate influence, D weak influence and E mixed influence.

The report found that the mean PISA scores for all subjects were higher for countries in models A and D (no or weak state influence on the textbook approval system). It is argued that textbooks may become more important where teachers are less qualified. Finland, the highest ranked PISA country in Europe, has highly qualified teachers and no state influenced formal approval system for textbooks. Textbooks are the main source for teachers’ lesson plans in the Netherlands, where teachers do not need to be certified (it is not clear what level of qualification, if any, is required).

The authors argue that *high quality* textbooks (paper and digital) are important to teachers and education and therefore approval systems are necessary to ensure quality, however, this is at odds with the PISA data which shows higher scores for countries where there is no or weak state influence on approval systems for textbook use. The conclusion that there may be a need for state-influenced textbook approval systems seems based on concerns that there is a high reliance on textbooks by teacher in the Netherlands where teachers may be less qualified rather than the evidence presented in the paper.

### Curriculum Stability and Development Time

Askew *et al.* (2010), as described above, reviewed evidence from both the international surveys that include mathematics assessments, TIMSS and PISA, to answer the research questions:

- What is the range and type of research evidence from countries with high performance in mathematics that gives insights into the reasons for their relatively high position?
- What constitutes high performance in mathematics learning and what factors appear to contribute most to achieving it?

The authors conclude, that there is no large scale research into textbook use in England or internationally other than TIMSS. They do find that textbook use in England is lower than textbook use in high attaining countries, particularly at grade 4. However, the authors also conclude that the frequent and extensive curriculum change in England has led to limited time for developing and trialling textbooks, which has, in turn, led to a reduction in their quality, citing Haggarty and Pepin (2001) who ‘find English textbooks to be less coherent and more routine than French and German textbooks’.

They conclude that ‘England’s textbooks are more routine and involve less variation in the construction of examples than those of many high attaining countries. Well-constructed textbooks not only support teachers but also provide support for pupils to work independently out of class’.

Askew *et al.* (2010) state that ‘English textbooks or e-resources for pupils and teachers need to be improved. Textbooks or resources should be designed to have more mathematical coherence, connections and variation, as well as provide better support for teachers and support for pupils in independent learning’.

### **Funding**

Tesfaye and White (2014) report on a nationwide survey of physics teachers in the US that has been running for 10 years. The focus of the survey is on specific named textbooks used by physics teachers, how highly they rate them and what other types of materials teachers use. In this article additional questions were asked about how textbooks are used and what, if any, additional materials are used to supplement teaching and learning. The first part of the survey findings related to specific textbooks. Many teachers reported using additional materials even when they report a high level of satisfaction with the textbook used.

The second part of the survey focused on textbook use and additional use of materials. A common barrier to textbook use was funding – schools have limited funds (some schools were unable to issue textbooks to each student and some borrowed textbooks from neighbouring schools). In some cases, teachers reported that they did not issue textbooks because the students rarely used them. Teachers were drawing from a wide variety of materials, including textbooks. Other materials included a wide range of online resources including video demonstrations, simulations, lectures, practice problems and lesson plans – these were available from many different websites (full list in paper pp.12 - 13). A few teachers reported using online tutorials to create a ‘flipped’ classroom – with students watching the tutorial first at home and bringing questions to class.

### **Providing a Supportive and Engaging Classroom Environment**

Guthrie and Klauda (2012) used a four year survey of more than 3,000 students and extended interviews with more than 250 students of diverse ethnicities and achievement levels to learn about their motivation and engagement in reading. They suggest that students may be reluctant to engaging with texts and that

*‘By providing engaging, supportive classroom instruction, effective teachers can help middle school students overcome their initial reluctance and master the art of learning from informational text.’ (p. 68)*

Drawing from this research and that of others, the project identified five crucial practices that motivate adolescents to read informational texts. The study was part of the Concept-Oriented Reading Instruction (CORI) project at the University of Maryland.

#### **i. Develop dedication**

Textbooks alone rarely motivate students to develop dedication. To foster student dedication, effective teachers use a variety of texts. They go beyond the textbook, incorporating the Internet, relevant trade books, and articles from science or history journals. Instead of offering a curriculum that is ‘a mile wide and an inch deep’, they provide in-depth units of study in which students have a chance to read extensively and deeply about topics.

#### **ii. Build Self-Efficacy**

When students struggle with reading the textbook, teachers sometimes sideline the book and teach the content directly. Avoiding the textbook, however, is a mistake. Students need repeated experiences of successfully learning from their textbooks and other informational texts to build their overall self-efficacy as readers and learners. The authors suggest the text should be matched to students' levels; when the available textbook is too difficult for individual students, effective teachers provide supplementary / more manageable texts, different media (eg videos) or online materials. The teachers need to select tasks appropriately to help students gain confidence in higher-order thinking with complex text; effective teachers gradually increase task complexity, moving from lower-level to higher-level tasks. The teachers should also help students gain confidence by assisting them in setting and accomplishing their own reading goals.

### iii. Show students the text's value

A first step for teachers in increasing the perceived value of reading is to help students understand how reading the text benefits them across a range of situations. For example, in one study, teachers asked students to write a paragraph about how the material they were learning in a section of their mathematics or psychology textbook was relevant in their personal lives.

### iv. Use Social Motivation

Social motivation can inspire dedication to text reading if students want to impress their peers and not let them down by failing to fulfil their role in the group. Effective middle school teachers set up frequent opportunities for collaboration to support students' social motivation for reading informational text. A wide range of interactive and collaborative arrangements can work in classrooms.

### v. Give students choices

The authors stress that they are not recommending that teachers let students choose whether or not to read a textbook or whether to complete assignments! Rather, they are suggesting that teachers provide more limited choices, for example —which paragraph to emphasize in drawing conclusions, or which examples to read closely.

## 5.3.1 Section Summary

This section contains a diverse range of articles each considering textbook use in a wider context and suggesting wider contributing factors to effective use of textbooks.

OECD (2014) have found in PISA studies that the link between resource allocation (including textbooks) and high standards is weak, however, in their 2014 paper they look into this in more detail. They find that the more important consideration is how equitably resources are allocated, so whereas overall spend links weakly to standards, if the resource is allocated evenly then this can have an impact on disadvantaged schools.

Wilkens (2011) also uses PISA data to look at links between state influence and textbook approval systems, and educational outcomes. The article found that the mean PISA scores for all subjects were higher for countries with no or weak state influence on the textbook approval system. It is argued that *high quality* textbooks (paper and digital) are important to teachers and education and therefore approval systems are necessary to ensure quality, however, the conclusion that there may be a need for state influenced textbook approval systems seems linked to concerns about teacher certification in the Netherlands, rather than the evidence presented.

Askew *et al.* (2010) review evidence from TIMSS and PISA and conclude that only TIMSS provides extensive evidence about textbook use in England and the link to outcomes. They find that teachers in England tend to use textbooks less, particularly in primary schools. The authors suggest that the textbooks in England (for mathematics) are lower quality than those found in high performing countries, although they do not go on to suggest that this is directly linked to the low usage. They do conclude that the frequent and extensive curriculum change in England has led to limited time for developing and trialling textbooks, which has, in turn, led to a reduction in their quality.

Tesfaye and White (2014) report on the results of an on-going survey in the US into the use of textbooks in physics lessons. They find that a common barrier to textbook use was funding – schools have limited funds (some schools were unable to issue textbooks to each student and some borrowed textbooks from neighbouring schools). However, they also find that teachers were drawing from a wide variety of materials, including textbooks. Other materials included a wide range of online resources including video demonstrations, simulations, lectures, practice problems and lesson plans.

Finally, Guthrie and Klauda (2012) report on a four year survey to learn about student motivation and engagement in reading. They suggest that students may be reluctant to engage with texts and identify five crucial practices that motivate adolescents to read informational texts.

## 5.4 E-books

As described above, Fan *et al.* (2013), summarise the research into mathematics textbooks over the last 60 years. Their review includes findings from 111 research articles which they categorise by date and by type of research. One element of their review is the evidence about the contribution of e-books in mathematics. They find limited research as yet in this area, stating researchers have ‘only started to look into issues concerning the use and development of electronic textbooks in mathematics and the research is at a very initial stage’. However, the searches for this review did find some evidence in this area, which we thought it would be useful to include, although not directly covering the research questions. Two articles are described below.

Felvégi and Matthew (2012) present a review of literature from multiple disciplines pertaining to using eBooks in the classroom in order to understand the underlying literacy and technology related issues and challenges. For the purposes of this article *electronic books* or *eBooks* are defined as self-contained digital texts whose basic structure mimics traditional books, are viewed on an electronic display, and are used by students.

The authors suggest that as books continue to evolve into eBooks, their changing formats and enhancements require changes in the skills and strategies used to read and to comprehend the book—resulting in changes in reading literacy pedagogy. In eBooks pages are turned by swiping side to side or by scrolling up or down. Graphics may be videos to watch or interactive graphs that allow students to enter their own data and immediately see the results. These differences in traditional and digital text processing require literacy strategies that focus on navigation, linearity, source, and content (Organization for Economic Co-operation & Development [OECD], 2009).

This review of literature used the following procedures:

- (a) established the time frame of 1990 to 2010, covering 20 years of research;
- (b) searched online databases including Academic Search Complete, ERIC, Information Science and Technology Abstracts, Library, Information Science & Technology Abstracts, Professional Development Collection, and PsychInfo, using a combination of search terms from group ‘a’—*ebook(s)*, *electronic text(s)*, *~textbooks*, *CD-ROM (story)books*, and group ‘b’—(new, digital or online) *literacy*, *reading*, *classroom*, *education*; and finally
- (c) identified articles from the search results based upon relevance and proximity to the overall goals of this review. The articles collected were analyzed based on key topics and trends.

The authors found that the enhancements embedded in eBooks can help students comprehend what they are reading, develop reading fluency, increase their vocabulary, and have the potential to motivate students to read. However, these enhancements can also hinder students from developing their reading skills, can interfere with comprehension, and can result in passive rather than active reading. Additionally, research in higher education shows students’ preferences for print and electronic text must be considered, that these preferences may change over time, and they may depend on the students’ purpose for reading or their gender.

Electronic text and interactive graphics, coupled with proprietary hardware and software, require readers to learn to use a variety of modalities and to apply new reading. Moving from print to electronic text resulted in

changes to the text itself, to the graphics, to the reader's role, and to the reading process. Changes to the reading process require readers to learn new literacies which in turn have led to changes in a signature pedagogy—reading literacy instruction. There is no consensus on who should teach new literacies or how to teach them. Nevertheless, the fact that new technologies continue to reshape literacy has an impact on literacy research, especially in relation to changes in signature pedagogies.

Kim and Jung (2010) report on a study from South Korea in which e-resources were introduced to schools. The project involved developing the materials, training the teachers, building the technical infrastructure, develop a distribution system and dealing with the legal issues (e.g. copyright). A system to reward teachers for effective implementation was introduced. Finally an assessment system was developed to evaluate if the implementation was successful or not.

The study expected, based on research evidence, to find improvements based on the following areas:

- **Learning with Hypermedia:** It is believed that hypermedia structures enhance and stimulate a self-controlled and non-linear interaction with learning materials as well as an in-depth exploration of vast amounts of information.
- **Learning with Multimedia:** Research on multimedia learning suggests that multimedia can foster cognitive change and facilitate information processing in learning.
- **Learning Through Interactivity:** There are five common types of interactivity in multimedia environments: dialoguing, controlling, manipulating, searching, and navigating. It is believed that providing interactive, manipulative function in multimedia can improve learners' problem-solving skills by (a) promoting their self-efficacy and (b) reducing the cognitive load involved in the problem-solving.
- **Learning from Web-Based Formative Assessment:** Digital textbooks provide forms of online formative assessment tools within the digital textbook system as well as supplementary and in-depth learning materials for each level. Digital textbooks allow teachers to use evaluation data to assess whether study goals are achieved.
- **Learning in Self-Regulated Learning Mechanism:** Learning with a hypermedia environment in digital textbooks requires a student to regulate his or her learning; that is, to make decisions about what to learn, how much time to spend on it, how to access other instructional materials, and to determine whether he or she understands the materials.

The authors conclude that digital textbooks allow students to learn content that is tailored to their abilities and interests. They also offer many advantages over paper-based textbooks: they are far less bulky, easier to update, and provide more meaningful learning experiences with multimedia. Using digital textbooks opens more possibilities and challenges in education.

The authors also quote other research into the same project that found that the academic effectiveness of digital textbooks has not been proven (KERIS, 2008, cited in Kim and Jung, 2010), even though Uyn (2007) found improvement in student interest, comprehension, satisfaction, and self-efficacy. A significant difference was also found between rural and urban students and low-achieving students (KERIS, 2008, cited in Kim and Jung, 2010).

### 5.4.1 Section Summary

Fan *et al.* (2013), in their comprehensive review, find limited research as yet in the area of e-Books, stating researchers have 'only started to look into issues concerning the use and development of electronic textbooks. However, Felvégi and Matthew (2012) present a review of literature from multiple disciplines pertaining to using eBooks in the classroom in order to understand the underlying literacy and technology related issues and challenges. The authors found that the enhancements embedded in eBooks can help

students comprehend what they are reading, develop reading fluency, increase their vocabulary, and have the potential to motivate students to read. However, the enhancements can also hinder students from developing their reading skills, can interfere with comprehension, and can result in passive rather than active reading.

Finally, Kim and Jung (2010) report on a study from South Korea in which e-resources were introduced to schools. The authors conclude that digital textbooks allow students to learn content that is tailored to their abilities and interests. They also offer many advantages over paper-based textbooks: they are far less bulky, easier to update, and provide more meaningful learning experiences with multimedia. Using digital textbooks opens more possibilities and challenges in education. However, they quote related evidence from the same project that found that the academic effectiveness of digital textbooks has not been proven (KERIS, 2008).

# 6 Conclusions and Recommendations

## 6.1 Conclusions

The underlying principle that teachers need good quality resources to support them seems uncontroversial. Particularly for primary school teachers who need to teach across the full curriculum, it is unreasonable to expect that they can be expert in every subject. This applies in secondary schools too, where a significant proportion of teachers are required to teach a subject which is not their primary area of expertise. In addition to this, the idea that every teacher in the country develops their own resources independently seems to make little sense. This would lead to huge amounts of duplicated effort, and also to materials of variable quality. Given these basic principles, it seems to make total sense that good quality textbooks, in support of each curriculum area, would be a valuable resource in any school.

Tim Oates' suggestion about the features of high quality textbooks, given in the introduction to this report, also seem to make sense, although there is no documented evidence that these are the main features of textbooks that would lead to high educational outcomes. Some of the features listed are non-controversial statements of fact, such as the need for coherent learning progressions and a clear delineation of content, others are more vague and could be interpreted in different ways, such as underpinned by well-grounded learning theory (yes, they need to have this but there is no single agreed statement of well-grounded learning theory so this could be interpreted in different ways), others may reflect a cultural view of what effective textbooks would look like, such as the stimulation and support of learner reflection. More research is needed to define the list of most crucial features to include in high quality textbooks.

This review has aimed to collect together the evidence from published articles and policy papers that supports the assumptions given here, that use of support materials lead to high outcomes, and that there are some key features that should be included. Clear evidence has been difficult to locate. Fan *et al.* (2013) conducted a comprehensive review of research evidence related to mathematics textbooks, they state that textbooks have served education well in conveying a clearer idea of the curriculum. However they, along with many others, have found limited evidence about the link between textbook use and high educational outcomes. Evidence from PISA 2012 data suggests that the amount of resources spent on education is only weakly related to student performance in the PISA assessments; the numerous high quality meta-analyses conducted by Slavin and his team suggest that the choice of textbook has little impact on outcomes; and Askew *et al.* (2010) concluded that cultural factors have a greater impact on educational outcomes than the various factors that they investigated, including textbook use. In addition to this lack of evidence about the link between textbook use and educational outcomes, as would be expected, there is no evidence about any causal relationship between the two.

This raises the question as to why such a mismatch occurs between what would be expected in terms of the value of good quality materials and the availability of research evidence. One reason for this could be the complexity of the issues that we are seeking to evidence. Conducting the research is not as simple as handing out the textbooks and then measuring the improvements that arise, as Glewwe *et al.* (2009) found when they did just that in rural schools in Kenya.

Classrooms are complex environments, and the interactions that take place in them between teachers, students, textbooks, other resources etc. are difficult to control. A textbook study looking to lead to an improvement in educational outcomes assumes, among many other things:

- That the textbook being researched is a high quality textbook that will support the teacher effectively

- That the teacher understands the pedagogic principles underlying the textbook sufficiently to use the content appropriately
- That the students are at the appropriate level for the textbook, that they are engaged and willing to learn, and that their reading skills are sufficient for them to engage with the text
- That any other resources that the teacher chooses to use to supplement the textbook do not impact on the quality of the learning outcomes.

The lack of evidence may reflect a limited focus on the questions addressed in this review, perhaps because everyone ‘knows’ the underlying principles to be true, and perhaps it reflects underlying methodological difficulties. Although the latter are being addressed more recently by the large increase in the use of randomised control trials in educational research.

The evidence related to features of textbooks that lead to high educational outcomes is also limited. Oates (2010) suggests that one important feature is curriculum coherence. This is an interesting debate. Again, it makes sense that any textbook should have content that is aligned to the desired content as put forward in the curriculum. However, again, this is a complex area. The curriculum as set out in the national curriculum in England is, by its nature, relatively brief. The way in which this is translated into textbook content can take many different forms. This content could be covered in the textbook in a predictable and superficial way, leading to shallow learning, or it could be covered in a varied, pedagogically skilled, and comprehensive way, which could lead to in-depth learning and understanding. Curriculum coherence is therefore not sufficient and too much alignment may lead to other issues as Ofqual (2012) describe.

The research covered in this review suggests some features that may be involved in developing higher order thinking, such as the development of causal understanding in geography (Newton and Newton, 2008) or the inclusion of problems requiring high procedural complexity in mathematics (Vincent and Stacey, 2008). However, we did not find a comprehensive list of what these features might be. It is possible that this evidence exists in studies into effective teaching practices, rather than those considering textbook design. Clearly the overlap between the two areas is extensive, although the links do not appear to have been made in the research covered in this review. As an example of this, Hattie (2009) lists the following as features which reflect effective teaching:

*‘the importance of learning intentions, success criteria, a classroom environment that not only tolerates but welcomes errors, attention to the challenge of the task, the presence of feedback to reduce the gaps, and a sense of satisfaction and further engagement and perseverance to succeed in the tasks of learning.’* (p. 199)

It is clear that these could be translated into design features for a new textbook. It is important to note, that the extensive and high quality reviews conducted by Robert Slavin and his team, consistently suggest that programmes that affect daily teaching practices and student interactions have an impact on educational outcomes more than the choice of textbooks or technologies alone. It is also important to note the additive effects of these different forms of interventions.

Some of the research presented here, such as Vincent and Stacey (2008), does include evidence that the features considered to be effective are included in some existing textbooks. Many of the studies find that there is a range in the quality of the textbooks which are reviewed. It is likely that some good quality textbooks exist in England and internationally, which could be used to support effective teaching. Askew *et al.* (2010) find that cultural factors have a huge impact on educational outcomes, and this is likely to also impact on textbook design and use. Textbook design will inherently reflect the expectations of the culture for which it is developed, either explicitly or implicitly. It will also have been designed for teachers and students who live in that given culture. Findings from PISA suggest that high outcomes often go with low enjoyment in high performing countries. We need to be careful about which elements from other jurisdictions we adopt and at what cost.

Having good textbooks is not sufficient. In many of the articles discussed in this report, the need for expert teachers is raised, and the requirement for training and support in selecting and using the right textbooks effectively. As Weinberg and Wiesner (2011) suggest, the teacher needs to act as a mediator between the textbook content and the student, rather than just letting the text act as an alternative to the teacher. In England, where teachers are free to choose the textbooks that they use, they need to have the necessary understanding of the subject to know which textbooks will effectively develop the higher order skills that are needed. They also need to have the necessary subject expertise to understand what is meant by the different elements of the textbook, and the nature and depth of the understanding it is aiming to develop in the student. Expert teachers will know how to:

- Select the right textbooks
- Use the textbooks effectively
- Supplement the textbook with additional materials as necessary
- Adapt the textbook for their students when required.

In addition to the provision of good quality training for teachers in the use of textbooks, other contributing factors were found to also have an impact. These include:

- Equity in distribution of the resources (OECD, 2014)
- Curriculum stability, to allow time for good quality materials to be developed and implemented (Askew *et al.* 2010)
- Appropriate funding (Tefaye and White 2014), and
- A supportive and engaging classroom environment Guthrie and Klauda (2012).

A final point is that the evidence surrounding the use of eBooks is currently limited (Fan *et al.*, 2013) as might be expected given their recent introduction to classrooms. However, there is some initial evidence of positive benefits. This is supported by evidence about effective teaching again, as Hattie (2009) finds:

*The use of resources, such as adjunct aids and computers, can add value to learning. They add a diversity of teaching strategies, provide alternative opportunities to practice and learn, and increase the nature and amount of feedback to the learners and teachers.’ (p. 236)*

To end, it is worth considering this quote from Askew *et al.* (2010) based on their extensive review of the evidence around mathematics education:

*‘Instead of trying to reconcile contradictions or dissolve them, we believe the research shows that there are many routes to high attainment. You can have an egalitarian education and high standards (Finland), or you can have a selective one and still have high standards (Singapore). You can have a problem solving pedagogy (Japan) or you can have a teacher centred one (Korea) and either can lead to high standards. The choice is about the sort of society and culture that education can help support or develop.’ (p. 14)*

The provision of high quality textbooks could well be an element of any high performing jurisdiction, although how they are designed, how they are selected by teachers, how they are used, and the other resources that are used alongside them are likely to have a significant impact.

## 6.2 Recommendations

It is clear from the articles summarised in this review that the research evidence about textbook use does not answer the key questions about whether their use is linked to high educational outcomes and, if they do provide effective support, what are the features of them which are important. More evidence is also needed

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around the wider context and other factors which would be needed to ensure that, even if we have the best textbooks, they are used to best effect. A large amount of systematic research is required before we have conclusive evidence about textbook design and use, and the links to high educational outcomes.

Firstly, the research evidence about teaching practices and approaches that lead to high educational outcomes needs to be collected together and translated into a design brief for selecting and developing textbooks. It is clear that the research evidence into effective teaching will be useful here, although it is likely that the findings will not all translate directly into textbook development.

Once a list of effective features is agreed then it will be possible to either select existing textbooks that include these features, or to design and develop new textbooks where they do not already exist. As pointed out by Askew *et al.* (2010) sufficient time and curriculum stability is required for this development to be successful.

It may be concluded that additional resources would be beneficial alongside the textbooks, perhaps using new technology, or that e-Books in their own right, would be the most effective way of including these features in a new textbook.

Research needs to be conducted into the key 'contributing factors' that are also required to ensure that the textbooks can be used effectively. These factors then need to be put in place as part of any research study.

Once the resources that meet the agreed criteria are available, and the appropriate supporting contributing factors are put in place, then rigorous research studies, possibly as randomised control trials, should be set up to measure if the textbooks do lead to higher outcomes than 'practice as usual' or other possible resources. The impact of the textbooks should include the impact on outcomes and also other factors such as enjoyment.

In an ideal world, the research would be designed to tease out the impact of different features included in the textbooks, and how each of these contribute to any high outcomes found, as well as the role and relative importance of the different contributing factors, although this would significantly increase the size of the task.

It is clear that the research recommendation here represents a huge task. However, it is necessary so that we have the evidence needed to really resolve the current debate about textbook use in England.

# Appendix 1: Search Strategy

The full search strategy was as follows:

## Bibliographic databases

The search strategy for each database reflects the differences in database structure and vocabulary. Throughout, the abbreviation 'ft' denotes that a free-text search term was used and the symbol \* denotes truncation.

### **Australian Education Index (searched via Proquest 23/07/15) – 777 hits**

- #1 Curriculum material evaluation
- #2 Curriculum materials
- #3 Instructional materials (ft)
- #4 Textbook content
- #5 Textbook evaluation
- #6 Textbook preparation
- #7 Textbook publication
- #8 Textbook research
- #9 Textbook selection
- #10 Textbook standards
- #11 Textbooks
- #12 Workbooks
- #13 #1 or #2 or #3...#12
- #14 Academic achievement
- #15 Achievement gap (ft)
- #16 Academic standards
- #17 Curriculum
- #18 Educational attainment
- #19 Educational effectiveness (ft)
- #20 Educational outcomes (ft)
- #21 Educational performance (ft)
- #22 Effective (ft)
- #23 High performing (ft)
- #24 Impact (ft)
- #25 Outcomes of education
- #26 Pedagog\* (ft)
- #27 Progress (ft)
- #28 School effectiveness
- #29 Standards (ft)
- #30 Success\* (ft)
- #31 Teacher effectiveness
- #32 Teaching effectiveness
- #33 Teaching process
- #34 #14 or #15 or #16...#33

#35 #13 and #34  
#36 Textbook evaluation  
#37 #35 or #36

**British Education Index (searched via EBSCO Host 28/07/15) – 287 hits**

#1 Curriculum resources (ft)  
#2 Instructional materials (ft)  
#3 Teaching aids and devices  
#4 Textbook editing  
#5 Textbook publishing  
#6 Textbook selection  
#7 Textbook standards (ft)  
#8 Textbooks  
#9 Textbooks - evaluation  
#10 Textbooks - research  
#11 #1 or #2 or #3...#10  
#12 Academic achievement  
#13 Achievement gains (Education)  
#14 Achievement gap  
#15 Curriculum alignment  
#16 Educational attainment  
#17 Educational outcomes  
#18 Educational performance (ft)  
#19 Educational standards  
#20 Effective (ft)  
#21 Effective teaching  
#22 High performing (ft)  
#23 Impact (ft)  
#24 Pedagog\*  
#25 Program effectiveness (Education)  
#26 Progress (ft)  
#27 Standards (ft)  
#28 Success\* (ft)  
#29 Teacher effectiveness  
#30 #12 or #13 or #14...#29  
#31 #11 and #30  
#32 Textbook evaluation  
#33 #31 or #32

**ERIC (searched via EBSCO Host 20/07/15) – 2444 hits**

#1 Curriculum resources (ft)  
#2 Instructional materials  
#3 Textbooks

#4 Textbook content  
#5 Textbook evaluation  
#6 Textbook preparation  
#7 Textbook publication  
#8 Textbook research  
#9 Textbook selection  
#10 Textbook standards  
#11 Workbooks  
#12 #1 or #2 or #3 ... #11  
#13 Academic achievement  
#14 Academic standards  
#15 Achievement gap  
#16 Curriculum  
#17 Educational attainment  
#18 Educational effectiveness  
#19 Educational outcomes (ft)  
#20 Effective(ft)  
#21 High performing (ft)  
#22 Impact (ft)  
#23 Instructional effectiveness  
#24 Pedagog\* (ft)  
#25 Progress  
#26 Standards  
#27 Success\* (ft)  
#28 #13 or #14 or #15 ... #27  
#29 #12 and #28  
#30 Textbook evaluation  
#31 #29 or #30

#### **IDOX (searched 22/07/15)**

#1 Textbooks (ft)  
#2 Curriculum resources (ft)

#### Journal 'hand searches'

We 'hand searched', i.e. the tables of contents were scanned for relevant material, volumes of the following journals published between 2005 and 2015:

- Curriculum Journal
- Journal of Curriculum Studies.

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## Website searches

We also reviewed the publications/research/policy sections of the following websites:

### **UK**

Cambridge Assessment; Centre for Evaluation and Monitoring (CEM); Institute of Education; National Literacy Trust; NFER; Nuffield Foundation; Pearson; Sutton Trust; Teaching and Learning Research Programme (TLRP); University of Durham (School of Education); University of Southampton (School of Education).

### **International**

Australian Council for Educational Research (ACER); Education GPS (OECD); Eurydice (European Commission); OECD (Education); International Association for the Evaluation of Educational Achievement (IEA); International Association for Research on Textbooks and Education Media; McKinsey & Co; National Educational Research Center (Institute of Education Sciences, US Education Department); What Works Clearing House (Institute of Education Sciences, US Education Department).

## 7 Appendix 2: References

- Askew, M., Hodgen, J., Hossain, S. and Bretscher, N. (2010). *Values and Variables: Mathematics Education in High Performing Countries*. London: Nuffield Foundation [online]. Available: [http://www.nuffieldfoundation.org/sites/default/files/Values and Variables Nuffield Foundation v\\_web\\_FINAL.pdf](http://www.nuffieldfoundation.org/sites/default/files/Values_and_Variables_Nuffield_Foundation_v_web_FINAL.pdf) 15 August, 2015].
- Charalambos, Y.C., Delaney, S., Hsu, H. and Mesa, V. (2010). 'A comparative analysis of the addition and subtraction of fractions in textbooks from three countries', *Mathematical Thinking and Learning*, **12**, 2, 117–151.
- Fan, L., Zhu, Y. and Miao, Z. (2013). 'Textbook research in mathematics education: development status and directions', *Mathematics Education*, **45**, 5, 633–646.
- Felvégi, E. and Matthew, K.I. (2012). 'e-books and literacy in K-12 schools', *Computers in the Schools*, **29**, 1/2, 40–52.
- Gibb, N. (2014). 'School Reform Minister Nick Gibb outlines how high-quality textbooks can benefit teachers, students and parents'. Speech at The Publishers Association and the British Educational Suppliers Association Conference, London, 20 November [online]. Available: <https://www.gov.uk/government/speeches/nick-gibb-speaks-to-education-publishers-about-quality-textbooks> 17 August, 2015]
- Glewwe, P., Kremer, M. and Moulin, S. (2009). 'Many children left behind? Textbooks and test scores in Kenya,' *American Economic Journal: Applied Economics*, **1**, 1, 112–135.
- Grubb, W.N. (2008). 'Multiple resources, multiple outcomes: testing the 'improved' school finance with NELS88', *American Educational Research Journal*, **45**, 1, 104–144.
- Guthrie, J.T. and Klauda, S.L. (2012). 'Making textbook reading meaningful', *Reading: The Core Skill*, **69**, 6, 64–68 [online]. Available: <http://www.allthingsliteracy.com/files/TextbookReading.pdf> [24 August, 2015].
- Haggarty, L., and Pepin, B. (2001). 'Mathematics textbooks and their use in English, French and German classrooms: a way to understand teaching and learning cultures', *Zentralblatt für Didaktik der Mathematik: International Reviews on Mathematical Education*, **33**, 5, 158–175. Cited in: Askew, M., Hodgen, J., Hossain, S. and Bretscher, N. (2010). *Values and Variables: Mathematics Education in High Performing Countries*. London: Nuffield Foundation [online]. Available: [http://www.nuffieldfoundation.org/sites/default/files/Values and Variables Nuffield Foundation v\\_web\\_FINAL.pdf](http://www.nuffieldfoundation.org/sites/default/files/Values_and_Variables_Nuffield_Foundation_v_web_FINAL.pdf) 15 August, 2015].
- Hattie, J. (2009). *Visible Learning: a Synthesis of Over 800 Meta-analyses Relating to Achievement*. New York, NY: Routledge.
- Herold, B. and Molna, M. (2014). 'Research questions common core claims by publishers', *Education Week*, 3 March [online]. Available: [http://www.edweek.org/ew/articles/2014/03/05/23textbooks\\_ep.h33.html](http://www.edweek.org/ew/articles/2014/03/05/23textbooks_ep.h33.html). Cited in: Leifer, R. and Udall, D. (2014). 'Support the common core with the right instructional materials', *Phi Delta Kappan*, **96**, 1, 21–24.
- Hiebert, J., Gallimore, R., Garnier, H., Givvin, K.B., Hollingsworth, H., Jacobs, J.K., Miu-Ying Chui, A., Wearne, D., Smith, M., Kersting, N., Manaster, A., Tseng, E., Etterbeek, W., Manaster, C., Gonzales, P. and Stigle, J. (2003). *Teaching Mathematics in Seven Countries: Results from the TIMSS 1999 Video Study* (NCES 2003-013 Revised). Washington, DC: U.S. Department of Education, National Center for Education Statistics. Cited in: Charalambos, Y.C., Delaney, S., Hsu, H. and Mesa, V. (2010). 'A comparative analysis of the addition and

subtraction of fractions in textbooks from three countries', *Mathematical Thinking and Learning*, **12**, 2, 117–151.

Hodgen, J., Monaghan, J., Shen, F. and Staneff, T. (2014). 'Shanghai mathematics exchange - views, plans and discussion.' In: Adams, G. (Ed) *Proceedings of the British Society for Research into Learning Mathematics*, **34**, 3, November [online]. Available: <http://www.bsrlm.org.uk/IPs/ip34-3/BSRLM-IP-34-3-04.pdf> [24 August, 2015].

Hughes-Hallett, D., McCallum, W. G., Gleason, A. M., Osgood, B. G., Flath, D. E., Quinney, D., et al. (2009). *Calculus: Single variable* (5th ed.). Hoboken: Wiley. (cited in Weinberg and Wiesner, 2011)

Jerrim, J., Austerberry, H., Crisan, C., Ingold, A., Morgan, C., Pratt, D., Smith, C. and Wiggins, M. (2015). *Mathematics Mastery: Secondary Evaluation Report*. London: Education Endowment Foundation [online]. Available: [https://educationendowmentfoundation.org.uk/uploads/pdf/Mathematics\\_Mastery\\_Secondary\\_\(Final\)1.pdf](https://educationendowmentfoundation.org.uk/uploads/pdf/Mathematics_Mastery_Secondary_(Final)1.pdf) 15 August, 2015].

Kablan, Z., Topan, B. and Erkan, B. (2013). 'The effectiveness level of material use in classroom instruction: a meta-analysis study', *Educational Sciences: Theory and Practice*, **13**, 3, 1638–1644.

Kim, J. H. and Jung, H. (2010). 'South Korean digital textbook project', *Computers in the Schools*, **27**, 3–4, 247–265.

Leifer, R. and Udall, D. (2014). 'Support the common core with the right instructional materials', *Phi Delta Kappan*, **96**, 1, 21–24.

Macintyre, T. and Hamilton, S. (2010). 'Mathematics learners and mathematics textbooks: a question of identity? Whose curriculum? Whose mathematics?' *Curriculum Journal*, **21**, 1, 3–23.

Newton, L. and Newton, D. (2008). 'To what extent can children's geography books help a primary school teacher explain cause and purpose?' *International Research in Geographical and Environmental Education*, **15**, 1, 29–40.

Oates, T. (2010). *Could do Better: Using International Comparisons to Refine the National Curriculum in England*. Cambridge: Cambridge Assessment [online]. Available: <http://www.cambridgeassessment.org.uk/Images/112281-could-do-better-using-international-comparisons-to-refine-the-national-curriculum-in-england.pdf> [10 August, 2015].

Oates, T. (2014). *Why Textbooks Count: a Policy Paper*. Cambridge: Cambridge Assessment [online]. Available: <http://www.cambridgeassessment.org.uk/images/181744-why-textbooks-count-tim-oates.pdf> 10 August, 2015].

OECD (2014). 'How is equity in resource allocation related to student performance?' *PISA in Focus 44*, October [online]. Available: [http://www.oecd.org/pisa/pisaproducts/pisainfocus/pisa-in-focus-n44-\(eng\)-final.pdf](http://www.oecd.org/pisa/pisaproducts/pisainfocus/pisa-in-focus-n44-(eng)-final.pdf) [24 August, 2015].

Ofqual (2012). *Textbooks: Risks and Opportunities*. Coventry: Ofqual [online]. Available: <http://dera.ioe.ac.uk/15933/1/2012-11-07-textbooks-risks-and-opportunities-action-plan.pdf> 10 August, 2015].

Repoussi, M., & Tutiaux-Guillon, N. (2010). New trends in history textbook research: Issues and methodologies toward a school historiography. *Journal of Educational Media, Memory and Society*, Vol. 2, No. 1, 154-170. (cited in Wilkens, 2011)

Rymarz, R. and Engebretson, K. (2005). 'Putting textbooks to work', . *British Journal of Religious Education*, **27**, 53–63.

Schmidt, W.S. and Cogan, L.S. (2009). 'The myth of equal content', *Educational Leadership*, **67**, 3, 44–47.  
Cited in: Leifer, R. and Udall, D. (2014). 'Support the common core with the right instructional materials', *Phi Delta Kappan*, **96**, 1, 21–24.

Slavin, R.E., Lake, C. and Groff, C. (2008). 'Effective programs in middle and high school mathematics: a best-evidence synthesis', *Best Evidence Encyclopedia (BEE)*, August [online]. Available: [http://www.bestevidence.org/word/mhs\\_math\\_Sep\\_8\\_2008.pdf](http://www.bestevidence.org/word/mhs_math_Sep_8_2008.pdf) [24 August, 2015].

Slavin, R.E. and Lake, C. (2009). *Effective Educational Programs: Meta-Findings from the Best Evidence Encyclopedia*. Evanston, IL: Society for Research on Educational Effectiveness [online]. Available: <http://files.eric.ed.gov/fulltext/ED524709.pdf> [24 August, 2015].

Slavin, R.E., Lake, C., Cheung, A. and Davis, S. (2009). 'Beyond the basics: effective reading programs for the upper elementary grades', *Best Evidence Encyclopedia (BEE)*, September [online]. Available: [http://www.bestevidence.org.uk/assets/primary\\_read\\_dec\\_09.pdf](http://www.bestevidence.org.uk/assets/primary_read_dec_09.pdf) [24 August, 2015].

Tesfaye, C.L. and White, S. (2014). 'High school physics textbooks, resources and teacher resourcefulness: results from the 2012-13 nationwide survey of high school physics teachers', *Focus On*, July [online]. Available: <https://www.aip.org/statistics/reports/high-school-physics-textbooks-resources-and-teacher-resourcefulness> [24 August, 2015].

Uyn, K. N. (2007). *The effects of digital textbooks in U-learning environments*. Unpublished. (cited in Kim and Jung, 2010)

master's thesis. Dong-Kuk University, Seoul, South Korea. Vignoles, A., Jerrim, J. and Cowan, R. (2015). *Mathematics Mastery: Primary Evaluation Report*. London: Education Endowment Foundation [online]. Available: [https://educationendowmentfoundation.org.uk/uploads/pdf/Mathematics\\_Mastery\\_Primary\\_\(Final\)1.pdf](https://educationendowmentfoundation.org.uk/uploads/pdf/Mathematics_Mastery_Primary_(Final)1.pdf) [15 August, 2015].

Vincent, J. and Stacey, K. (2008). 'Do mathematics textbooks cultivate shallow teaching? Applying the TIMSS Video study criteria to Australian Eight-grade mathematics textbooks', *Mathematics Education Research Journal*, **20**, 1, 82–107.

Weinberg, A. and Wiesner, E. (2011). 'Understanding mathematics textbooks through reader-oriented theory', *Educational Studies in Mathematics*, **76**, 1, 49–63.

Wilkens, H.J. (2011). 'Textbook approval systems and the Program for International Assessment (PISA) results: a preliminary analysis', *IARTEM e-Journal*, **4**, 2, 63–74.

## 8 Appendix 3: About AlphaPlus

[www.alphaplusconsultancy.co.uk](http://www.alphaplusconsultancy.co.uk)

AlphaPlus are a team of 'educational' researchers, working on studies *for* education rather than purely studies *of* education. We undertake a range of education research and evaluation studies across all education phases. Our work varies from research for government departments to inform policy, to work helping clients understand the impact of interventions (such as programmes to improve teaching and learning), to reviews of specialist literature.

AlphaPlus has a core team of seven directors, plus in house statistical and project support. We can draw upon a team of over 200 associates, each of whom brings many years' experience in education, covering both schools and post compulsory education, as well as roles in many of the supporting agencies and government departments. We are actively engaged with the latest educational developments, on both a strategic level, through our research and evaluation projects for UK government, and at a practical level, through the experience of our associates in all aspects of educational development and change.

Clients include DfE, BIS, Ofqual, NFER, The Welsh Government, The Institute of Physics, Pearson, City & Guilds, NCFE, SQA, Saudi Skills Standards, and The Chartered Institute of Taxation.