Institutionalising the Re-sourcing of Mathematics Teaching: The Case of the English School System

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The idea of re-sourcing teaching

- Is rooted in critique of standard classroom materials for system-wide use
- Advocates more devolved creation, diffusion and adaptation of resources:
  - to diversify sources in play in subject teaching and learning
  - to match resources to local working contexts and educational values
- Suggests that localised design efforts have important beneficial effects:
  - in generating resources better tailored to specific school contexts
  - in deepening teacher understanding of the basis for their effective use
- Has a long history in some educational systems, often organised around local or national professional networks

The idea of re-sourcing teaching is rooted in various lines of critique of standard classroom materials designed for system-wide dissemination, particularly in educational systems where school contexts are highly differentiated and educational values contested. The idea of re-sourcing advocates a more devolved approach to the creation, diffusion and adaptation of resources; it seeks to bring a more diverse range of sources for subject teaching and learning into play, and to involve teachers themselves in matching these to local working contexts and educational values. The re-sourcing movement suggests that more localised design efforts have important beneficial effects, in generating resources better tailored to specific school contexts, and in deepening teacher understanding of the basis for their effective use. Indeed, some educational systems have a long history of re-sourcing activity often organised around local or national professional networks.
The case for standard programmatic materials

- The best educational programs of this type:
  - are informed both by research insights and professional wisdom
  - have been refined through extensive trialling and feedback from users
  - provide a coherent system of high-quality pedagogical resources
  - include guidance designed to make them “educative” for teachers
- Historically, such programs have been an important vehicle for:
  - renewing the school curriculum
  - developing the knowledge of teachers
  - improving the quality of teaching and learning
- A shift from the diffusion of standard programs towards more localised re-sourcing raises important questions:
  - about quality and coherence
  - about viability and economy

Nevertheless, it is worth recalling that the best educational programs are informed both by research insights and professional wisdom; they have been refined through extensive trialling and feedback from users; they provide a coherent system of high-quality pedagogical resources; and they include guidance designed to make them “educative” for teachers (Davis & Krajcik 2005). Historically, standard programmatic materials have been an important vehicle for renewing the school curriculum, developing the knowledge of teachers, and improving the quality of teaching and learning. Of course, not all educational programs achieve such high quality, and the weaknesses of some widely used programs have attracted particular opprobrium. Nevertheless, a shift from the diffusion of standard programs towards more localised re-sourcing by teachers themselves raises the same important questions about quality and coherence, about viability and economy.
The tradition of schools developing their own “scheme of work” in mathematics is a longstanding—even if minority—one in England. The official guidance accompanying the introduction of a national curriculum in mathematics (1989), followed by a national framework for mathematics teaching (1998 to 2001), encouraged, then mandated, all schools to develop such a scheme. While such schemes can make reference to conventional curriculum materials, the expectation is that the use of such materials will be locally customised and complemented by a more diverse range of resources. This paper examines how this institutionalised expectation has unfolded in practice, focusing on secondary schools. The main evidence used is drawn from international and national studies produced by various official bodies and commissioned research teams.

This paper examines how this institutionalised expectation has unfolded in practice, focusing on secondary schools. The main evidence used is drawn from international and national studies produced by various official bodies and commissioned research teams.
Evidence from the most recent TIMSS study shows why the English case is an unusual and interesting one; I will compare the use of resources in England with the other educational systems participating in TIMSS, and particularly with 5 which are English-speaking and/or have close cultural ties: Australia, Hong Kong, New Zealand, Singapore, the United States. The TIMSS 1995 report does not provide particularly fine-grained evidence about use of resources, perhaps because of an assumption of the primacy of the textbook. The finding that 100% of English teachers of mathematics reported using a textbook in teaching their Grade 8 class (Beaton et al. 1996, Figure 5.4) places England firmly amongst those systems that appear to conform to that assumption. However, by TIMSS 2011, the information available is more fine-grained, and England has moved from an apparently conventional position to become an extreme amongst the 42 systems surveyed: highest in the reported avoidance of any textbook use; second lowest in the use of textbooks as a basic resource; and highest in the use of software as a basic resource (Mullis et al. 2012, Exhibit 8.26).
This graph shows, in gross terms, how textbook use in England compares with the 5 reference systems. The starkest difference is with Hong Kong where the textbook retains its traditional role as a basic curricular resource. The closest similarity is to New Zealand and the United States where there are also appreciable proportions of teachers reporting no use of textbooks, and only a minority reporting the textbook as a basic resource. Australia and Singapore emerge as intermediate systems in this group.
This graph shows similar information about use of “computer software”, a term which one imagines is interpreted by many teacher respondents as covering a wide range of types of digital material. In terms of an appreciable proportion of teachers reporting use of digital material as a basic resource, the United States and New Zealand are again the more proximal systems to England, Singapore and Australia again intermediate, and Hong Kong the most different system with its very low incidence of use of digital material as a basic resource. In terms of the proportion of teachers making no use of digital resources, however, New Zealand and the United States are the most different from England, with substantial fractions of teachers reporting no such use.

Perhaps most important, however, if we combine the proportions of teachers reporting either textbook or digital materials as being a basic resource for their teaching, this comes to at most 50% in England, similar to New Zealand, but well below the other comparators, most notably Hong Kong.
Recent reports indicate the main ways in which digital resources are being used in mathematics teaching in English schools. An OfStEd (2008) state-of-the-system review of mathematics teaching based on school inspections indicates that, by 2008, it had become the norm for classrooms to be equipped either with an interactive whiteboard or with a data projector to which a classroom or teacher computer is attached. The most commonly used types of further resource are PowerPoint presentations (either locally prepared or purchased commercially) and banks of online materials (many adapted from conventional textbook exercises or worksheets but some more dynamic and interactive). Teachers in a survey of mathematics teaching in London secondary schools (Bretscher 2011) rated PowerPoint and MyMaths as their most frequently used resources. They reported using PowerPoint somewhere between “once per month” and “every week” on average (on a scale with the next point being “most lessons”), and MyMaths around “once per month” on average.
Use of textbooks in mathematics lessons

- Over the last 20 years, the intensification of high-stakes assessment and evaluation has shaped the style of textbook use in English schools.
- Widely used English textbooks tend to present mathematics as a set of unrelated rules and facts; they serve mainly to provide exercises for repeated practice of routine skills by pupils (Haggarty & Pepin 2002).
- Such textbooks make few demands on pupils for deeper thinking; this is compounded by the advice given in teacher’s guides where little account is taken of research on students’ learning (Hodgen et al. 2010).
- Such use of currently popular textbooks has led many of their critics to a general depreciation of the role of mathematics textbooks and programs in favour of a re-sourcing approach.

Over the last 20 years, the intensification of high-stakes assessment and evaluation has shaped the style of textbook widely used in English schools. One study compared the use of mathematics textbooks in English, French and German schools: it reported that the textbooks in widespread use in England tend to present mathematics as a set of unrelated rules and facts; they serve mainly to provide exercises for repeated practice of routine skills by pupils (Haggarty & Pepin 2002). Another study compared the mathematics textbook series most widely used in the 1970s and in the 2000s: it found that the current textbook made few demands on pupils for deeper thinking; and that this was compounded by the advice given in the teacher’s guide where little account was taken of research on students’ learning of mathematics (Hodgen et al. 2010). Similar observations are reported by OfStEd (2008) as common in school inspections. Such use of currently popular textbooks has led many of their critics to a general depreciation of the role of mathematics programs in favour of a re-sourcing approach.
The development by each school of its own local scheme of work for mathematics was, in effect, mandated in the guidance on planning associated with the *Framework for Mathematics* (DfEE 2001), part of a system-wide strategy for educational improvement introduced to English secondary schools from 2001. The *Framework* provides long-term plans setting out the mathematical objectives to be taught over the course of each year. The responsibility of the school is to develop medium-term plans which specify how teaching towards these objectives will be organised in the school over the course of the year, and short-term or lesson plans providing a framework of teaching units directed towards these objectives. Typically, too, in a spirit of re-sourcing, the scheme of work identifies a range of relevant resources to support each teaching unit.

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**Official guidance on planning a scheme of work**

- **Long-term plans**
  - The *Framework* provides sets of objectives of what to teach over the course of each year, based on the National Curriculum programmes

- **Medium-term plans**
  - These name the units of work or main topics that pupils will be taught, specifying the number of hours or lessons and the objectives to be addressed, adjusted as appropriate for higher and lower attainers

- **Short-term or lesson plans**
  - These consist of teaching notes for a block of lessons which show how a unit of work will unfold to meet the intended objectives
  - They outline starter activities, how work will be developed in the main part of lessons through teaching input and pupil activities, how lessons will be rounded off, and what homework will be set
  - They may include references to relevant resources, such as textbooks and ICT applications
This slide shows the first page of the first year secondary scheme of work for the topic of probability in a school with a professionally highly regarded mathematics department. This scheme organises teaching of the topic in four tiers directed at students of different levels of attainment on entry to the school. The large table to the left of the page breaks the teaching sequence down in a way which shows exactly which of the officially specified learning objectives are to be covered by each tier, and identifies suitable textbook material as a primary resource to support each tier. The smaller tables to the right of the page presents key information about official assessment criteria and the specialist vocabulary specified in official curriculum documents.
This slide shows the second page of this same part of the scheme of work. Each box on the page relates to a key component of the school’s local pedagogical approach. Together these provide a framework for building these components into appropriate lessons within the teaching sequence, identifying a more diverse repertoire of further resources suited to supporting each component, some compulsory for use with all classes, others optional.
For purposes of comparison, this slide shows a more typical extract from a school scheme of work, organised in the form of a skeleton lesson plan, in terms of Starter, Core and Extension phases. The leftmost column provides a reference to the relevant part of the official curriculum specification; the central column contains a selection of appropriate activities for use in the lesson; the rightmost column provides references/links to relevant resources of a range of types and in various media.

Schemes of work, then, provide an illuminating window to assess the quality of the re-sourcing activity in schools.
General trends in quality of school schemes of work for mathematics according to the national inspectorate

- Some schools do display many of the qualities attributed to re-sourcing through localised schemes of work:
  - “The best schemes of work included guidance on approaches, interesting activities and resources that help nurture pupils’ understanding. They were seen as living documents, subject to regular discussion and review, which helped staff to develop their expertise.” (OfStEd 2008)
- However, such schools are the exception rather than the rule:
  - “Good schemes of work were rare in secondary schools. It was not uncommon for teachers to use only examination specifications and textbooks to guide their lesson planning, focusing on content rather than pedagogy.” (OfStEd 2008)
  - “Schemes of work were rarely adapted to the particular circumstances of the school and its pupils. They were often simply the schemes provided by awarding bodies or in conjunction with textbooks. Other schemes of work were little more than a list of topics.” (OfStEd 2012)

The state-of-the-system reviews produced by the schools inspectorate on the basis of their regular visits to schools around the country can provide a useful overview. However, it is important to remember that these documents serve a political function, talking up forms of practice that the contemporary inspectorate considered recommendable, and criticising those viewed as inadequate. Such reviews indicate that some schools do display many of the qualities attributed to re-sourcing through localised schemes of work. Equally, however, they reveal that such schools are the exception rather than the rule; the schemes of work in many schools are impoverished, falling well short of most of the aspirations associated with re-sourcing.
Common weaknesses in school schemes of work for mathematics according to the national inspectorate

- Lack of consistency in topic approach and coverage:
  - "lack of agreement among teachers in the same school or guidance in the schemes of work about the preferred ways of tackling particular topics, or the depth of treatment expected for different groups"

- Lack of coherent development of mathematical ideas:
  - "little clarity about how concepts were to be introduced and linked to ensure the development of understanding"

- Lack of attention to differentiation by attainment level
  - "common schemes of work being provided for entire year groups, with no guidance to teachers about what was expected in each set"

- Lack of attention to mathematical processes/practices
  - "few opportunities for pupils to develop their skills in using and applying mathematics or, where using and applying activities were included in the scheme, no guidance on how pupils should develop skills progressively over time" (OfStEd 2012)

The later review goes into greater detail about what the inspectorate perceives as common weaknesses of school schemes of work in mathematics. While one could debate each of these criteria, what is perhaps most notable is that they all relate to essentially programmatic weaknesses concerned with the functioning of resources as a coherent system providing appropriate consistency across the curriculum and over its duration, and doing so equitably for all students regardless of class or teacher or movement between these. This brings us back to a fundamental challenge that resourcing materials of varied type and provenance presents: that of constructing a coherent system of resources (rather than an eclectic collection) capable of supporting teaching and learning over the longer term and across the subject as a whole.
Factors impeding development of schemes of work

- **Need not perceived**
  - “When the schools had a stable and experienced staff, they frequently did not see the need to formalise guidance, though they had the capacity to do so.” (OfStEd 2012)

- **Lack of capacity**
  - “Schools with many inexperienced, non-specialist and/or temporary teachers, which would most benefit from guidance, lacked the capacity to prepare it” (OfStEd 2012)

- **Intensification of workload**
  - “[Creating] schemes of work continued to be problematic... for mathematics departments, with high degrees of resentment apparent in teachers’ statements on the time spent in finding appropriate resources to match objectives” (Barnes et al. 2003)

- **Absence of consensus**
  - Respect for professional autonomy leads teachers with differing pedagogical orientations to “agree to disagree”, setting only a skeleton scheme of work that ensures little more than common pace and coverage.

A number of factors have been identified as impeding the development of school schemes of work. The school inspectorate reports that, on the one hand, well staffed schools may not see any need for such a document, while, on the other, schools with staffing difficulties and weaknesses often lack the capacity to produce one. A study of teacher responses to the introduction of the Framework also reported that these reforms constituted just one of a number of overlapping professional changes that teachers experienced as intensifying their workload (Barnes et al. 2003). Finally, in my experience of working with schools, many mathematics departments are dependent on contributions from peripheral members whose major professional commitment is elsewhere, often working from very different pedagogical orientations. Under such circumstances, the line of least resistance is often one of “live and let live”; absence of consensus accompanied by respect for autonomy leads teachers to “agree to disagree”, setting only on a skeleton scheme of work that ensures little more than common pace and coverage.
Indeed, aspirations to professional autonomy and reasonable workload emerge as two particularly important factors influencing teachers’ job satisfaction. A recent national survey of the mathematics teaching workforce indicates that whereas teachers tend to be relatively contented with their “freedom to teach in the way you choose”, they tend to be much more discontented with “the hours you spend working” (Moore et al. 2006, Table 5.3). Opinions are more evenly divided on “managing your workload” and “resources allocated to the mathematics department”. This sense of “freedom to teach in the way you choose” alongside satisfaction with “managing your workload” and “the hours you spend working” were found to be amongst the strongest correlates of teachers’ reports of overall satisfaction with their work and likelihood of remaining in teaching (Moore et al. 2006, Table 5.4).

The shift to mandating the production of school schemes of work for mathematics, particularly when associated with an emphasis on re-sourcing such schemes from varied sources and continuously updating them, risks undermining two of the pivotal factors that underpin the job satisfaction of teachers and retain them in the profession: freedom to teach in their preferred way and the manageability of their workload. Indeed, these are linked further by considerations of locus of control: the more that such development work takes place under external constraint the more it is liable to be experienced negatively in terms both of professional freedom and workload intensity.
Building more robust approaches to re-sourcing

- The example of seeking to institutionalise a re-sourcing approach in the English school system shows:
  - relative success in a minority of schools, typically those working in favourable circumstances of stable staffing, departmental collegiality, and substantial consensus around pedagogical orientation
  - relative failure in a majority of schools, in the face of a range of inhibiting factors and fundamental weaknesses in organisational capacity to surmount them
- Even in relatively successful schools, re-sourcing was commonly associated with weaknesses in programmatic coherence
- For re-sourcing to become a credible system-wide approach, ways need to be found to address these key weaknesses and inhibiting factors

The example of the movement to institutionalise a re-sourcing approach in the English school system shows relative success in a minority of schools, typically those working in favourable circumstances of stable staffing, departmental collegiality, and substantial consensus around pedagogical orientation. Against that must be set the relative failure of a re-sourcing approach in a majority of schools, in the face of a range of inhibiting factors and fundamental weaknesses in organisational capacity to surmount them. Moreover, even in relatively successful schools, re-sourcing was commonly associated with a range of weaknesses in programmatic coherence.

By way of conclusion, then, I suggest that, for re-sourcing to become a credible system-wide approach, effective ways need to be found to address these key weaknesses and inhibiting factors.
References