BUILDING THE EVIDENCE BASE

STRAND 3

CHALLENGE REVIEW REPORT

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Contents

Executive summary

How much do we understand about how teachers construct the idea of 'challenging' young people in curriculum terms?

The starting point for this review was the 2008 survey finding that revealed that a significant minority of students did not feel 'challenged' by their curriculum experiences. The review is based on 43 studies, which described curriculum interventions that encompassed the following definition of challenge:

Irrespective of ability, challenging young people in curriculum terms means designing teaching and learning to elicit from students their best efforts (i.e. challenge needs to be motivating) and to enable them to think and act in ways that are transferable and/or discipline-specific; and which are progressively more complex, critical, creative and independent.

We found that constructing challenge related to both curriculum design and to its enactment in the classroom. Constructing challenge was geared to not only raising attainment or achievement, but also to engaging students at risk of disengagement, such as underachieving gifted and talented students, black minority ethnic (BME) students and low achievers. While teachers deployed varied curriculum tasks and resources, curriculum enactments largely involved students in developing critical thinking through collaborative inquiry and problem solving, with guided interaction between them.

Teachers had to make many judgements when constructing curriculum challenge, including:

- diagnosing students' starting points in terms of existing knowledge and skills in order to plan for building on these
- judging when to step back and be more of a facilitator
- creating a balance between support and challenge through offering a mix of easier tasks that ensured success and opportunities for pushing students beyond their comfort zones, where they risked failure.

The impact of the various individual interventions reported by the studies included students:

- showing greater interest in their work
- gaining higher grades

- developing a broad range of learning skills, including coordination and project work.

In addition, the studies specifically involving collaborative group work noted changes in students' views of learning from being a process of receiving knowledge to one that is largely investigative and this change was linked to improvements in their work. Students' perceptions of mathematics in particular changed noticeably – from viewing the subject as 'boring' to one that 'makes you think'.

We concluded that the principles of constructing challenge are similar for all students, whatever their achievement levels. They involve constructing challenge, in the sense of designing curriculum tasks, materials and resources, and the enactment of the curriculum in the classroom, often through collaborative inquiry processes. Our findings suggest the value of research and development programmes that support teachers in moving towards facilitative roles and help them to structure group work and collaborative problem solving as well as to develop tools such as targeted curriculum materials, tasks and activities.

Introduction

A key element within the 'Building the evidence base for a curriculum for the 21st century' project is to mine the existing public knowledge base by means of a series of research reviews.

Our first foray into harnessing evidence relevant to the QCDA's comprehensive curriculum framework in 2008 took the form of a 'map' of existing reviews of research.[1] This was followed by an in-depth exploration of the individual review studies relative to the six key findings from the map.[2] These findings related to evidence for the effectiveness of curriculum design[3] and its enactment in the classroom that included the six key features:planning for learning that is 'context based'

planning activities that connect the curriculum with young people's experiences of home and community

realising the curriculum through structured dialogue in group work and collaborative learning

planning to build on students' existing understandings

securing flexibility across different areas of the curriculum in order that learners deepen understanding by connecting ideas

building such opportunities through teachers' excellence and professional development in subject knowledge.

These six key findings have been built into the year 2 research work and were also used to test and build the evidence for the QCA's key curriculum claims. Alongside this review, The Centre for the Use of Research and Evidence in Education (CUREE) undertook a large-scale survey of student views of the implementation of the

[1] Bell. M., Cordingley, P., Gibbons, S. & Hawkins, M. *Map of Research Reviews QCA Building The Evidence Base Project: September 2007–March 2011.* (CUREE 2008)

[2] Bell, M., Cordingley, P. & Goodchild, L. *Review of individual studies from systematic research reviews: February 2008–August 2008.* (CUREE 2008)

[3] QCDA defines the curriculum as 'the entire planned learning experience of a young person'. We have found it helpful, when unpacking teacher construction of challenge in the curriculum, to distinguish between what we have called curriculum *design* (deciding on content, developing resources, materials and plans) and the *enactment* of the curriculum in the classroom where these carefully designed plans, tasks and activities were deployed in a variety of teaching and learning processes.

curriculum. A key finding from this survey, which related closely to the review findings 4 and 5, was that a significant minority of students did not feel challenged by their curriculum experiences. The decision was therefore taken to undertake a research review to explore what is known about how teachers construct challenge in the curriculum.

Specifically, the overarching question for the review was:
How much do we understand about how teachers construct the idea of 'challenging' young people in curriculum terms?

To help scaffold the analytic framework for the review, CUREE and the QCDA developed two sub-questions:

- What are the key judgements teachers make that affect the level of challenge within their curriculum offers?
- What do teachers see as the most challenging learning terrain and learning processes?

The report is organised in six stages. They comprise:

1. a description of the review process and the definition of challenge
2. a description of the nature of the studies in the review
3. an overview of the review findings on teachers' construction of challenge in the curriculum
4. a report on the nature of student impact
5. an illustrative study[4]
6. discussion and conclusions.

1 Summary of the review process

Stage 1

Because the review question directly addressed the exploration of teachers' perceptions and actions, and hence their understandings of what constitutes 'challenge', we did not start out with a predetermined, imposed, theoretical or

[4] We have presented one particular study in some detail at stage 5 because it contextualises and illustrates the full range of the review findings about the curriculum processes involved in the construction of challenge. It also offers a clear and helpful contrast between the nature of the mathematics curriculum design and enactment before and after the intervention.

academic definition of ‘challenge’ in relation to the curriculum. In the absence of a universally accepted definition of ‘challenge’ in curriculum terms, we approached the initial searches for the review in two stages. First, we wanted to get a sense of the nature of the research terrain. We began by searching for studies using search strings designed to uncover titles and/or abstracts that related both to challenge and to teachers. We used a keyword search on ERIC, BEI and Education-Line databases, which yielded approximately 7000 studies. The keywords used (in various combinations) included pupil/s, college, student/s teacher/s, challenge, challenged, challenges, school, schools, schooling, school challenge, curriculum, school curricula.

The research team conducted an initial filter of titles and abstracts against the broad criterion ‘Does this study appear to have the potential to inform the review question?’ which resulted in the retrieval of 208 full studies for further investigation. Cross moderation and re-filtering of titles and abstracts reduced this to 188 full studies.

Following this first-stage filtering process we needed to devise an authentic data extraction tool (see Appendix 2) that had the capacity to inform the review question (and sub-questions) and to yield comparative data across the studies that was capable of meaningful synthesis. We started by creating a broad definition of challenge that spanned the literature base we had thus far identified as part of the review process:

Irrespective of ability, challenging young people in curriculum terms means designing teaching and learning to elicit from students their best efforts (i.e. challenge needs to be motivating) and to enable them to think and act in ways that are transferable and/or discipline-specific; and which are progressively more complex, critical, creative and independent.

The definition reflected the preliminary scan of the key messages from the challenge literature identified in the stage 1 process and was subsequently discussed and agreed with the Curriculum Evidence Advisory Panel (CEAP) members and tested with four focus groups of practitioners, including senior and middle managers. Using this definition, we then applied full study filtering to the 188 studies. Full study filtering involved members of the research team in scanning the full studies against four simple criteria:

- Does the study relate to the construction of challenge for learners in terms of curriculum design and/or enactment?
- Does the study include teacher data and/or detailed description of the curriculum design/enactment?
- Does the study provide a clear rationale for the curriculum intervention?
- Is there reference to contextual data?

As a result of this process 34 full studies were included for in-depth data extraction. The focus of the studies was largely on teachers' experiences and perceptions of challenge in diverse contexts. These included, for example, gifted learners; teachers' reported pedagogical practices; teaching experiments and professional development. Unlike reviews, which are concerned with synthesising the measured impacts of particular interventions, the task in this one was to explore teacher constructions and perceptions of challenge across the full range of effectiveness. We wanted, for example, to understand the starting points of the teachers whose students had reported that they felt under-challenged in our first review. So there was not an *a priori* requirement for applying methodological exclusion criteria in relation to impact on students. Studies which had the potential to yield evidence in relation to the overarching review question were included, irrespective of whether or not they were designed to capture empirical data about the impact on students. Nonetheless, we were careful to record details of the study samples and data collection and analysis methodologies, along with any reported impacts of the curriculum interventions on teachers and on the target student populations. As a result of this, in Section 4 we have reported on the types of impact (in terms of motivation, engagement and achievement) that were linked to the different ways in which teachers constructed challenge in the review studies.

Stage 2

At stage 2 we revisited our search databases and included UK Educational Evidence Portal, IngentaConnect, Current Educational Research in the UK (CERUK) databases, Ofsted and the Department for Children Schools and Families (DCSF). The search strings used for stage 2 were shaped by our initial scan of the stage 1 studies. We had found from the latter that teachers' design and/or implementation of challenge in the curriculum seemed to have been explored empirically by researchers in genres, for example:

- for particular student groups such as gifted and talented, inclusion and special educational needs
- on a subject/disciplinary basis
- in relation to particular pedagogic approaches such as structured group work.

Hence the stage 2 search strings included, variously, challenge, challenge education curriculum, curriculum, curriculum challenge, gifted and talented, special educational needs, special educational needs, mixed ability, BME, low achievers, disengaged, English challenge, mathematics challenge, science challenge, geography challenge, history challenge, citizenship challenge, cooperative learning challenge, group work challenge, assessment for learning, thinking skills. Initial filtering at stage 2 produced 3,328 studies for filtering, using the same four criteria as for stage 1. At the end of this two-stage process we had a total of 45 studies for in-depth data extraction; 36 were single studies and nine were research reviews.

2 The studies

An overview

The studies included in the review tended to cluster in three groups: those which focused on particular student groups such as gifted and talented, inclusion, special educational needs; those which focused on a particular curriculum area; and those which focused on particular pedagogic approaches such as thinking skills. We did not come across studies that attempted to synthesise across these and other domains to identify any common characteristics that might emerge. This has been one of the key tasks for this review. Although the majority of the studies focus on English, mathematics or science, or a combination of these, they span a wide range of contexts and students.

Of the 45 studies initially included for data extraction, two were subsequently dropped from the synthesis of findings after further cross-moderation by members of the review team because they were, on further scrutiny, essentially more about supporting students than challenging them.

Of the remaining 43 studies, the level of detail varied between the studies. Although we were explicitly looking for teacher perceptions of challenge, the majority of the studies involved researcher-manipulated interventions. There were very few teacher action research projects. Data about teacher perceptions were collected in a variety

of ways, including questionnaires, observations, teacher journals and interviews. Evidence of impact on learners included teacher perception data (for example relating to engagement, motivation), questionnaires, pre- and post-tests, teacher assessment, reading levels and documentary analysis of units of work. The studies themselves ranged from systematic reviews and large-scale empirical investigations to small-scale, closely observed case studies involving a small group of teachers. These and other attributes of the studies are presented in tables (below) and in Appendix 1.

For each study we have identified whether there is a focus on particular student groups such as gifted and talented, inclusion, special educational needs; or on a subject/disciplinary basis*;* or in relation to particular pedagogic approaches such as thinking skills. The elements of the three clusters which we found, in descending order of frequency and not mutually exclusive between clusters, are:

Target group	
Low achievers	13
Gifted and talented	10
BME	8
Mixed ability	7
Disengaged	7
Special educational needs	6
Pedagogic intervention	
Cooperative learning/dialogic learning/ structured group work	23
Thinking skills	11
Assessment for learning	5
Curriculum area	
English	12
Mathematics	11
Science	7

Language development	3
Physical education	2
History	1
Geography	0
Foreign languages	1
Citizenship	0
Cross-curricular	17

(Categories are not mutually exclusive)

The following brief excerpts from some of the studies give a flavour of the kinds and range of issues with which teachers were grappling. Most of the studies involved the use of strategies focused on the needs of particular students, including low achievers (13 studies) and those identified as gifted and talented (10 studies). Most also employed learning processes and activities which were in themselves challenging and which attempted to engage students more actively and enthusiastically in their learning.

Examples involving gifted students included:

- challenging talented readers by using some of the pedagogy of gifted education (for example creative problem solving and thinking, acceleration, curricular modification and differentiation, independent study, advanced content) (Reis *et al*., 2004)
- working with highly gifted students who 'are not challenged to their full potential...' (Sheehan, 2000)
- supporting students who are gifted in some areas but not in others: '…most of these kids came to me because of their great success in other areas, and although I knew I needed to challenge those areas where they couldn't do as well, it often became hard for them to experience the occasional failure.....' (Graffam, 2006).

Examples of curriculum enactment using collaborative inquiry included:

- promoting challenge through inquiry skills using computers in science (Maor and Fraser, 1996)

- challenging students to think and make sense of what they are learning, including seeking connections between mathematics and the real world (Balfanz *et al*., 2004)
- requiring teachers to identify projects that challenge students to work either individually or in groups to create plans, solve problems…test out their ideas, and present their projects to peers (Wurdinger *et al*., 2007)
- building the appropriate level of challenge and cognitive demand into tasks to ensure that children's real potential, within Vygotsky's Zone of Proximal Development (ZPD) could be recognised and acted on. This meant stressing the important role played by adults and peer groups for the effective construction of knowledge during the training sessions (Koshy *et al*., 2009).

There were also some insights in the studies about contexts where students were not challenged. Two studies explored school environments where teachers either did not feel able to challenge students (Reis et al 2004) or where students were simply 'demoted' rather than challenged. 'Teachers perceived students… as willfully failing and undeserving of instructional resources… the overwhelming majority of teachers located the cause of student failure within students and their environments' (Anangnostopoulous, 2003).

3 Constructing challenge: an overview of the findings

The definition of challenge we used for this review (based on our initial scan of the research) embraces both motivational and performance related aims. Promoting engagement (designing curriculum content, materials and activities to enhance motivation and subsequent engagement) thus becomes an integral part of constructing challenge in the curriculum. Hence constructing challenge involves more than raising attainment or achievement. The target student groups in some of the studies in this review were students who were disengaged from the curriculum; others were students who were at risk of disengagement from the curriculum because of their persistent low achievement, background characteristics such as English as a second language (ESL) or socio-economic factors. A number of studies focused on students identified as gifted or talented who were not being challenged to their full potential. Many of the studies highlighted the use of collaboration and structured group work as key learning processes. We have drawn an important conclusion from this and from the detailed scrutiny of the elements of curriculum

construction (embracing, as we have said, both curriculum design – developing resources, materials and plans around specified content knowledge – and the enactment of the curriculum through the learning processes) across the studies. The intention behind teachers' construction of challenge appears from the evidence to involve both cognitive and/or performance gains and the promotion of participation/curriculum access. In other words, when teachers construct challenge in relation both to curriculum design and to its enactment, they tend to focus on both motivation and achievement.

Our approach to building the evidence base is cumulative. So we were interested, although not surprised, to find considerable overlap between this and the previous two reviews. In particular we have noted the importance for teachers in constructing challenge, in terms of the design of the curriculum content, resources, plans and activities, of incorporating:

- the capacity to build on young people's different starting points or existing knowledge and understanding. We found the actual diagnosis of these differences, in order to target challenge effectively, to be the most significant of the key judgements teachers make that affect the level of challenge within their curriculum offers (14 studies)
- critical thinking (11 studies)
- links with real world contexts (6 studies).

In terms of the classroom enactment of challenge, or the implementation of the curriculum design, we found that the predominant approach was through carefully designed tasks that engendered and guided peer collaboration (23 studies). The latter is variously described as structured group work, learning through dialogue and co-operative learning. The specific curriculum tasks and resources varied between subjects, levels and contexts, but the curriculum enactments overwhelmingly involved students in inquiry and problem solving by means of guided interaction with each other.

What are the key judgements teachers make that affect the level of challenge within their curriculum offers?

We found that teachers were required to make a number of judgements in constructing curriculum challenge, including:

1. diagnosing students' starting points in terms of their existing knowledge and skills in order to plan for curriculum differentiation (or personalisation) in terms of tasks and activities (14 studies)
2. judging when to step back from an authoritative, instructional role and to become more of a facilitator in order to devolve aspects of choice and responsibility to the students (10 studies)
3. setting appropriately personalised and challenging learning goals (6 studies)
4. creating a balance between support and challenge (3 studies) through offering a mix of opportunities for easier tasks and opportunities for pushing beyond students' comfort zones and thus risking failure (more challenging tasks) (4 studies)
5. prioritising and juggling resources in order to target students' different needs, particularly more able students, when there is pressure to focus on test attainment results for less able/marginal students (6 studies).

3.1 Diagnosing starting points

To construct appropriately challenging curriculum experiences and to gauge content level, teachers in many studies were explicit about the need to design content, tasks and resources appropriate to students' particular starting points. That meant knowing what individual students knew and could do already. In one example, involving more than 100 children in three experimental and three control schools, researchers analysed the impact of a 'catching up' programme in reading and mathematics. (Balfanz *et al*., 2004). This involved both organisational and institutional restructuring, including timetabling mathematics and English for 90 minutes a day for the whole year and intensive, sustained professional development of teachers. Support for students was also personalised because of their different needs. In mathematics, for example, teachers found that some students had 'decent prior knowledge of geometry, but not of data or operations, while others could solve operations problems, but not the geometry questions.'

A case study of teachers of gifted and talented students described some of the ways in which the teachers judged individuals' starting points: 'I do criterion reference testing here… it lets me see that [Gloria] is spelling at third grade level while [Ashley] is spelling at the fifth grade level… I want to start with their grade placement level so they can learn the rules, then I accelerate' (Graffam, 2006). In other studies teachers used questioning: 'Sometimes I ask students to explain their thinking… I will ask him

or her how s/he came up with that answer. That helps me learn their thinking' (Norton and McCloskey, 2008). However, this was not always easy. One teacher in the same study appreciated that the students think differently from each other but said that the size of the class made it difficult for her to address these differences. Her solution was to form 'rough groups of students in her mind' whom she believed to be thinking similarly.

Teachers also found diagnostic judgements difficult in identifying mathematically gifted learners in the first place. In one study of 300 students, teachers found the process of selecting a group of gifted mathematicians to be one of the most difficult aspects of the project (Koshy *et al*., 2009). They had difficulty in observing the attributes of mathematically gifted learners within the recommended structure of mathematics lessons as suggested by the National Numeracy Strategy. They also felt uncomfortable about basing judgements on test achievements because they believed that their students' performance could have been affected by their background of social deprivation, disadvantage, low expectations and the lack of adult support. Hence they found the judgement difficult both from an operational and from an emotional/values perspective.

A research report on effective teaching and learning for learners in low attaining groups found that teachers overcame some of the diagnostic (as well as the teaching and learning) problems by teaching in smaller groups. Teachers drew curriculum resources from multiple sources. These resources incorporated a range of cognitive demands to allow learners to select the level of challenge (Dunne *et al*., 2007).

Schneider *et al.*'s (2005) study, (which is reported in more detail under 3.2 below), covers both types of judgement, that is, assessing student starting points and balancing classroom enactments between transmission and facilitation. In this study each of the teachers in the four schools involved found it difficult to build on students' thinking despite high levels of curriculum support in the form of materials and guidance. Researchers attributed this to insufficient subject knowledge.

3.2 A more facilitative role

In many studies teachers believed that one of the key judgements they had to make related to the development of students' independent inquiry and problem-solving skills. This was variously described as 'student ownership and responsibility for their learning' (Clarke and Quill, 2003); 'offering the students an opportunity to take responsibility for their own learning and development (Maor and Fraser, 1996); 'self–

monitoring and self-instruction' skills (Davis and Florian, 2003); and 'learner centred instruction' (Yilmaz, 2008). Teachers had to judge when to hand more responsibility and ownership to their students and to learn how to step into a more facilitative role.

Examples ranged from sport education to mathematics. In one study of sport education in two year 8 classes, ownership and responsibility was handed over to students gradually. To begin with teachers initiated the skills and practices but during each session the learners were given a more active role until they were capable of devising and leading relevant practices themselves – teachers would then increasingly become facilitators of teaching and learning (Clarke and Quill, 2003).

In another (science-based) study of over 100 children, teachers wanted to introduce their students to inquiry-based skills using ICT. They realised that this required them to change their role in the classroom. They needed to move from an 'authoritarian' role – in which they emphasised whole-class activities led by the teacher and made use of textbooks and worksheets that stressed the learning of facts and the application of algorithms – towards being 'guides, initiators and facilitators'. This often involved the perception that there was less organisation and structure to the lessons, which was initially difficult for both teachers and students. As the students became accustomed to using the database they began to develop higher-level questioning and inquiry skills (Maor and Fraser, 1996).

One study looked at teacher perceptions of actively involving students in their learning. Although the study found that teachers had difficulty in articulating their perspectives on learning theories, they had strong beliefs about the educational value of actively involving students in their learning. They saw themselves as guides and facilitators of students' learning and were committed to helping students become 'lifelong learners, independent thinkers and self directed learners…Their emphasis was on learning by doing' (Yilmaz, 2008).

A study of an intervention which involved project-based learning in a middle school found that 'teachers must relinquish some control with this approach and allow students to work independently for periods of time… teachers may be uncomfortable with this approach, especially when students make mistakes… during the process' (Wurdinger *et al*., 2007). Other studies involving independent learning and student choice, with teachers needing to be facilitative, included a case study of teachers of gifted learners (Graffam, 2006); a systematic review of interventions aimed at improving achievement among gifted and talented learners (Bailey et al 2008); and a

large-scale study of enterprise education in Sweden (Leffler and Svedberg, 2005). An Australian study (Gillies and Boyle, 2006) involving 10 teachers and their practices during cooperative learning identified facilitative processes during classroom enactment as: setting expectations for children's group behaviours; teaching the social skills students needed to deal with disagreement in groups; and establishing group structures so that children understood what was required both from each other and the task.

Another study helps illustrate the fine judgements required by teachers in implementing such processes. It highlights the importance of carefully developed curriculum support materials plus subject-based professional development. The study focused on science education for low-achieving BME students in four US schools (Schneider *et al*., 2005). Researchers wanted to explore what classroom enactment looked like when teachers were given 'reform-based' curriculum materials (that is, geared towards a more challenging, inquiry-based approach as opposed to a more transmission-oriented approach). They asked 'what does classroom enactment look like in comparison to the intent of the materials?' The targeted science content was clearly identified and appropriate supports were identified throughout. These included ways to:

- guide students in doing tasks
- focus student attention on important events or ideas
- guide student thinking.

Importantly, teachers were offered content support before each learning set to help them understand Newton's first law and related ideas. They were guided about student ideas that were likely to emerge, including probable prior knowledge and experiences, challenging concepts, probable responses and appropriate levels of student understanding. Nonetheless all four teachers seemed to struggle to build on students' thinking – which the researchers attributed to insufficient knowledge about their subject. The study also highlighted that some teachers found it more difficult than others to balance student autonomy and teacher input in small group work. When the teachers allowed students opportunities to discuss ideas uninterrupted by prompts for completion, it left students without teacher support for thinking. In attempting to give students opportunities to collaborate, teachers sometimes gave students too much responsibility and not enough guidance.

3.3 Setting appropriate learning goals

Teachers' own levels of understanding of the task appeared to be a key element in judging the appropriate learning goals for students. In addition to appropriate learning goals, teachers needed to make judgements about the position of the task in the curriculum, the level of support provided for the students (for example additional mathematical activities and/or prompting questions) and anticipating the type of difficulties learners might meet when tackling the task. In one small-scale study involving five teachers (Leikin and Kawass, 2005), it was not until the teachers themselves had tackled a non-familiar, challenging mathematical task that they were able to set stretching but realistic tasks for the learners to tackle.

A study for the DCFS on raising boys' achievement (Younger and Warrington, 2005) found that target setting (together with mentoring) was a critical element in raising achievement but that these judgements needed to be carefully exercised. It suggested that target setting needs to be both realistic and challenging, not simply based on historic data within the school but based on higher expectations and detailed analysis of contextualised value-added data for the individual concerned. The research suggests that teachers within subject departments, that is with the same curriculum focus, needed to engage in professional dialogue about learning at the level of the individual child.

A large-scale systematic review of research on the impact of summative assessment and tests on students' motivation for learning suggested that teacher professional development needed to emphasise learning goals and active involvement of students in their learning rather than performance goals. Students were likely to be more motivated when they understood their learning goals and the criteria by which they were assessed and developed their ability to assess their own work (Harlen and Deakin Crick, 2002).

Evidence from studies of unsuccessful practice reinforces these findings. In one study, identifying differentiated learning goals, planning appropriate curricular resources and enacting learning through carefully structured processes was more honoured in the breach than the observance. In this study of student failure in two urban high schools, involving 32 teachers (Anagnostopoulos, 2003), researchers found that teachers did not regard themselves as responsible for remedying student failure. This enabled them to 'maintain their routine practices, altering them only to lower expectations'.

3.4 Combining support and challenge/balance between success and risking failure

In their study of the curricular needs of academically low-achieving students in mathematics, Woodward and Brown (2006) implemented curriculum principles found in the special education literature. This included efforts to provoke deeper mathematical thinking through student work on challenging mathematical problems – usually in paired or small group work – for a substantial part of each lesson. The intervention programme they used mixed relatively easy tasks with more challenging application and problem-solving activities, based on real-world scenarios and designed for students at risk of academic failure. The researchers concluded that creating opportunities for success – and hence the possibility that it is possible to succeed in mathematics – can be complicated. They conclude that 'offering students a series of relatively easy tasks can lead to a false sense of self-efficacy [their capacity to reach their goals], and this practice is at odds with the intent to give students access to challenging mathematics… students need to experience periodic challenge and even momentary failure to develop higher levels of self-efficacy and task persistence'. Evidence from other studies in this review showed that judging the balance between support and challenge in curriculum terms and between success and the risk of failure was particularly important in mathematics, although not confined to low achievers or to special educational needs.

In a case study of teachers of gifted learners, teachers constructed challenge by compacting, accelerating and enriching the curriculum according to student need. Many of their students had been identified as gifted in one or more areas of the curriculum but not in all. One teacher felt that she needed to challenge those areas where students did not perform as well as others, which meant that students found it hard when they experienced the 'occasional failure'. 'They often didn't want to do the things they knew they couldn't do well and I'd have to get them to… work on it' (Graffam, 2006).

A systematic review (Kyriacou and Goulding, 2006) of strategies to raise students' motivational effort in key stage 4 mathematics explored strategies for student engagement with, among other things, challenge separately from the issue of 'student identity'. The latter concerned the extent to which students see themselves as 'mathematicians', that is as people who can understand and can do mathematics, and feel a sense of belonging in their mathematics class. The researchers' conclusion illustrates the nature of the judgements about balance between support

and challenge that teachers in many of the studies found themselves required to make. ‘Whereas in this section (teaching for engagement) the emphasis was more on the notion of caring, support and enjoyment, the section on pupil identity had more of an emphasis on the importance of pupils gaining a deeper understanding of the mathematics they were doing as being crucial to the development of a more positive pupil identity. It could be that the first emphasis without the second may make pupils feel comfortable but not challenged mathematically, and hence not given the chance for deeper learning.’

In a small-scale study of investigations by two high school principals (Flores and Roberts, 2008) into productive strategies for raising student achievement in algebra, high content knowledge appeared to be key in making judgements about levels of support and challenge. Teachers taught the same concepts and standards at the same time. They then collaborated to share strategies, including those that were successful and those they felt had failed. They used this shared learning to devise worksheets, presentations and other curricular materials to help and support students in understanding rigorous and challenging algebra content which they would not otherwise have understood if the teachers had followed an ordained timeline set by the textbook or district pacing guide.

In one US study (Gainsburg, 2008), the researcher surveyed mathematics teachers in two middle and two high schools to explore their use of real world connections in teaching mathematics. From this and subsequent classroom observations the researcher found that some teachers believed that students should master mathematical concepts and skills abstractedly before connecting them to the real world. There was a strong tendency amongst the teachers to use such real-world connections more with mathematically advanced students and those with no behavioural problems. The study also found that while some teachers valued tasks requiring critical thinking, a larger number feared that complex or language intensive tasks would overwhelm students. The overall conclusion of the study was that teachers worry more about over-challenging their students than about under-challenging them. As the researcher suggests, little is known about how pervasive this view is among teachers, and more investigation is needed both to find this out and to explore ways of overcoming this attitude.

In a report for the DCFS on effective teaching and learning for learners in low-attaining groups (Dunne *et al*., 2007) researchers found that effective teachers

considered both cognitive and affective outcomes. Supportive strategies included a slower pace of delivery, increased scaffolding, reduced levels of challenge, peer support and more feedback and praise. However, to avoid the risk of imposing limits to attainment, teachers gave learners opportunities to select and vary the level of challenge in their learning by selecting the curriculum tasks they tackled. The balance between providing learners with appropriate opportunities for success and maintaining high expectations was seen as particularly difficult in these low-attainment groups. Assessment for learning and peer evaluation were identified as effective strategies in achieving this balance.

3.5 Juggling priorities

Perceptions of pressure from within or outside the school environment also required judgements to be made in relation to the ways in which teachers did or did not construct challenge in the curriculum. Teachers felt that they were required to make judgements about effective use of time and resources, particularly in circumstances involving competing pressures. For example, in a study of reading instruction for talented readers in 12 cross-phase classes (Reis *et al*., 2004), nine out of the 12 teachers did not differentiate instruction. Most said that they had received no prior training, little support and minimal professional development in how to do this. Most also said that the state assessment procedures and tests forced them to concentrate on students who were working below expected levels. All the teachers said they were concerned about the continued development and progress of their talented readers and expressed frustration about lack of time, resources, the district priorities and their lack of knowledge about how to use innovation and provide continuous progress for talented readers. There were emotional and value aspects to this type of judgement as well: teachers felt it was hard to justify not working with lower-ability students whom they felt were more needy than students of higher ability. (One teacher attended a summer conference as a result of his participation in this study. He learned strategies for differentiating curricula for his talented students that could also be applied to enhance his instructional repertoire for other students.)

Findings from a study of student failure and teacher work in urban high schools in the USA (Anangnostopolous, 2003) suggest that administrative pressure for teachers to reduce student course failure may, paradoxically, reinforce poor practice rather than prompt teachers to try and improve achievement by constructing more challenging curriculum interventions. The research found that accountability policies can directly

and indirectly impinge on teachers' perceptions of their control over the curriculum and hence the degree of autonomy they feel in making curricular adaptations.

Evidence from a systematic review of the impact of summative assessment and tests on student motivation for learning (Harlen and Deakin Crick, 2002), has a similar finding in relation to the effect of such tests on teachers and teaching. The evidence strongly suggests that when passing tests is 'high stakes', teachers adopt a teaching style that emphasises transmission teaching of knowledge, thereby disadvantaging and lowering the self esteem of those who prefer more active and creative learning experiences. External tests were found to have a constrictive effect on the curriculum, resulting in an emphasis on testing subject knowledge at the expense of creativity and personal and social development.

What do teachers see as the most challenging learning terrain and learning processes?

As far as the learning terrain was concerned, we found little direct evidence in the studies about whether or how far some aspects of particular subjects were more challenging than others. A total of 33 of the studies in the review were centred on curriculum design and enactment for learning in mathematics (especially algebra), science and reading comprehension/literacy/English/language development. A further nine involved combinations of numeracy and literacy development. This would be consistent with the findings from the four systematic reviews of teacher professional development, where the same three curriculum areas (mathematics, English and science) dominated the research agenda, and with findings from our meta review (that is, review of reviews) in 2008 where the same curriculum areas tended to be targeted in such diverse research domains as thinking skills, assessment for learning, raising achievement and improving motivation. While it might be possible to infer from this that these are the curriculum areas that teachers regard as most challenging they may simply be a reflection of researchers' interests.

The only specific area of learning to be highlighted was algebra, which was identified by Swann (2006) as a difficult topic and as presenting 'complex teaching and learning problems' by Flores and Roberts (2008).

4 Impact

4.1 Experimental studies

The majority of the studies involved in-school, researcher-manipulated curriculum interventions, largely employing inquiry-based and co-operative learning strategies. Given the consistency of this finding (that constructing challenge involved the design of curriculum content, materials and tasks which promoted curriculum enactment through collaborative inquiry/problem solving), we wanted to explore the nature of the impact of these interventions relative to their aims in relation to targeted groups of students. For this section, therefore, we applied methodological criteria and selected only those studies which:

- used independent methods of data collection (for example pre- and post-tests, comparison groups or triangulated case study data such as observations/surveys/interviews/ journals/work samples/assessments)
- clearly identified the student samples
- clearly defined their aims and objectives.

4.1.1 Raising achievement and/or motivation

A 2007 analysis of curriculum models in gifted education analysed in depth the findings from six models that produced robust evidence of effectiveness in terms of achievement and motivation with gifted students – in comparison with other treatments or no treatments (Van Tassel-Baska and Brown, 2007). The findings from this review suggest that:

- inquiry should be a central learning strategy
- there is a strong emphasis on affective issues like motivation and student engagement. This suggests that attention to affect in the curriculum provides an important connection between teacher and learner, perhaps accounting for greater growth gains as the motivation of both escalates. (This is consistent with Graffam's (2006) findings about the importance of relationships and teacher attributes and those of Bailey *et al*. (2009), who found that gifted and talented programmes improved students' motivation, confidence and self esteem.)
- best practice calls for actively engaging students in their own learning through opportunities that are issue or problem based and relevant to the students' world

- school and district administrators should receive professional development sessions on curriculum implementation targeted at curriculum differentiation and pedagogical practices and embedded in a context of how to support teachers in implementing curriculum pitched above state-level curriculum frameworks
- teachers should receive training on the teaching and learning models, performance-based assessment approaches and curriculum resources that can extend, enrich and augment.

The studies with experimental data that provided evidence about both the different ways teachers construct challenging curriculum experiences and about the impact this had on curriculum outcomes highlight a range of impacts. Seven studies identified positive impacts on attainment and achievement, including, for example:

- key significant increases in attainment for schools
- a range of assessed improvements in achievement in relation to the use of mathematical concepts in the real world and control of a range of mathematical strategies (at the same time as the development of a broad range of learning skills including co-ordination and project work)
- improvements in attainment from low to acceptable
- evidence of effectiveness in terms of achievement and motivation for gifted students.

Sheehan (2000) used teacher observations, interviews, and student and parent surveys to establish that gifted students in an advanced-track high school class were not being challenged to their full potential. *Following the introduction of several co-operative group projects plus opportunities for students to make choices about assignments, students' interest in their work increased and their grades went up.*

A large-scale study involving schools, colleges and businesses (Adler and Laurel, 2000) targeted students at risk of being expelled, dropping out or failing. They were low achieving in reading, writing and mathematics and deemed to be unable to apply skills in the outside world. This was a multi-faceted intervention, which involved ongoing monitoring and support services. The curriculum was designed to incorporate real world contexts, including business internships, teaching strategies based on problem solving in real-life contexts, thinking skills and co-operative learning groups. *High school students' attainment test scores improved by 97% in one year. Middle school students increased their scores by between 300 and 400%.*

In a study involving three experimental and three control schools, researchers evaluated the impact of curriculum interventions in reading and mathematics with low-achieving students in high-poverty high schools (Balfanz *et al*., 2004). The interventions included:

- using a more varied set of activities
- using co-operative learning strategies
- using group projects
- requiring students to present multiple solutions or methods (or use multiple strategies to construct meaning from their texts)
- relating mathematical concepts or reading to real-world examples or experiences.

Students in the experimental schools significantly outperformed students in the control schools in terms of both overall level of achievement obtained and in achievement gains.

In a study of effective literacy practices and curriculum challenge for struggling readers, particularly students from low socio-economic backgrounds and ethnic minorities, researchers set out to evaluate an approach to improve children's literacy learning and content area knowledge (Janisch and Johnson, 2003). In this case, the teachers participated in continuing professional development (CPD) and worked collaboratively to develop their practice. They were able to expand their understanding about literacy learning, consider curricula that could challenge their students and encourage one another in modifying and improving instructional practice. Although teachers worked individually in their classes, each approach reflected increased expectations and heightened opportunities for children to learn. In one class, for example, teachers and children worked collaboratively to design a KWL (Know, Want to know, Learn strategy) where children charted their knowledge, continually added questions and updated the learned information. *Overall, test scores at the school have changed from low performance to acceptable performance*.

Ongoing debates in Australia about how best to meet the needs of linguistically and culturally diverse students have shifted from calls to modify the curriculum to an emphasis on ways of enabling students to participate fully in the mainstream curriculum. In one study (Hammond, 2006), an intervention programme was designed for year 7 boys to be both high challenge and high support. The study

shows how one teacher wove both content and language teaching into her English literature lessons. Her explicit teaching of language as well as her ability to incorporate drama into the unit contributed to her students' successful learning of intellectually challenging curriculum content and their affective engagement with that content. While at the beginning of the year assessment outcomes had indicated that these students were behind the majority of their English-speaking peers, *their end of year assessment outcomes indicated that, relative to their peers, the majority had made substantial academic gains.*

4.1.2 Impact: developing collaborative problem-solving and inquiry skills

There was also a range of impacts related to the development of collaborative and problem-solving inquiry skills that were linked to efforts to construct challenging curriculum experiences.

These encompassed:

- changing students' views of learning from being a process of receiving knowledge to one that is predominantly investigative with associated increases in their enquiring skills and analytic thinking
- moving students' views of mathematics from the idea that 'it's about sums' and 'learning about fractions and them stuff' to a view that it is primarily about 'sorting problems, looking at information in charts and writing about it'.

This led to improvements in students' work, specifically in their use of tables, their ability to make informed conjectures and to extend their work by posing their own questions.

In one study (Gillies and Boyle, 2006), the teachers participated in a two-day workshop and subsequently implemented classroom learning processes involving co-operative working, learning to give and receive help, sharing ideas, clarifying differences and constructing new understandings by actively engaging in discussion with one another. Analysis of audio-tapes, observations and interviews found that students modelled many of the types of mediated learning behaviours. For example, they probed each other's opinions, acknowledged each other's points and attempted to link new information to previous understandings. They did this in a context that was enquiring and task-oriented yet open and supportive of each other's ideas.

Swann's (2006) study, which analysed teaching behaviours prior to a curriculum intervention involving collaborative enactment, provides an indication of the contrast

between this active approach and what learning may have looked like before. Prior to the intervention, teachers:

- emphasised routine skills to be practised independently
- closely followed a textbook
- allowed students to use only the methods they were taught
- taught the whole class at once.

Student learning in this type of approach to the curriculum therefore lacked opportunities to develop the collaborative skills and understandings outlined above.

A study involving seven teachers and more than 100 students aimed to promote challenge in the science curriculum by using a computerised database within an inquiry-orientated teaching approach (Maor and Fraser, 1996). Researchers were using the approach to overcome the emphasis they had found in most science curricula on the learning of facts and the lack of emphasis on high-level cognitive learning. The researchers used a computer database as a tool for investigation to enable students to engage in inquiry-based learning. They also designed a booklet to facilitate the use of the database and to help students focus specifically on inquiry skills, generating questions and designing investigations. Students were given opportunities to construct their own understandings by exchanging ideas with one another, and exploring and reinforcing these through discussions and negotiations. Overall, students' perceptions of their learning had changed significantly. They viewed classes as being predominantly investigative and believed that they had significantly developed their inquiry skills and had become more analytic in their thinking.

A study involving 33 year 5 teachers and 300 learners set out to identify possible factors which contribute to the effective identification of, and provision for, mathematically promising learners (Koshy *et al*., 2009). The project was launched on the basis of a research review which found that acknowledging students with mathematical gifts and talents is crucial and that it is important that they are challenged with appropriate stimulation, guidance and teaching. An action research model was used in which practitioners followed a cycle of planning, teaching, collecting data, evaluating the effectiveness of the intervention and reflecting on the outcomes. Teachers had to decide between acceleration of the curriculum (that is, using materials and activities from higher levels of the National Curriculum) or additional 'enrichment' materials and activities. Children responded in most cases to

open-ended investigational tasks with greater motivation than they did to mathematical exercises and tasks selected from mathematics textbooks designed for older age groups. Also, if motivated by an investigational task, children tended to seek knowledge and skills required from higher levels on the mathematics curriculum without being prompted to do so. In the light of this, teachers felt more at ease with the enrichment (that is, inquiry) strategy.

As a result of the intervention, children's perceptions of mathematics changed noticeably. More than half the children who had (pre-project) described mathematics in terms of 'sums', 'learning about numbers', 'fractions and them stuff', changed their perception and described the subject as involving 'solving problems', looking at information on charts and writing reports about it'. They also changed from perceiving mathematics as boring to finding it 'very enjoyable but very hard', 'making you think' and 'teaching you to do whizzy things like adding all the numbers from 1 to 10 000 within 3 minutes'. An analysis of the children's work also showed an improvement. There was evidence of more systematic work, use of tables and children making conjectures and extending their thinking by posing their own questions. Teachers and children both worked collaboratively. For teachers, one of the significant findings was the need to provide adequate professional development support in empowering teachers to enhance and enrich their own mathematical knowledge and methodological expertise in teaching mathematically promising children.

A study of students in years 9–12 set out to explore whether the introduction of sport education into the physical education (PE) curriculum would enhance student learning (Clarke and Quill, 2003). Specifically, researchers wanted to see if the curriculum initiative would meet its aims of helping learners take part effectively on their own, with partners and in groups, in both competitive and co-operative situations, to set their own goals and learn to cope responsibly with success or failure. In order to encourage challenge among learners, researchers handed responsibility to them to direct their own learning (in whatever roles: as captain, official, spectator). The data generated from the research showed that the sport education curriculum model had given learners a more authentic and less abstracted learning experience, which had maintained their interest and improved their understanding in games, gymnastics and athletics.

4.2 Descriptive studies

We set out in this review to explore teachers' construction of challenge in the curriculum. Consequently we included a range of studies, irrespective of methodology, provided the data collected had the capacity to inform the overall review question and the study met our inclusion criteria. Some studies were descriptive, that is, researchers collected data about what teachers were doing in particular circumstances. For example, researchers in one study set out to explore how teachers in 12 cross-phase classes differentiated instruction for talented readers, but found that they didn't much. Teachers tended to concentrate efforts on low achievers and had little knowledge and experience of curricular adaptations that were differentiated so that they challenged the highest achievers or most talented readers (Reis *et al.*, 2004). The three classroom teachers who did provide opportunities for challenging more talented readers used three or more differentiation strategies (including grouping for reading, curriculum compacting, opportunities for independent reading and writing choices, and book discussion groups). Each of these teachers worked in suburban schools where gifted and talented programmes were available and two worked with principals who had prior training and direct experience in addressing the needs of gifted and talented learners.

A further study (Graffam, 2006) set out to explore the characteristics/nature of successful teachers in gifted education and to identify what knowledge or skills such teachers should have. The study found that teaching gifted learners required the teacher to frame personalised and whole-group teaching simultaneously. Other findings were that:

- important teacher factors included personal background, pre-service training and professional reflection
- some curriculum strategies could be used with all gifted learners
- the relationships between teachers of gifted children and their learners were key to higher challenge, motivation and investment on the parts of the learners.

Teachers maintained that a personalised and challenging curriculum was essential for motivating and directing children's learning. The researcher concluded that:

- there was a need for more observations to build models to feed into teacher training

- there needs to be greater understanding of what is meant by differentiating, compacting and accelerating in curriculum terms
- research on gifted learners needs to move from prescribed packages of practice (or programmes) to described models of practitioners which take into account teacher characteristics (including their beliefs and training) and their approach to teaching and learning.

5 An illustrative study

Swann's 2006 study of a year-long intervention designed to promote mathematics learning through collaboration and discussion illustrates many of the main findings of this review. Because of its capacity to contribute substantially to the review question and sub-questions, we have summarised it here in some detail.

The researcher designed a series of algebra lessons that were used with low-attaining GCSE students in 44 different classes over one year. The approach was intended to promote discussion as a route to learning, using carefully designed tasks and resources that encouraged reasoning and improved understanding of concepts and collaboration. The teachers attended a series of workshops to introduce them to the materials and methods, which they then put into practice. As a result of the intervention, students' conceptual understanding of mathematics had improved. Their scores in algebra tests were improved, their motivation had increased and their anxiety levels about mathematics were reduced. In terms of the individual areas of the algebra tests, the greatest gains were made in:

- substitution
- constructing algebraic expressions and equations
- solving simple equations
- handling inequations.

Research conducted prior to the intervention had established that the majority of the teachers tended to favour transmission methods of teaching, following textbooks and completing calculations repetitively, using the same methods. Before the project, the teachers in the sample:

- used predominantly teacher-centred approaches
- tended to present mathematics in a pre-determined, closed and heavily structured fashion

- emphasised routine skills to be practised independently.

The teachers were asked to give ratings to the frequency with which they adopted 25 classroom practices. The top 13 most frequently used practices were all teacher centred and included:

‘I tell the students which questions to tackle’
‘I teach the whole class at once’
‘I know exactly what the mathematics lesson will contain’
‘I tend to follow a textbook closely’
‘Students use only the methods I teach them’
‘Students learn through doing exercises’.

The teachers generally did not encourage the students to work collaboratively, show creativity or make decisions about what they learned. Lessons were typically full of carefully graded practical exercises, with topics presented sequentially from the beginning, even though students had studied many of the topics previously. Similarly, students experienced such lessons passively. One of the main intentions behind the introduction of the discussion-based approach was to encourage students to move from passive learning strategies to more active ones. Active strategies involve students:

- co-operating with peers
- taking the initiative
- facing challenges
- being creative
- showing determination.

When learning passively, students tended to:

- work alone
- avoid challenge
- memorise methods and results provided by others.

By the end of the project the teachers involved reported that they were using more student-centred ways of working, with the following features occurring much more frequently in their lessons:

- collaboration and discussion
- encouragement of identification of mistakes

- linking of, and movement between, different mathematical topics.

Teachers also used a ‘diagnostic teaching’ programme to expose common learning obstacles which students faced and to motivate students to reformulate their own understanding of concepts. There were three phases to the ‘diagnostic teaching lesson’:

- exploring students’ existing understanding and methods by tests and interviews prior to teaching
- provoking and sharing ‘cognitive conflicts’ by getting students to compare their responses with those of others, or by asking them to do the same task using a different method
- resolving and consolidating conflict by discussing the new concepts and methods in groups, and then using them on other problems.

These lessons contained novel features that the teachers were not already using, including using sorting activities and creative activities in which students were invited to design their own examples.

The researcher built on lessons learned and designed the ten research lessons for the main group of teachers, employing the following principles:

- lessons to be conducted in supportive social contexts, with plenty of opportunities for feedback to students other than marks awarded
- lessons to consist of rich, challenging tasks and questions
- students to be encouraged to make mistakes and learn from them
- teaching to emphasise methods and reasons rather than answers, with students encouraged to act as teacher whenever possible
- students to create links between mathematical topics
- the purpose of each lesson should not be too broad and should be communicated clearly to students
- appropriate use was to be made of technology.

After the project the teachers also reported a change in priorities for the teaching and learning of mathematics. The priorities at the end of the project were the ‘interpretation of concepts’ and the ‘development of strategies for problem solving’, whereas at the beginning the top priority had been the ‘fluency of recalling facts and performing routine skills’.

6 Discussion and conclusions

From this review we have begun to build up a detailed picture of how teachers construct challenge in designing curriculum experiences. Although student perceptions were not within the purview of the review question, we found that some of the findings from a systematic review of research on student motivation and learning offer a helpful student perspective on the key messages from our review. A systematic review in 2005 explored what 11- to16-year-olds believed to impact on their motivation to learn in the classroom (Smith *et al.*, 2005). In particular, students believe that they are better motivated when:

- lessons are perceived as 'fun'
- lessons are varied and participative
- teachers favour collaborative methodologies
- students perceive activities as useful and authentic.

Some students also:

- perceived the curriculum to be restricted in what it recognises and values as student achievement
- believed that curricula can isolate students from their peers and from the subject matter
- believed that the way the curriculum is mediated can send messages that it is not accessible to all.

The research also suggests that the way the assessment of the curriculum is constructed and practised in school appears to influence how students see themselves as learners and social beings.

There appears to be considerable symmetry between students' and teachers' views about how challenge is constructed. Teachers in the review studies tended to construct challenge around the kind of tasks and classroom activities, especially collaborative activities, which are targeted as much at participation and motivation, as cognition. This leads us to suggest that designing curriculum materials without also planning for their enactment (that is, how curriculum plans are experienced by students) in the classroom risks a mismatch between the intent behind the materials and the learning processes employed while using them. Hence careful planning and design of curriculum content, materials and resources needs also to be accompanied

by an appropriate repertoire of pedagogical skills, including diagnostic skills and skills in facilitating and guiding group work.

These and other findings, appear consistent in their emphasis on guided discussion/collaboration and diagnostic practice. Put simply, challenging one group of students is very like challenging another – irrespective of their achievement levels. The principles would appear to be very similar. This accords with Woodward and Brown's (2006) finding also: that the application of special educational needs principles were effective for low achievers generally. Curriculum challenge, when effectively constructed, includes recognition of planning for all points on the spectrum at the level of the individual. Hence, we suggest that constructing challenge in the sense of differentiated curriculum tasks, materials and resources and their enactment through collaborative and inquiring learning processes could be effective across all types of learner.

Conclusions

- Constructing challenge in the curriculum has the potential to improve the attainment and motivation of all learners.
- When constructing challenge, teachers need to consider curriculum design and enactment in relation to different target groups as well as individual learners.
- The principles of constructing challenge are similar for all learners, whatever their achievement levels. They include constructing challenge through differentiated curriculum tasks, materials and resources together with the use of processes that embed challenge such as collaborative enquiry.
- As with the previous two reviews, we have noted from the research and evidence that to provide challenging curriculum experiences for young people, it is important to:
    - build on young people's different starting points or existing knowledge and understandings
    - incorporate opportunities for developing their critical thinking
    - ensure learning links with real-world contexts.

Implications

The findings of the review suggest some possible implications for practice. Planning and designing of curriculum content, materials and resources for challenge needs to be integrated with/developed through a repertoire of pedagogical skills, including

diagnostic skills and skills in facilitating and guiding group work. There are five key areas for consideration:

1. Curriculum materials: The studies in this review suggest that challenging learners involves paying attention to motivation and to content at the same time when designing curriculum materials.

2. CPD: All the evidence for effective challenge points to the close association between the design of the curriculum and its enactment in the classroom and the need for CPD that focuses on helping teachers make these connections.

3. Managing complexity: The review findings show that constructing curriculum challenge is complex. The evidence highlights the importance of personalisation, particularly in diagnosing starting points and understanding progress.

4. Facilitating learning: One of the key judgements teachers had to make in constructing challenge was to know when to stop telling and instead to stand back and use facilitating skills in order that learners could become more independent and develop their own learning skills through, for example, designing tasks that students can carry out interdependently. This finding is strongly linked with the evidence from year 1 and year 2, across the strands, about the effectiveness of group work that is structured for collaboration in promoting learning.

5. Under-challenge: Nearly a quarter of the secondary learners in the 2009 survey reported that they felt under-challenged. Perhaps significantly, one of the review studies suggested that many teachers were more concerned about over-challenging learners than under-challenging them. It may be that teachers' concerns are linked to the views of this significant minority of students about the scope for more challenge.

Appendix 1: Further characteristics of the studies

N=45

Who?	
Age of students	**Frequency**
5–11	17
12–14	27
15–16	17
16+	9
Phase	
Primary	19
Secondary	31
Further education	1
Gender of students	
Male	4
Female	1
Mixed	37
Target group	
Special educational needs	6
Gifted and talented	10
Mixed ability	7
BME	8
Low achievers	13
Disengaged	7
Pedagogic intervention	

Cooperative learning/dialogic learning/structured group work	23
Assessment for learning	5
Thinking skills	11
Curriculum area	
English	12
Mathematics	11
Science	7
Language development	3
Physical education	2
History	1
Foreign languages	1
Geography	0
Citizenship	0
Cross-curricular	17
Sample of students	
1–5	2
6–10	2
11–15	0
15–20	0
21–30	1
31–40	0
41–50	1
51–60	3
61–70	0
71–80	1
81–90	0

91–100	0
100+	12
Methodology	
Qualitative	26
Survey	19
Case study	14
Quantitative	11
Direct teacher discourse/perception data	8
Pre-test/post-test	5
Control group	2

Categories are not mutually exclusive

Appendix 2: Data extraction framework

Basic information

Title of article:

Authors: (name(s)

Date of publication: (year and month)

Country of origin:

Journal/book:

Reviewer: (name)

Who?

Age of students:	(5–11), (12–14), (15–16), (16+), (Other)
Phase:	(Primary), (Secondary), (Further education), (Other)
Gender of students:	(Male), (Female), (Mixed)
Target group:	(Special educational needs), (Gifted and talented), (Mixed ability), (BME), (Low achievers), (Disengaged) (Other)
Curriculum area:	(English), (Mathematics), (Science), (History), (Geography), (Physical education), (Foreign languages), (Language development), (Citizenship), (Cross-curricular), (Other)
Pedagogic intervention:	(Co-operative learning/dialogic learning/structured group work), (Assessment for learning), (Thinking skills), (Other)
Sample of students:	(1–5), (6–10), (11–15), (16–20), (21–30), (31–40), (41–50), (51–60), (61–70), (71–80), (81–90), (91–100), (100+),

(Inferred) or (Stated)

Sample of teachers: (Number) and/or (other)

Information about teachers: Position in school, years of service, type of teacher etc... (Free text)

Why?

Cause/issue/problem/aspiration which sparked research: (Free text)

(What was the 'target group' in the research? Who was affected by the research?)

Aims and objectives of research: (Free text)

(What were the core issues and aspirations for the research? What did the researchers hope for?)

How?

Description of curriculum construction: (Free text)

(What did the teachers do in response to the problem? What actions did they take?)

Methodology: (Case study)
(Pre-test/post-test)
(Control group)
(Direct teacher discourse/perception data)
(Survey)
(Quantitative) and/or (Qualitative)

Outcomes

What happened/results/findings:

(a) Teacher outcomes (Free text)

(b) Student outcomes (Free text)

(Include any problems/issues as well as any positive outcomes)

Sub-questions

What are the key judgements teachers make that affect the level of challenge within their curriculum terms? (Free text)

What do teachers see as the most challenging learning terrain and learning processes? ('*What teachers think is the most challenging terrain for student learning'.)* (Free text)

Comments

Reviewer comments about study: (Free text)

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