

Learning skills and the development of learning capabilities

Review conducted by the Thinking Skills Review Group

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REPORT

Describes the background and the findings of the review(s) but without full technical details of the methods used

**TECHNICAL
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Includes the background, main findings, and full technical details of the review

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List of abbreviations

BEI	British Education Index
CPD	Continuing professional development
CVS	Control of variables strategy
DfES	Department for Education and Skills
EPPI-Centre	Evidence for Policy and Practice Coordinating Centre
GCSE	General Certificate of Secondary Education
ICT	Information and Communications Technology
Ofsted	Office for Standards in Education
PNS	Primary National Strategy
QCA	Qualifications and Curriculum Authority
REEL	Research Evidence in Education Library
SNS	Secondary National Strategy
UK	United Kingdom
WoE	Weight of evidence

Abstract

The review question

The initial review question used to identify and map the research literature in this area was as follows:

Which teaching approaches that explicitly aim to develop pupils' learning capabilities are effective?

Then a specific question for in-depth review was identified as follows:

Which teaching approaches that explicitly aim to develop pupils' learning capabilities and which have been used in at least 3 schools show evidence of improved learning of pupils?

A further sub-question was added to identify issues in scaling up interventions or teaching approaches across schools:

What issues are identified in these studies about implementation or scaling up of the teaching approach?

Who wants to know and why?

The key aim of this review is to support current policy initiatives to develop learning and teaching in schools. One specific objective is to support one of the five core components of the development of personalised learning through 'teaching and learning strategies that actively engage and challenge learners and develop their ability to focus on their learning skills and their capability to take ownership of their own progress' (NCSL, 2005). This provides a clear focus on approaches which support metacognition and self-reflection as is made explicit in Key Stage 3 and Primary Strategy materials:

personalised learning is an approach to teaching

and learning that stresses deep learning as an active, social process and which is explicit about learning skills, processes and strategies (DfES, 2005a, p 5)

The Primary Strategy will develop a framework for learning and teaching across the curriculum. The framework will propose the range of learning skills, knowledge and understanding that children should develop as they progress through primary school. (DfES, 2003, p 29)

A second aim was to identify evidence from research which can inform practice. This is challenging as findings from research needed to be translated (Toth *et al.*, 2000) rather than applied to different teaching and learning contexts. Our objective is therefore to develop an understanding not just of what works in terms of specific teaching approaches in specific contexts, but also an understanding of why different approaches are successful in order to support teachers in making informed choices about what is likely to be effective in their own context.

In terms of research, the aim is to build on earlier reviews in this area (e.g. Hattie *et al.*, 1996) and to identify recent research evidence about the how pupils' learning capabilities can be developed in the light of recent conceptual development in the area of metacognition and self-regulation (Pintrich, 2003).

Methods of the review

A systematic search of the literature was undertaken to identify relevant studies. This aimed to identify research which had been undertaken in primary and secondary schools in order to develop pupils' learning capabilities (rather than just their attainment in specific aspects of the curriculum) by the explicit teaching of learning skills or strategies. 'High' weight of evidence (WoE) was applied to studies which looked at issues of implementation,

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and sustaining change and improvement as this was identified as a key challenge from the members of the advisory groups. Once this literature had been identified, it was classified or keyworded and analysed to produce a map of the kinds of research that have been undertaken and where there was evidence about developing pupils' learning capabilities (such as in which subjects of the curriculum and what ages of learners). From this map, a sub-sample of studies was identified where the research had been conducted on a larger scale and which was then reviewed in greater depth.

Results

There are effective approaches which teachers can use to develop pupils' learning capabilities and the characteristics identified in the review include the following:

- structured tasks that focus on specific metacognitive strategies in the context of the lesson/subject
- capacity built into activities in lessons for more explicit transactions between the learner and the teacher concerning the purpose of the activity
- small group interactions promoting the articulation of the use of strategies during teaching
- mechanisms built into the task to promote the checking of mutual understanding of the goals by peers and with the teacher
- enhanced opportunities for the learner to receive diagnostic feedback linked directly to the task

For example, in science, explicit processes necessary for designing experiments should be identified, such as planning, justifying and evaluating and tasks developed within the specific context of the lessons to scaffold learners' performance and to establish effective feedback loops to monitor progress (Olina and Sullivan, 2004; Toth *et al.*, 2000). In another example (Vauras *et al.*, 1999), inquiry skills are developed by envisioning snapshots of what it would mean to be successful at each stage of the task combined with consolidation through the completion of concrete tasks. The key components of the interventions are planning, based on a good understanding of the processes of learning, key concepts of the content to be studied, and an awareness of the learning context. There is also support for the view that the orientation towards learning should be one in which success results from appropriately guided effort and not on a construct of ability (Dweck, 1999). In short, approaches which explicitly develop learners' awareness of strategies and learning techniques by which they can succeed are effective, particularly when they are targeted at the metacognitive level.

The key components identified from the studies included in the in-depth review are as follows:

- the need for a clear understanding of the features of the relevant learning processes to achieve success in a particular context
- the design of concrete tasks to scaffold the development of the awareness of the processes and their importance for success
- opportunities to feedback during the task, thus enabling teacher intervention and also provision for this to become gradually internalised as self-regulation
- explicit emphasis on developing capability through effort and the possibility of improving performance by responding to feedback and adaptation

We can also identify some necessary conditions:

- The teacher needs to have an alignment of a good understanding of learning, in terms of the subject and the context - what European educationalists would call 'didactics'.
- There is also the need for the teacher to have access to concrete tools and strategies to guide the learner and enhance opportunities for feedback.
- Both teachers and learners should have an orientation towards learning, characterised by a willingness to engage in dialogue and negotiation regarding the intent and purpose of a particular teaching and learning episode.
- The focus should be on how to succeed in terms of the selection of appropriate strategies and making the right effort rather than on ability.

However, the messages in the research are neither simple, nor conclusive. The lack of conceptual clarity regarding the provenance and use of terms, such as 'learning capability', means that the studies included in the review are located within different, if overlapping, frameworks offering different interpretations of why an intervention might be effective. There is also a tension between approaches to learning skills which emphasise content (in terms of mastery of specific skills) and process (in terms of locating skills within an overall understanding of learning approaches). Therefore, in the short term, the most effective means to improve performance where the assessment focuses on content knowledge is likely to be direct instruction. In the longer term, or where assessment focuses on conceptual understanding, metacognitive or strategic approaches are more likely to be effective.

Implications

While there are approaches which can be used effectively by teachers in classrooms in schools to develop pupils' learning skills and capabilities, research findings need to be 'translated' (Toth *et al.*, 2000), rather than simply applied to school settings. There is a reported tension between teachers adhering closely to the *format* of a programme and their having the deeper understanding and critical distance necessary to adapt the *ideas* to context (Dusenbury *et al.*, 2003). It is therefore important that teachers understand the principles underpinning approaches which seek to develop pupils' learning skills and capabilities (Hattie *et al.*, 1996). This is so that, as different approaches are used and adapted, in various learning contexts, they achieve the aims or intentions underpinning the approach. The planning of professional development to support teachers in using these approaches is therefore both essential and challenging, if development in schools is to be sustained beyond an initial innovative phase.

At policy level, specific consideration of the development of learning skills and capabilities as part of the curriculum needs to include explicit

advice that such development should not only be embedded in the curriculum, but should also be taught in such a way that this is explicit to pupils. Opportunities to achieve this should be identified in the early stages of schooling as well as for older pupils. It should also be recognised that it can be difficult to assess the impact of such approaches in both the short term and in terms of the development of a learner's identity over time. Further research is needed to identify what would be the most appropriate learning outcomes to judge the effectiveness of such interventions (James and Brown, 2005). Any such research needs to identify both short-term and longer-term indicators which can be related both to attainment in the curriculum and to learners' meaningful participation in learning.

This review has been conducted as part of a series of reviews of education research supported by the EPPI-Centre. Other completed reviews have much to say about the development of pupils' learning skills and capabilities and the best conditions for teachers' professional development. Further work is required to relate the findings of this review to the implications from these related reviews.

CHAPTER ONE

Background

The aim of this document is to set out detailed information about a systematic review of the educational research evidence about the teaching of learning skills. The intention of the review is to inform and support current government policy and its implementation, while at the same time supporting the work of practitioners and managers in schools in making strategic decisions to develop an integrated approach to improving teaching and learning in their schools. One of the key issues is to identify how the application of such knowledge by teachers can support development of learning and teaching in their schools and ensure progression in pupils' learning. In particular, strategies to support systematic whole school implementation need to be identified from a research and evidence base.

This report details the processes of the review and the methods used to locate, describe and synthesise research studies relevant to the themes.

Outcomes of the review are as follows:

- A research report describing the background and processes of the review, a map of the evidence base, and an in-depth review of a key area (to be determined by a policy steering group)
- A research summary for policymakers identifying the key issues
- A research summary for practitioners with recommendations to support systematic whole-school implementation
- Guidelines for practitioners and school managers on developing learning skills to be disseminated via the National Strategy networks.

1.1 Aims and rationale for current review

Although there is extensive research evidence about the effectiveness of a wide range of learning

and teaching interventions, it is difficult to interpret and use this knowledge at both policy and practice levels. While systematic reviews can go some way towards clarifying matters, they are only part of the answer (Higgins and Hall, 2004). A degree of consensus has been achieved in a few key areas - such as thinking skills, following the review by Carol McGuinness (1999), and assessment for learning, resulting from the work of the Assessment Reform Group (Black and Wiliam, 2004). It is still challenging for schools to use this information and to manage development effectively and ensure that this development is sustained. This is partly because there is a lack of information about what the indicators are in terms of a progression in pupils' thinking and learning, and what can be achieved with a whole-school approach. As a result, there is a danger that schools may not be in a position to make informed choices about effective approaches to develop learning and teaching more systematically.

The key thinking and learning skills are identified in the White Paper *14-19 Education and Skills* (DfES, 2005b) as follows:

- Enquiry includes asking relevant questions, planning and testing conclusions.
- Creative thinking includes suggesting hypotheses and imaginatively challenging ideas.
- Information processing includes locating and classifying information.
- Reasoning includes explaining opinions, actions and decisions, using deduction.
- Evaluation includes assessing evidence, judging against criteria and values.

One of the intentions behind the review was to bring together evidence from a range of sources and to relate it to current policy initiatives,

particularly SNS and PNS initiatives currently being implemented in schools. This is to map what is known from the research and evidence base onto subject specialisms and effective pedagogies. The aim is therefore to develop an understanding not just of what works in terms of specific teaching approaches in specific contexts, but also an understanding of why different approaches are successful in order to support teachers in making informed choices about what is likely to be effective in their own context.

1.2 Definitional and conceptual issues

'Learning skills' is a very broad term used to describe the various skills needed to acquire new skills and knowledge, particularly in a formal learning setting, such as school or university. The broad general category is often broken down into sub-categories which commonly include the following:

information and communication skills: often including aspects of literacy or literacies

thinking and problem-solving skills: particular the development of critical thinking

interpersonal and self-management skills

The aim of developing learning skills or capabilities is therefore to improve subsequent learning, either by developing more effective study skills and habits, or by improving specific skills (for an aspect of literacy, such as comprehension or inference) which will be the basis or the prerequisite for further learning. The concept is therefore closely associated with *learning to learn* and the development of *independent learning skills* as well as the concept of *transfer of learning* across or between contexts. In terms of current policy initiatives, it has clear links with *personalised learning* and *assessment for learning* in the way that it focuses on the role of individual learners in improving their own performance.

1.2.2 Skills, competencies, capacities and capabilities

Vocabulary and terminology in this area are disputed (Hargreaves, 2005) and there is no consensus about language to talk about how training or education develops and changes an individual's ability to benefit from what they have learned in their subsequent experience. There is a general dissatisfaction with the concept of skills and its limited view of learning and performance, particularly from a philosophical perspective. This is evident both in the literature about thinking skills (e.g. Higgins and Baumfield, 1998) and transferable skills (e.g. Bridges, 1993). The underlying concern is that a learner should not only be able to make choices intellectually or academically but should also be able to

pursue them practically. Bridges (1993) explores some of the different concerns underlying the notions of cross-curricular, generic, core and transferable skills, and relates these to what is in some sense more fundamental or generally applicable in learning. In particular, he identifies that cross-curricular skills tend to be discussed in terms of their relationship to cognitive domains, and transferable skills in relationship to social domains. In either case, the notion of transfer has to be based upon some theory of discrete domains as Higgins and Baumfield (1998) also argue. Bridges suggests that the solution may be in what kinds of capacity might be involved in being able to perceive the *applicability* of knowledge and skills derived from one social or cognitive context in another, to adapt, modify or develop it so as to enable a person to use it in different circumstances. The shortcomings of the concept of skills are particularly evident therefore when the notion of transfer of learning skills from one context to another; for a more detailed discussion, see Moseley *et al.* 2005, Chapter 1. Different possible solutions to this issue have emerged, with developments in critical thinking and learning to learn adopting the notion of dispositions for learning (Claxton and Carr, 2004; Perkins, Jay and Tishman, 1993; Perkins *et al.* 2000) or habits of mind (Tishman, 2000). In higher education and educational leadership, the idea of learning capabilities rather than skills has also gained some acceptance (Duignan, 2004; Stephenson & Weil, 1992).

Looking originally at mathematical learning, Sfard (1996; 1998) proposed that 'education research seems to be caught in between two metaphors', which she calls the 'acquisition metaphor and participation metaphor' (p 399). According to Sfard (1996), the learning as acquisition metaphor is deeply embedded in thinking about learning. Language such as 'acquisition of mathematical concepts and processes, building up mathematics...' (p 400) implies that knowledge is something that is acquired. Phrases such as 'the teacher may help the student to attain her goal by delivering, conveying, facilitating, mediating etc.' (p 400). All these expressions suggest that skills and knowledge are viewed as a commodity which can be accumulated and learning is amounts to the acquisition of this commodity. However, there has recently been a shift in the language of learning mathematics, where the metaphor of 'learning-as-participation' has become more apparent. Unlike the acquisition metaphor, learning as participation highlights the importance of learner as a participant in activities. It represents a 'linguistic turn' (Sfard, 1998) in which 'the permanence of having gives way to the constant flux of doing' and further 'suggests that the learner should be viewed as a person interested in participation in certain kinds of activities rather than in accumulating private possessions' (p 6). Learning activities are therefore seen as experiences which take place in contexts which have significant social, cultural

Figure 1.1 Strategic and reflective thinking

Engagement with and management of thinking/learning, supported by value-grounded thinking (including critically reflective thinking)

PHYSICAL	COGNITIVE		EMOTIONAL
<i>Information-gathering</i>	<i>Building understanding</i>	<i>Productive thinking</i>	
Experiencing recognising and recalling	Development of meaning (e.g. by elaboration, representing or sharing ideas)	Reasoning	
Comprehending messages and recorded information	Working with patterns and rules	Understanding casual relationships	
	Conception formation	Systematic enquiry	
	Organising	Problem-solving	
		Creative thinking	

and situational specificity. From this perspective, learning is also ‘process of becoming a member of a certain community’ (p 6) about learning the language of that community and participating according to the expected social and cultural norms; see James and Brown (2005) for a further discussion of this issue and the challenge of understanding the nature of learning outcomes in the light of this issue. Sfard (1996) stresses that both perspectives have value and concludes that ‘the acquisition and participation metaphor, when combined together, run a good chance of gratifying all our needs without perpetuating the drawbacks of each one of them’ (p 409).

Mindful of these issues, we have framed the key research question for this review in terms of pupils’ learning *capabilities*. Stephenson points out that the concept of ‘capability depends much more on our confidence that we can effectively use and develop our skills in complex and changing circumstances than on our mere possession of those skills’ (1992, p 1). This therefore includes an effective as well as a cognitive dimension. He further suggests that capable people have confidence in their ability to ‘take effective and appropriate action within unfamiliar and changing circumstances’. He defines the concept of capability as follows:

an all round human quality, an *integration* of knowledge, skills, personal qualities and understanding *used appropriately and effectively* - not just in familiar and highly focused specialist contexts but in response to new and changing circumstances. (Stephenson, 2000, p 2; author’s italics)

1.2.3 Frameworks for classifying thinking and learning skills interventions

In a recent review conducted by the Centre for Learning and Teaching (Moseley *et al.*, 2004) of classifications and frameworks for describing thinking, conducted for the Learning Skills Development Agency (LSDA) and the further extension of this work (Moseley *et al.*, 2005) across the ages of schooling, we have proposed an integrated framework of classifications and taxonomies of thinking as it applies to teaching and learning. This is based on a systematic review of over 50 distinct approaches to describing and classifying thinking. The model maps on to the National Curriculum thinking skills framework, but is more comprehensive in the thinking and learning skills covered. This is particularly in terms of memory and recall and in terms of metacognition and self-regulation of learning. The model has been adapted to include categories for the physical domain (for example it encompasses learning in Physical Education) and emotional domain (following Bloom’s (1956) original taxonomy and its revision (Anderson and Krathwohl, 2001)).

One of the intentions of using this model was to classify studies located in the mapping stage of the review in terms of the broad categories of physical, cognitive (and the sub-categories of information-gathering, building understanding and productive thinking) in order to show where there is research evidence applicable to learning skills in each of these areas. In addition, the classification can be used to identify potentially relevant studies for in-depth review (such as in the area of problem solving or creative thinking for example). The areas therefore form part of the keywording to create the map of research and help to structure the in-depth review.

1.3 Policy and practice background

One of the aims of this review in terms of its policy background is to support one of the five core components of the development of personalised learning through ‘teaching and learning strategies that actively engage and challenge learners and develop their ability to focus on their learning skills and their capability to take ownership of their own progress’ (NCSL, 2005). This provides a clear focus on approaches which support metacognition and self-reflection as is made explicit in Key Stage 3 Strategy materials: ‘personalised learning is an approach to teaching and learning that stresses deep learning as an active, social process and which is explicit about learning skills, processes and strategies’ (DfES, 2005a, p 5). A similar vision is set out for primary schools:

The Primary Strategy will develop a framework for learning and teaching across the curriculum. The framework will propose the range of learning skills, knowledge and understanding that children should develop as they progress through primary school. It will help teachers to map the development of different learning skills against the opportunities offered by the different curriculum areas. Bringing together the development of learning skills and progression across the subjects in the National Curriculum will help schools to shape and define their individual whole school curriculum, and make sure that children are acquiring a really wide range of skills as they learn. (DfES, 2003, p 29)

The Primary National Strategy has also focused in its *Learning and Teaching* materials (2003) on affective as well as cognitive aspects of learning. The review, has therefore included within the definition of self-regulation features such as self-awareness, managing feelings, motivation, empathy and social skills (see Figure 1.1).

1.4 Research background

The most relevant review in the area of learning skills is the meta-analysis of the effects of learning skills interventions on student learning by Hattie *et al.* (1996). Their review aimed to identify the features of study skills interventions which lead to successful learning. The kinds of studies which they identified typically focused on task-related skills, self-management of learning, or affective components, such as motivation and self-concept. Interventions were also classified with regard to their impact in terms of near and far transfer of learning (Perkins and Salomon, 1989). Their findings support the notion of situated cognition in that teaching other than for basic recall should ‘be in context, use tasks in the same domain as the target context and promote a high degree of learner activity and metacognitive awareness’ (p 1). There is a general consensus that the direct teaching of all-purpose learning or study skills is not effective (e.g. Pintrich and De Groot, 1990; Tabberer,

1984) and that ‘if strategy training is carried out in a metacognitive, self-regulative context, in connection with specific context rather than generalised skills, and if such training is supported by the teaching context itself, positive results are much more likely’ (Hattie *et al.*, 1996, p 129).

Other reviews broadly support this position. Sipe and Curlette (1997) used meta-analytic techniques to identify factors which support student achievement and used Walberg’s (1984) educational productivity model as a theoretical framework. This model identifies aptitude (ability, development and motivation), instruction (amount and quality) and environment (home, classroom, peers, television) as significant factors affecting student achievement. They refer to their study as a ‘meta-synthesis’ as they undertook a quantitative synthesis of other meta-analyses.

One of the key findings from this review and an earlier metasynthesis by Hattie (1992) is that the effect of typical educational interventions is to raise pupils’ achievement by about 0.4 of a standard deviation (the effect size). This is equivalent to raising the average attainment of class by about 16 percentage points. This provides a good benchmark against which to judge the impact of different approaches to raising attainment; see Higgins *et al.* (2005) for a more extensive discussion of interpreting effect sizes in the context of research into thinking skills approaches.

Hattie’s (1992) metasynthesis included 134 meta-analyses published between 1976 and 1985; the metasynthesis by Sipe and Curlette included 103 meta-analyses (of over 4,000 primary research studies) published between 1984 and 1993. One further significant meta-analysis is that of Marzano (1998), who summarised research on the teaching and learning of over 4,000 effect sizes, involving 1.2 million students. His approach was also theory driven and examined the impact on learning across several aspects of thinking and learning: the self-system, and metacognitive, cognitive and knowledge domains.

The majority of techniques identified in Marzano’s meta-analysis were designed to be used by teachers (2,893). However, those designed to be used by students (1,164) had a higher average effect size (0.73 versus 0.61). Techniques designed to be used by students (explicit techniques and strategies) produced an average percentile gain of 27 points; techniques designed to be used by teachers (implicit techniques and strategies or teaching approaches) produced an average percentile gain of 23 points. Marzano speculates that the difference might be due to the fact that any techniques employed by students automatically demand the use of the metacognitive system, thus increasing the extent to which students generate strategies, monitor the effectiveness of those strategies, and employ various dispositions, such as

seeking accuracy or restraining impulsiveness.

Other reviews have focused on specific aspects of thinking and learning skills. Examples of these include the meta-analysis of the value of the teaching of note-taking by Kobayashi (2006), the effects of problem-based learning on knowledge and skills (Dochy *et al.*, 2003) and the impact of cognitive training (Hager and Hasslehorn, 1998). Another example of a study which fits a broader definition of learning skills is the review of reciprocal teaching by Rosenshine and Meister (1994). This is a teaching approach which features 'guided practice in applying simple concrete strategies to the task of text comprehension' (Brown and Palincsar, 1989). It includes cognitive techniques, such as summarisation, question generation, clarification and prediction, supported through dialogue between teacher and students (or students and students) as they attempt to gain meaning from a text. Rosenshine and Meister's review includes 16 studies with quantitative data of reciprocal teaching. The review found an average effect size of 0.32 when the impact of the intervention was measured, using standardised tests, and an average effect size of 0.88 when more specific tests developed by the researcher were used.

The current review conducted by the Centre for Learning and Teaching specifically focuses on the explicit development of pupils' learning capabilities in schools by their teachers. It aims to build on earlier existing systematic reviews. Learning skills was the focus of considerable research in the 1980s but, by the end of the decade, the consensus that developed from this work was that the direct teaching of general or all-purpose study skills is not effective (e.g. McCombs, 1984; Tabberer, 1984; Pintrich and De Groot, 1990). Subsequently, the research focus moved to other factors, such as learner strategy training, motivation, self-efficacy and self-regulation, with a keen interest in the specific and social nature of the learning situation (e.g. Brown *et al.*, 1983; Derry and Murphy, 1986; Garner, 1990).

In the area of learning skills, the analysis by Hattie *et al.* (1996) has some important findings which remain relevant to policy and practice. This review aimed to identify features of learning skills interventions that are likely to lead to success. Using meta-analysis, the authors reviewed 51 studies where the reported interventions aimed to enhance student learning using either one or a combination of learning or study skills. They found the following:

- The effects of learning skills interventions are greatest on performance, but are also effective at improving learners' attitudes and feelings towards learning (affective measures).
- Approaches which target learners' attributions, memory or structural aids (such as advance

organisers, graphic organisers, or writing strategies) tend to be more successful than those which aim to improve motivation or study skills directly.

- It is easiest to improve performance on closely related content, tasks and activities; the further the 'transfer', the harder improvement is to achieve.
- Low attaining pupils tend to benefit from all types of approaches, mid-range attainers tend to benefit most from approaches which offer specific strategies or techniques, and high attainers benefit most from approaches which target memory or approaches which support self-management.
- The younger the students, the more they tend to benefit. Learning habits develop at a young age and are hard to change.
- In terms of strategy training, they suggest a number of successful conditions:
 1. High and appropriate motivation, including self-efficacy and appropriate attributions (such as attributing failure to lack of effort and setting realistic and attainable goals)
 2. The strategic and contextual knowledge for doing the task
 3. A teaching and learning context that supports and reinforces the strategies being taught

The Thinking Skills Review Group have undertaken three EPPI-Centre reviews in the area of thinking skills (Higgins *et al.*, 2003; Higgins *et al.*, 2005; Baumfield *et al.*, 2005), looking at the impact of thinking skills approaches on pupils using narrative and quantitative synthesis as well as reviewing the impact on teachers. The inclusion criteria for this review were therefore specifically designed to avoid replication of this work, and to avoid replicating the work of other reviews in related areas (such as peer- and self-assessment, and the use of learner strategies in Modern Foreign Language teaching (Hassan *et al.* 2005).

A further review was deemed necessary in order to support current policy initiatives in England and to ensure that research evidence in the area of learning skills was sufficient to cover current needs (taking into account existing and commissioned EPPI-Centre reviews), as well as to update earlier published reviews in this area.

1.5 Authors, funders and other users of the review

The review was conducted to support the development of current national policy in developing the role of learning skills in schools in England and is complementary to other

national initiatives, such as the development of personalised learning. As an EPPI-Centre review, it is part of the development the evidence-based policy and practice initiative funded by the Department for Education and Skills. This aspect of the review is reflected in the expertise of the Policy Steering Group.

The Review Group were all members of the Research Centre for Learning and Teaching at Newcastle University, which has significant expertise in systematic and critical literature reviews. Members of the Group have been involved in a number of major reviews and have developed skills in the identification, review and management of large review libraries. The outcomes have been both qualitative and quantitatively focused reviews exploring areas, such as frameworks and taxonomies of thinking (Moseley *et al.*, 2005), the impact of thinking skills approaches on teaching (Baumfield *et al.*, 2005) and learning (Higgins *et al.* 2003; 2005a), learning styles (Coffield *et al.*, 2004), school building programmes (Woolner *et al.*, 2005), the effects of the physical learning environment (Higgins *et al.*, 2005b) and information and communication technologies (ICT) (Higgins, 2003).

The practitioner perspective was developed through the involvement of the Local Advisory Group who each had experience of involvement in either EPPI-Centre reviewing or similar initiatives.

1.6 Review questions

Following the agreement of the outline of the review by the Policy Steering Group, the Review Group completed a review protocol in accordance with procedures for conducting an EPPI-Centre review. After feedback from the EPPI-Centre team, some revisions to the review question and the inclusion/exclusion criteria were made to ensure that the focus of the review did not overlap

significantly with earlier reviews undertaken by the group (such as excluding published thinking skills programmes) or other reviews currently underway (such as studies which focus on self- or peer-assessment as this is the subject of an Assessment Review Group systematic review).

The review question was refined accordingly as follows:

Which teaching approaches that explicitly aim to develop pupils' learning capabilities are effective?

The search strategy therefore sought to identify empirical classroom-based research in which the aim of the approach or intervention was explicitly to improve aspects of pupils' learning by focusing on particular teachable skills and capabilities. Particular weight was given to studies which looked at issues of implementation and sustaining change and improvement as this was identified as a key challenge from the members of the advisory groups.

The review was undertaken in two main stages. The first stage involved searching and mapping to produce a map of existing research and evidence. The key terms for this mapping stage were agreed with the policy steering group as this classification determined the questions which could then be answered at the second stage of the review. The second stage was a more detailed, in-depth review of a sub-set of these studies relevant to the development of learning capabilities through metacognition and self regulation where the approach had been implemented in three or more schools in order to identify issues about implementing such approaches across schools and about the sustainability of any such initiatives.

CHAPTER TWO

Methods used in the review

This section describes the methods used in the review in terms of the involvement of potential users of the review, how relevant research was identified and used in the review, and the systematic reviewing techniques used in its analysis.

2.1 User involvement

2.1.1 Approach and rationale

The intention was to involve potential users of the review and to seek their advice in identifying possible outcomes from the review. There were two main advisory groups, one with a policy focus and one with current practitioner experience in schools. These groups were consulted and met to provide feedback on the focus and process of the review. Feedback to identify the in-depth question was crucial in determining the final focus of the review.

2.1.2 Methods used

User perspectives on the review process and the provisional report have been incorporated into the final report. Details of this review were circulated to those involved. Meetings were held locally and nationally with the two key user group to solicit feedback about the focus of the review and the provisional findings. Methods for this participation included the critical reading of drafts of the protocol and review, and specific involvement of users to assist in incorporating outcomes relevant to different users.

2.2 Identifying and describing studies

2.2.1 Defining relevant studies: inclusion and exclusion criteria

The review identified educational research literature in which there was empirical evidence about effective approaches to developing thinking and learning skills through pupils' active involvement in their awareness and management of their own learning. In order to identify this literature, a set of key terms was used for searching for literature, such as metacognition, self-regulation / self-regulated learning, assessment for learning, and thinking for learning. These criteria therefore included studies set in schools with mainstream pupils aged 4-19, where the focus of the study was an explicit attempt to improve learning skills but where the approach was not a published thinking skills programme (for full details, see Appendix 2.1).

The search covered the ages of schooling (from the Foundation Stage to Key Stage 4) and all National Curriculum subjects (plus RE). Emphasis was placed on studies in which the teaching of learning capabilities was integrated or infused into the curriculum. Priority was given to studies for which the research was set in schools and the teaching undertaken by usual teaching staff (both class teachers and specialists or classroom assistants, according to what was usual in a particular setting). For further details about the search strategy and the inclusion criteria for the review, see Appendix 2.2 and Appendix 2.1.

Classifying the studies aimed to take account of the possible links with a range of policy areas. This meant that a set of review-specific keywords (see Appendix 2.3) was developed in consultation with the Advisory Group so that potential sub-questions in these areas for the in-depth review could be addressed.

2.2.2 Identification of potential studies: search strategy

The review focused on journal articles as the main source of identifying potential studies. Journal articles offer some degree of quality control, since such papers are usually (but not necessarily) peer-reviewed 'blind' by at least two referees with expertise in the topic area; submissions to a journal normally contain the authors' considered presentation of empirical data from a research study and its interpretation, which may have also benefited from revisions suggested by the referees. Furthermore, journal articles are evidently in the public domain and can usually be obtained easily, so the use made of a particular article in a systematic review of the literature is open to scrutiny and validation.

The arguments about publication bias which can occur if unpublished studies are not included in a systematic review are well-known (e.g. Lipsey and Wilson, 1993; Thomas and Harden, 2003; Torgerson, 2003). However, the problem of publication bias is felt to be much more applicable to quantitative synthesis (especially randomised controlled trials), although this potential bias will need to be taken into account in interpreting the findings of the review. Experience from other reviews suggests that the lists of sources below are likely to be the key sources for both electronic searching and handsearching for this review. The importance of carrying out an extensive handsearch has been noted by Black (2004).

Searching of these sources was limited to identifying studies conducted in a specific time period (1994-2005) in order to build on the major metasyntheses of Hattie et al. (1996), Sipe and Curlette (1997), and Marzano (1998).

A database system, using bibliographic software (Endnote), was used to keep track of studies in the searching phase and coding studies found during the review. Titles and abstracts were imported and entered manually into the first of these databases.

2.2.3 Screening studies: applying inclusion and exclusion criteria

There were five stages involved in the process of identifying and analysing the studies used to address the review question:

1. Creation of the main review database of citations, involving all possible papers based on the search strategy (recorded using EndNote)
2. First-stage inclusions were identified, based on applying the inclusion and exclusion criteria to the titles and abstracts of papers identified in the main review database.
3. Second-stage inclusions were identified, based on applying the inclusion and exclusion criteria to a full-paper copy of papers identified as first-

stage inclusion.

4. Mapping stage: the second-stage inclusions were then be mapped according to their key characteristics (using the EPPI-Centre and review-specific keywords - see section 2.2.4).
5. In-depth analysis: data-extraction of papers included in the in-depth analysis was undertaken using EPPI-Centre's online software, EPPI-Reviewer (see section 2.3).

Inclusion and exclusion criteria were therefore applied successively to (i) titles and abstracts, and (ii) full reports. Full reports were obtained for those studies that appear to meet the criteria or where there was insufficient information to be sure. These reports were entered in to a second bibliographic database. The inclusion and exclusion criteria were re-applied to the full reports and those that did not meet these initial criteria were excluded.

2.2.4 Characterising included studies

Retrieved reports that met the inclusion criteria were classified according to a standard keywording system developed by the EPPI-Centre (EPPI-Centre, 2002). This classifies studies in terms of the type of study; the country in which the study was carried out; the educational focus of the study; and the study population. An additional set of review-specific keywording questions was developed by the Review Group (see Appendix 2.3); these questions were also applied to each study. Questions included further details about the research sample, the teacher and pupils, as well as about the focus of the intervention and data collected.

2.2.5 Identifying and describing studies: quality-assurance process

Application of the inclusion and exclusion criteria and the keywording was conducted by pairs of Review Group members, working first independently and then comparing their decisions before coming to a consensus. Members of the EPPI-Centre assisted in applying criteria and keywording studies for a sample of studies.

2.3 In-depth review

2.3.1 Moving from broad characterisation (mapping) to in-depth review

Due to the number of studies included at this stage of the review, the mapping process was used to refine the review question and the scope of the review in order to reduce the number of papers that were subjected to in-depth analysis. This decision was taken with guidance from both the National Policy Steering Group and the Local Advisory Panel. Keywording of papers included in the map was undertaken using the EPPI-Centre's online software, EPPI-Reviewer.

To be included in the review, studies need to meet the following criteria:

Scale: The studies were conducted in three or more schools.

Ecological validity: The teaching was undertaken by staff normally working in the schools involved.

Focus of the intervention: The study concerned the development of learning capabilities and described an intervention of which the aim was to develop students' strategic learning skills through metacognition or self-regulation.

2.3.2 Detailed description of studies in the in-depth review

Studies identified as meeting the refined inclusion criteria were analysed in depth using the EPPI-Centre's data-extraction guidelines together with its data-extraction software: the EPPI-reviewer. Additional questions specific to this review question were also included.

2.3.3 Assessing quality of studies and weight of evidence for the review question

Studies identified as meeting the map and in-depth inclusion criteria were analysed using the EPPI-Centre's detailed data-extraction software, EPPI-Reviewer.

The specific question for in-depth review was identified as follows:

Which teaching approaches that explicitly aim to develop pupils' learning capabilities and which have been used in at least 3 schools show evidence of improved learning of pupils?

A further sub-question was added to identify issues in scaling up interventions or teaching approaches across schools:

What issues are identified in these studies about implementation or scaling up of the teaching approach?

Three components were identified to help make the process of apportioning different weights to the findings and conclusions of different studies explicit. Such weights of evidence (WoEs) were based on the following:

- A. Soundness of studies (internal methodological coherence), based upon the study only
- B. Appropriateness of the research design and analysis used for answering the review question
- C. Relevance of the study topic focus (from the sample, measures, scenario, or other indicator of the focus of the study) to the review question

- D. An overall weight taking into account A, B and C.

The EPPI-Centre guidelines for assessing the quality of studies in EPPI-Reviewer require the WoE to be judged both according to the internal validity and reliability of each study, and external or ecological validity in terms of the value for our particular review.

Weight of evidence 'A' refers to the internal consistency of the study in the sense of: Can the reported findings be trusted in answering the researchers' own study question? Or the extent to which a study is carried out according to accepted practice for the methodology adopted.

Weight of evidence B is concerned with the appropriateness or applicability of the research design for our review question.

Weight of evidence C is concerned with the focus of the study for our review question.

The review specific WoE criteria involved judgements about the three key areas of the studies as set out in section 2.3.1 in-depth review criteria: Scale, ecological validity, and focus of the intervention.

Weight of evidence D is concerned with the overall weight of evidence when A, B and C are combined.

A, B, C and D are all classified as high, medium or low. The classification of WoE D is determined by the average grade given for A, B and C.

Issues in establishing the weight of evidence often revolved around the transparency of reporting and whether sufficient information was provided in the study to make judgements about aspects of the research (such as fidelity of implementation of the thinking skills programme or approach).

2.3.4 Synthesis of evidence

At the heart of the concept of systematic review is the notion of synthesis: the combination and integration of findings from research evidence. Two main approaches to literature review have been used in education: narrative review and meta-analysis (statistical or quantitative synthesis), although both have been the subject of criticism with suggestions for improvement and combination: for example, the proposals by Slavin (1986) for best evidence synthesis or the meta-analysis of Azevedo and Bernard (1995) of the effects of computer-presented feedback on learning from computer-based materials, where quantitative and qualitative meta-analytic techniques were used to synthesize the empirical evidence of the effects of feedback on learning from computer-based instruction.

The EPPI-Centre techniques and tools maintain this broad dichotomy between narrative and meta-

analytic techniques, although the data extraction procedures and synthesis tables go some way to making narrative reviews more transparent, similar to some of the procedures in thematic analysis (Mays *et al.*, 2001) or case survey techniques (Yin and Heald, 1975).

EPPI-reviews, however, still require critical decisions to be made about the scale and scope of the review which have a direct impact on the synthesis of evidence. These are particularly in the early stages of the review design, the choice of research question, development of review-specific keywording, and weight of evidence criteria, inclusion/exclusion criteria, and the search strategy.

The tension in reviewing research evidence can be characterised as the challenge of balancing flexibility with transparency. Narrative review techniques tend to be flexible in the forms of evidence that they can include, both qualitative and quantitative, but can lack transparency in terms of the specific criteria used to inform any judgements. Statistical synthesis methods, on the other hand, promote transparency in their methodology (in that there are generally agreed meta-analytic procedures for combining studies), but they are more restricted in terms of the types

of evidence that can be included. In this review, the data was synthesised to bring together the studies which answered the key review questions and which met the quality criteria relating to applicability and methodology. This was achieved using narrative techniques and the synthesis tools within EPPI-Reviewer (see Appendix 2.4). The synthesis addressed the questions of effectiveness and implementation separately, although, in interpreting the impact of different approaches, judgments were inevitably mediated by the interaction of these two aspects of studies. This was achieved by completing synthesis tables looking at the findings of the study (Appendix 2.3) and at the conclusions in terms of learning skills and implications regarding implementation (Appendix 4.3).

2.3.5 In-depth review: quality-assurance process

Data-extraction and assessment of the weight of evidence to address the review question was conducted by pairs of Review Group members, working first independently and then comparing their decisions before coming to a consensus. Members of the EPPI-Centre assisted in this process for a sample of studies in the in-depth review.

CHAPTER THREE

Identifying and describing studies: Results

This chapter reports the results of searching for, and screening of, studies for this review. It then describes some of characteristics of studies found and included in this review's systematic map - that is, empirical studies conducted in schools about the development of pupils' learning capabilities.

3.1 Studies included from searching and screening

From the electronic databases and full-text collections searched as described in section 2.2, 1,379 citations or references to documents were identified.

Following screening of titles and abstracts, and duplication of citations, 1,198 citations were excluded, leaving 181 reports of studies for further consideration. A further 14 citations were identified through handsearching or personal contacts, making a total of 195 reports of research identified at this stage. After 11 duplicates had been eliminated, the remaining 184 reports were targeted for retrieval. These reports were books or chapters in books, published articles, conference papers, project reports and theses. For these, full copies (either electronic or paper) were then sought through the internet, local university libraries and inter-library loans. Of these, a total of 146 reports were obtained within the timescale identified for this phase of the review. These reports were screened again, using the inclusion and exclusion criteria, once the full report was available and checks were made that the reports referred to different studies. Seven reports described aspects of studies already included and were coded accordingly as linked documents. Fifty-nine further reports were excluded, once the full paper was available. This left a total of 80 studies in the review which were then included in the systematic map.

Figure 3.1 summarises the number of citations, reports and studies involved at the different stages

of the review.

3.2 Characteristics of the included studies (systematic map)

The studies remaining after application of the criteria were keyworded, using EPPI-Centre (2003) Core Keywording Strategy (version 0.9.7). Additional keywords specific to the context of the review were added to those of the EPPI-Centre (see Appendix 2.3). All the keyworded studies were added to the larger EPPI-Centre database, REEL, for others to access through the website.

Twenty countries were represented in the research studies included the review. The largest group come from the United States, with clusters in the UK, Australia and Israel. The majority of the studies are from 'first world' countries.

The curricular focus of studies is dominated by first language literacy, numeracy and science, reflecting the common association of learning skills with core-curriculum subjects, and more generally the focus on these subjects of the curriculum in educational research (Higgins *et al.*, 2003). This is outlined in Table 3.4.

When characterising the included studies, particular attention was paid to identifying how the aspects of developing learning capabilities applied to the framework for classifying thinking and learning skills interventions (Figure 3.1). Due to the nature of the inclusion criteria, all studies included metacognitive thinking or the self-regulation of learning; the additional aspects of learning from each study are represented in Table 3.5.

3.3 Identifying and describing studies: quality-assurance results

Preliminary keywording was undertaken by the core Review Group, who coded a sample of 10 studies collaboratively. Any disagreements were discussed

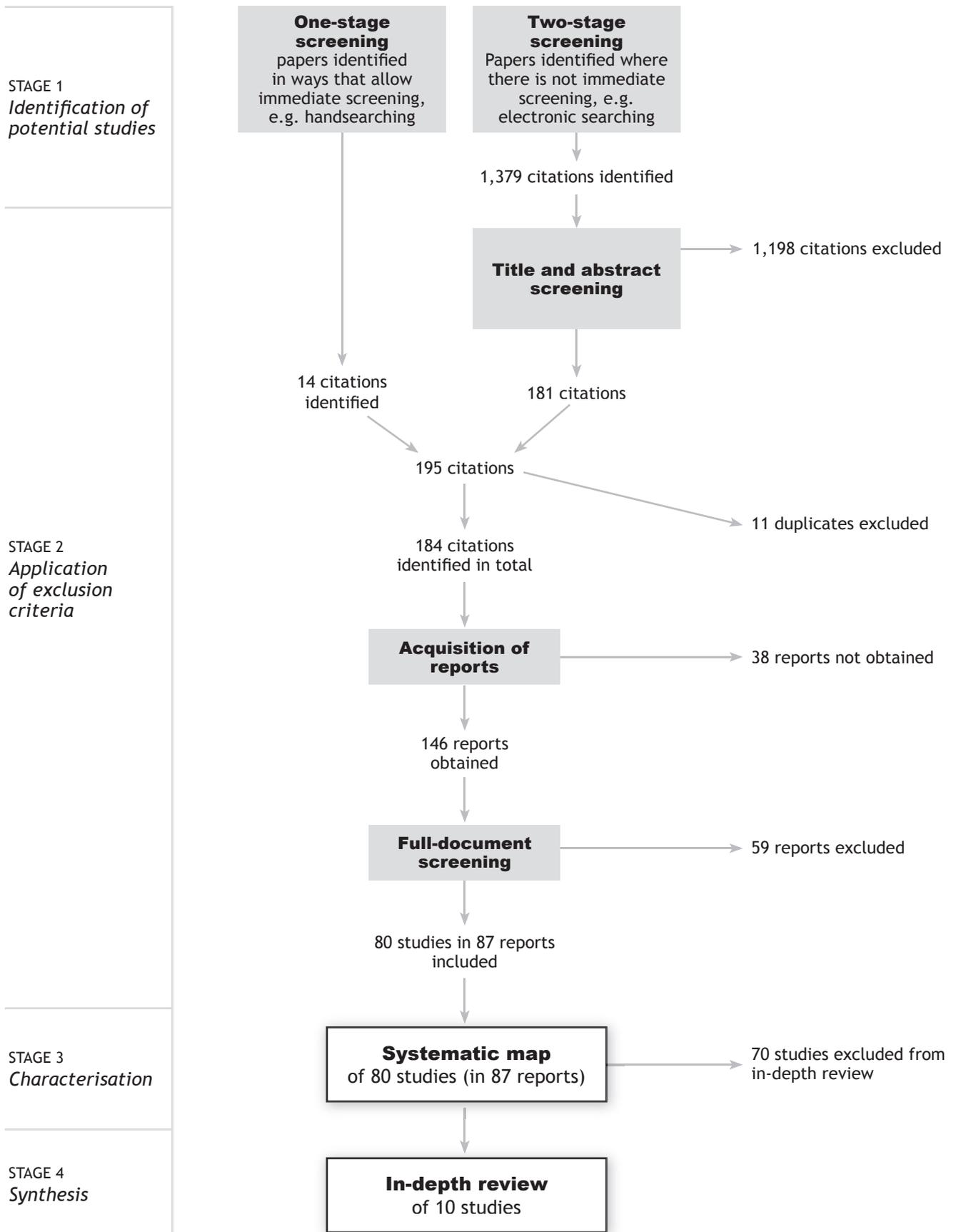
Figure 3.1 Filtering of papers from searching to map to synthesis

Table 3.1

Country in which the study was carried out (N=80, mutually exclusive)

Country of origin	Number of studies
Austria	8
Belgium	2
Canada	2
Croatia	1
Cyprus	2
Finland	3
France	1
Germany	1
Greece	1
Israel	7
Italy	2
Latvia	1
Netherlands	3
New Zealand	2
Singapore	2
Slovenia	1
Spain	2
Taiwan	2
UK	12
USA	25
Total	80

Table 3.2

Distribution of the school setting (N=80, not mutually exclusive)

Type of setting	Number of studies
Primary	33
Secondary	45
Middle	5
Total	83

Table 3.3

Distribution of pupil age (N=80, not mutually exclusive; totals are greater than 80 as studies often included more than one year group)

School setting	Number of studies
5-10 year olds	39
11-16 year olds	54
17-20 year olds	1
Total	94

Table 3.4

Distribution of curriculum focus (N=80, not mutually exclusive)

Subject	Number of studies
Geography	2
Literacy L1	21
Literacy L2	2
Science	23
Maths	20
ICT	2
Art	1
PE	1
Cross-curricular	2
Total	74

Table 3.5

Distribution of aspects of learning (N=80, not mutually exclusive)

Aspects of learning	Number of studies
Physical aspects	2
Information gathering	18
Building understanding	34
Productive thinking	27
Emotional aspects	12
Total	93

and resolved in this initial session. Following this studies, were keyworded individually with a further 10 studies keyworded by two coders to check inter-rater reliability. A further sample of 10 studies was also coded by EPPI-Centre staff to ensure overall consistency.

3.4 Summary of results of map

There is evidence in the educational research literature of the teaching of the explicit teaching of learning skills and learning capabilities. Although the majority of this literature reports studies in the United States, Australia and the UK (all English speaking countries which to some extent reflects the search strategy which only included

studies in English), there is evidence that this kind of research is being conducted rather more internationally. As was found in earlier reviews (Higgins *et al.*, 2003), the majority of studies focus on science, mathematics, English (or the first language of the country where studies were undertaken) as the curriculum focus. Research has been undertaken across the age range in primary and secondary schools, with slightly more research investigating the learning of older pupils. In addition to the metacognitive elements they all share, the balance of aspects of learning in the studies is weighted towards building understanding and productive thinking, rather than information gathering, emotional or physical aspects.

CHAPTER FOUR

In-depth review: Results

4.1 Selecting studies for the in-depth review

In order to meet the aims of the review, specific issues were identified by the Policy Steering Group as potentially valuable. These were issues of scale, applicability of the research to other school contexts, and the explicit development of learning capabilities by teachers. To meet these criteria, the specific question for in-depth review was identified as follows:

Which teaching approaches that explicitly aim to develop pupils' learning capabilities and which have been used in at least 3 schools show evidence of improved learning of pupils?

A further sub-question was added to identify issues in scaling up interventions or teaching approaches across schools:

What issues are identified in these studies about implementation or scaling up of the teaching approach?

Applying these additional criteria to the studies in the systematic map produced a subset of 10 studies which met the additional criteria (see Appendix 4.1 for further details about these studies).

4.2 Further details of studies included in the in-depth review

The in-depth review focuses on ten studies identified from the systematic map in which there is evidence from research undertaken in schools about interventions, which explicitly aimed to develop pupils' learning capabilities. These studies are international in their spread and were undertaken on a scale where at least three schools were involved. The approaches used in the research vary and are based on different theoretical perspectives about learning. However, all have in common a key feature of the research:

the approach included is the development of metacognitive thinking or self-regulation by the learners involved. Further details about the studies in the in-depth review can be found below.

Adey P, Robertson A, Venville G (2002) Effects of a cognitive acceleration programme on year 1 pupils. British Journal of Educational Psychology 72: 1-25

This study was undertaken in the UK with about 300 5-6 year-olds, with activities designed to promote cognitive conflict (based on the principles of cognitive acceleration through science education, CASE) and encourage social construction and metacognition over one school year. The experimental group overall made significantly greater gains in cognitive development over the period of the experiment than the controls, in both direct (effect size 0.47) and transfer (effect size 0.43) tests, although, when genders were considered separately, experimental boys' greater gains than controls did not reach significance. There was no interaction with various social and linguistic variables. In the context of this study, a cognitive intervention programme can have a significant immediate effect on the rate of children's cognitive development. Further work will investigate the longevity of this effect. The intervention consisted of structured small group activities.

De Corte E, Verschaffel L, Van De Ven A (2001) Improving text comprehension strategies in upper primary school children: a design experiment. British Journal of Educational Psychology 71: 531-559

With respect to the acquisition of competence in reading, new standards for primary education stress more than before the importance of learning and teaching cognitive and metacognitive

strategies that facilitate text comprehension. There is therefore a need to design a research-based instructional approach to strategic reading comprehension. The design experiment aimed at developing, implementing and evaluating a research-based, but also practically applicable learning, environment for enhancing skilled strategy use in upper primary school children when reading a text. Four text comprehension strategies (activating prior knowledge, clarifying difficult words, making a schematic representation of the text, and formulating the main idea) and a metacognitive strategy (regulating one's own reading process) were trained through a variety of highly interactive instructional techniques (modelling, whole class discussion, and small group work in the format of reciprocal teaching). Participants in the study were four experimental fifth-grade classes (79 children) and eight comparable control classes (149 pupils).

Method: The effects of the learning environment were measured using a pre-test/post-test retention design. Multilevel hierarchical linear regression models were used to analyse the quantitative data of a reading strategy test, a standardised reading comprehension test, a reading attitude scale, a transfer test and an interview about strategy use during reading.

Results: The data of the reading strategy test, the transfer test and the interviews about strategy use showed that the experimental group outperformed the control group in terms of the strategy adoption and application during text reading. While, the experimental group also scored higher on the reading comprehension test than the control group, the difference was not significant.

Conclusions: This design experiment shows that it is possible to foster pupils' use and transfer of strategic reading comprehension skills in regular classrooms by immersing them in a powerful learning environment.

Desoete A, Roeyers H, De Clercq A (2003) Can offline metacognition enhance mathematical problem solving? *Journal of Educational Psychology* 95: 188-200

The effectiveness of a short metacognitive intervention, combined with algorithmic cognitive instruction, was assessed in an elementary school setting. Two hundred and thirty-seven third-grade children were randomly assigned to a five-session metacognitive strategy instruction, an algorithmic direct cognitive instruction, a motivational programme, a quantitative-relational condition, or a spelling condition. Children in the metacognitive programme achieved significant gains in trained metacognitive skills compared with the four other conditions. Moreover, the children in the metacognitive programme performed better on trained cognitive skills than children in the algorithmic condition, with a follow-up effect

on domain-specific mathematics problem-solving knowledge. Despite the consistency of findings, no generalisation effects were found on transfer of cognitive learning.

Guterman E, Boxall W (2002) Teachers' voices on integrating MCAG into Reading Assessment Tasks. *Reading* 36: 38-43

The paper is an attempt on behalf of the teacher of reading to address some pedagogically significant aspects of metacognition. A study was designed to test the effect of using metacognitive awareness guidance (MCAG) in reading assessment tasks given to nine-year-old pupils (fourth grade in Israel). MCAG addresses five basic habits of mind (HOM) through questions and activities. The rationale for applying it was influenced by Vygotsky's notion of the 'zone of proximal development'. After the study ended, each teacher whose class was part of the treatment group was interviewed. The purpose of the interviews was to gain the teachers' perspectives, thoughts and opinions on applying MCAG to assessment tasks in reading; its role and effects on learner performance and outcomes; and its influence on their daily teaching and learning activities. Their reactions related to four aspects: the use of self-talk, the use of metacognitive learning strategies, the written MCAG, and integrating habits of mind into reading assessment tasks. The implications of the findings are discussed.

Kolic-Vehovec S (2002) Self-monitoring and attribution training with poor readers. *Studia Psychologica* 44: 57-68

This report examined the effects of the self-monitoring and attribution training on accuracy and fluency of reading, as well as on reading comprehension and reading attribution in 60 second-grade poor readers (age 7-8 years). The participants were divided into three experimental groups and one control group. One experimental group was encouraged to carry out self-monitoring and self-correction by token-economy. The second group was instructed to attribute reading success to effort and ability, and failure to lack of effort. The third experimental group was made to follow a combination of self-monitoring and attribution training, while the control group practised reading without feedback. All students showed improvements in reading fluency and comprehension. Self-monitoring training, as well as attribution training and their combination, improved reading accuracy. Changes towards more internal attribution were obtained only in the experimental groups with explicit attribution training being applied.

Olina Z, Sullivan HJ (2004) Student self-evaluation, teacher evaluation and learner performance. *Educational Technology Research and Development*

52: 5-22

A total of 341 Latvian students and eight teachers participated in this study of student self-evaluation and teacher evaluation. Students completed a 12-lesson teacher-directed instructional programme on conducting and writing a report of their own experimental research. Sixteen classes were randomly assigned to one of four treatment conditions: (1) no in-programme evaluation, (2) self-evaluation and revision at the research design and draft final report stages, (3) teacher evaluation and student revision at both stages, and (4) self-plus-teacher evaluation and student revision at both stages. Students in the teacher-evaluation and self-plus-teacher evaluation conditions received significantly higher ratings from an independent rater on their final research reports. However, students under the self-evaluation conditions had greater confidence in their ability to conduct future experiments.

Toth EE, Klahr D, Chen Z (2000) Bridging research and practice: a cognitively based classroom intervention for teaching experimentation skills to elementary school children. *Cognition and Instruction* 18: 423-459

This report describes the first cycle of a multi-year research project aimed at establishing a common ground between educationally relevant psychological research and educational practice. The authors translated a theoretically motivated and laboratory-based instructional procedure into a classroom intervention. 77 students (with a mean age of 10) from four fourth-grade classrooms in Pennsylvania participated. The research design included a set of nested pre-instruction and post-instruction measures. This intervention produced significant gains in fourth-grade students' ability to create controlled experiments, provide valid justifications for their experiments, and evaluate experiments designed by others. It also raised questions about how students understand sources of error during experimentation and how that understanding is related to their level of certainty about conclusions that are supported by the experimental outcomes. The authors view this report as part of a continuing research cycle that includes three phases: (1) use-inspired, basic research in the laboratory; (2) classroom verification of the laboratory findings; and (3) follow-up applied (classroom) and basic (laboratory) research.

Vauras M, Rauhanummi T, Kinnunen R, Lepola, J (1999) Motivational vulnerability as a challenge for educational interventions - a conceptual framework for education. *International Journal of Educational Research* 31: 515-531

The focus of this study was 202 children aged between 4 and 7 years with the question, 'Are there differences among young (third grade) students who are poor learners in their metacognitive (in)competence and motivational vulnerability that are crucial for better self-regulation?' This question was studied in an intervention context, where an effort was made mindfully to implement teaching methods that have been found to be effective in promoting strategic learning. The intervention program was carried out during the school hours in small groups of three to four students during 43 one-hour sessions. Each group received instruction twice a week. During the five-hour introductory phase, the students were helped in building an overall goal for the activities and, in this way, a concrete, holistic vision of skilled learning. All skills-to-be-learned during the forthcoming months were envisioned as snapshots and strengthened by concrete tasks. These tasks also reinforced students' incremental idea of cognitive ability. The subjects were reading comprehension (in environmental science) and mathematical problem solving. The results suggest there is a need for more coordinated, long-term analyses of transactional, strategy-focused instruction that (a) extends over a long period of time, (b) moves from innovative to more conventional settings as students' cognitive and motivational competence increases, (c) is based on students' own, personal and meaningful experiences and competencies, and (d) moves from individual to collaborative, shared and multiple transaction. There also is a need to train students in the use of cognitive and metacognitive strategies, emotional coping, and motivation strategies that promote self-regulation.

White BY, Frederiksen JR (1996) Inquiry, modeling and metacognition: making science accessible to all students. *Cognition and Instruction* 16: 3-118

This study reports on the instructional trials of the ThinkerTools Inquiry curriculum by three teachers in urban 7th-9th grade classrooms in the United States. The curriculum centres around a metacognitive model of research, called the Inquiry Cycle, and a metacognitive process, called Reflective Assessment (RA), in which students reflect on their own and each other's inquiry. The authors collaborated with the teachers to create a computer enhanced, middle school science curriculum that engages students in learning about and reflecting on the processes of scientific inquiry as they construct increasingly complex models of force and motion phenomena. A controlled comparison was made to determine the impact of including the RA. The curriculum proved successful and students' levels of performance improved significantly on both physics and inquiry assessments. Adding the RA to the curriculum was beneficial for low-achieving students. Performance on their research projects and inquiry test was significantly closer to that of high-achieving

students than was the case for controls. This approach was beneficial to both low achieving students and high-achieving students. (Examples of scaffolded inquiry activities, instructions for the mass project, and an example of a student's project report and self assessment are appended.)

Williams W, Blythe T, White N, Li J, Gardner H, Sternberg R (2002) Practical intelligence for school: developing metacognitive sources of achievement in adolescence. *Developmental Review* 2: 162-210

In this US-based study, the researchers sought to boost school achievement by creating an intervention that would develop 'practical intelligence for school' in over 200 middle-school students. The research team worked with teachers in schools in Connecticut and Massachusetts over a two-year period. Teachers were trained to deliver a five-part programme, developed to inculcate practical intelligence by emphasising five sources of metacognitive awareness: knowing why, knowing self, knowing differences, knowing process, and revisiting. A broad range of assessments was administered in a pre-post design both to the children receiving the practical intelligence programme and to matched control children. The programme successfully enhanced both practical and academic skills in each of the target skill areas (reading, writing, homework and test-taking) in children from diverse socioeconomic backgrounds attending diverse types of schools. These results are discussed in terms of the acquisition of cognitive and metacognitive insights during adolescence and the promise such insights hold for enhancing adolescent achievement over and above traditional g-based approaches to learning. Finally, the trade-offs between ecologically based and laboratory-based interventions are discussed.

4.2 Assessments of weights of evidence

Nine of the 10 studies identified for in-depth review were rated as medium quality or above in terms of overall weight of evidence. Seven of which were rated as having a 'high' weight of evidence. Only two studies were rated 'medium' and one study rated as 'low' quality of evidence.

4.3 Synthesis of evidence

The findings from the particular studies in this review and their implementation issues are summarised in Table 4.3. Further details of the particular outcomes of the studies and more detail of the findings as they apply to the review can be found in Appendix 4.2.

There are effective approaches which teachers can use to develop pupils' learning capabilities (Adey *et al.* 2002; Desoete *et al.*, 2003; Toth *et al.*, 2000; White and Fredriksen, 1999; Williams *et al.*, 2002) and the characteristics identified in the review include the following:

- structured tasks that focus on specific metacognitive strategies in the context of the lesson/subject
- capacity built into activities in lessons for more explicit transactions between the learner and the teacher concerning the purpose of the activity
- small group interactions promoting the articulation of the use of strategies during teaching
- mechanisms built into the task to promote the checking of mutual understanding of the goals by peers and with the teacher

Table 4.2 Distribution of aspects of learning (N=80, not mutually exclusive)

Item ID	Author/date	A	B	C	D
IT16621	Adey <i>et al.</i> (2002)	H	H	H	H
IT13509	De Corte <i>et al.</i> (2001)	H	H	H	H
IT266551	Desoete <i>et al.</i> (2003)	H	M	H	H
IT26598	Guterman and Boxall (2002)	L	M	L	L
IT26649	Kolic-Vehovec (2002)	M	M	L	M
T24029	Olina and Sullivan (2004)	M	M	H	M
IT26653	Toth, <i>et al.</i> (2000)	H	H	H	H
IT26611	Vauras, <i>et al.</i> (1990)	H	H	H	H
IT26660	White and Frieriksen (1998)	H	H	H	H
IT26600	Williamson <i>et al.</i> (2002)	H	H	H	H

Table 4.3 Summary of effectiveness and implementation issues

ID/Study	WoE	Evidence of effectiveness	Implementation issues
IT13509 De Corte et al. (2001)	H	Overall positive gains, with some evidence of transfer with lower attaining pupils making the greatest gains in strategy use	Teachers were generally positive about the intervention, but implementation is an important factor where teachers need support.
IT16621 Adey et al. (2002)	H	Significant improvement in the intervention classes in terms of improvement in rate of cognitive development	The significant effect of the teacher suggests professional development and support are important issues.
IT26600 Williams et al. (2002)	H	Practical skills essential to school success can be defined and taught. Significant gains in favour of the intervention groups Practical intelligence for schools (PIFS) at both sites after one year (in reading, homework) and after two years (academic-intelligence and all curriculum measures)	Flexibility in implementing the curriculum is essential. Stand alone and infused lessons play complementary roles. Collaboration between teachers is valuable and PIFS was a tool for teacher reflection and change. Teachers in the elementary schools could follow up and build on skills more easily than subject specialist teachers in middle schools.
IT26653 Toth, Klahr & Chen (2000)	H	Positive impact on learning skills. Expository instruction embedded in exploratory and application experiments is an effective method of teaching aspects of research skills and control of variables. The ability to perform control of variables in specific contexts can be improved relatively rapidly and through experience to experimentation.	Quality of instruction is a key element, as is the students' perceptions of their confidence, which might actually decrease as their skills improve. 'Translation' of research findings into effective practice is challenging.
IT26655 Desoete et al. (2003)	H	Positive impact on mathematical problem solving, but no generalisation effects in terms of transfer of cognitive learning	Metacognitive skills have to be taught explicitly over a significant period of time. The involvement of classroom teachers in supporting the development of metacognitive skills is essential, although para-professionals with adequate training and ongoing supervision can successfully support children in school.
IT26660 White and Frederiksen (1998)	H	Positive impact on inquiry skills. All experimental students showed gains, with low achieving students performing especially well when working in mixed groups with high performing students. There were no gender differences in performance. Younger students (11-13 years) benefited as much as older students. Direct effect on conceptual and factual science learning as well as self-efficacy and attitudes towards learning science. Reflective self-assessment as a component of inquiry learning enhances metacognitive thinking.	Research-based science classes create a climate in which students of widely varying backgrounds and levels of academic achievement can be actively engaged.
IT24029 Olina and Sullivan (2004)	M	Some positive learning gains. Improvement in self-evaluation supported the development of research skills and students' confidence in their ability, although there were no significant differences in their test results.	Teachers' and students' perceptions of what is effective may need to be challenged with evidence.
IT26649 Kolic-Vehovec (2002)	M	Positive impact on reading skills. Attribution training in conjunction with self-monitoring training was no better than self-monitoring training alone. However, early attribution training may prevent the development of learned helplessness.	Duration of the training was sufficient to produce changes in pupils' attributions, but may not have been long enough to ensure changes in reading skills.
IT26598 Guterman & Boxall (2002)	L	Teachers were convinced of learning gains and that 'self-talk' was a successful learning strategy for themselves and for the pupils, who continue to use it in other contexts.	Teachers were found to need reassurance that spending time on metacognitive strategies was valuable and felt 'under prepared' to implement the learning principles effectively.

- enhanced opportunities for the learner to receive diagnostic feedback linked directly to the task

For example, in science, explicit processes necessary for designing experiments should be identified (such as planning, justifying and evaluating) and tasks developed within the specific context of the lessons to scaffold learner's performance and to establish effective feedback loops to monitor progress (Olina and Sullivan, 2004; Toth *et al.*, 2000). In another example (Vauras *et al.*, 1999), inquiry skills are developed by envisioning snapshots of what it would mean to be successful at each stage of the task, combined with consolidation through the completion of concrete tasks. The key components of the interventions are planning based on a good understanding of the processes of learning, key concepts of the content to be studied and an awareness of the learning context. There is also support for the view that the orientation towards learning should be one in which success results from appropriately guided effort and not on a construct of ability (Dweck, 1999). In short, approaches which explicitly develop learners' awareness of strategies and learning techniques by which they can succeed are effective, particularly when they are targeted at the metacognitive level (Guterman and Boxall, 2002; Desoete *et al.*, 2003; White and Fredriksen, 1999) or use self-regulatory approaches (Kolic-Vehovec, 2002).

4.4 In-depth review: quality-assurance results

All the studies in the in-depth review were checked for inclusion by all three members of the core Review Group. Each of the studies was then data-extracted by two members of the team and entered on to REEL, the EPPI-Centre database of educational research. Three studies were also data-extracted by EPPI-Centre staff to ensure consistency across reviews. Any differences were resolved before an agreed version was used in the final synthesis.

4.5 Nature of actual involvement of users in the review and its impact

Feedback from the Policy Steering Group and members of the Local Advisory Group were central to the development of the review question, the inclusion and exclusion criteria and the focus for the in-depth review. A meeting with the Policy Steering Group was also held as the findings from the review were emerging to ensure that any further useful or relevant issues could be fed into the final report.

4.6 Summary of results of synthesis

The key components identified from the studies included in the in-depth review are as follows:

- a clear understanding of the features of the relevant learning processes are necessary to achieve success in a particular context
- the design of concrete tasks to scaffold the development of the awareness of the processes and their importance for success
- opportunities to feedback during the task, thus enabling teacher intervention but also providing for this to become gradually internalised as self-regulation
- explicit emphasis on developing capability through effort and the possibility of improving performance by responding to feedback and adaptation

We can also identify some necessary conditions:

- The teacher needs to have an alignment of a good understanding of learning, in terms of the subject and the context - what European educationalists would call 'didactics'.
- There is also the need for the teacher to have access to concrete tools and strategies to guide the learner and enhance opportunities for feedback.
- Both teachers and learners should have an orientation towards learning, characterised by a willingness to engage in dialogue and negotiation regarding the intent and purpose of a particular teaching and learning episode.
- The focus should be on how to succeed in terms of the selection of appropriate strategies and making the right effort rather than on ability.

However, the messages in the research are neither simple, nor conclusive (De Corte *et al.*, 2001; Olina and Sullivan, 2004; Vauras *et al.*, 1999). The lack of conceptual clarity regarding the provenance and use of terms, such as 'learning capability', means that the studies included in the review are located within different, if overlapping, frameworks, which offer different interpretations of why an intervention might be effective. There is also a tension between approaches to learning skills which emphasise content (in terms of mastery of specific skills) and process (in terms of locating skills within an overall understanding of learning approaches). In the short term, therefore, the most effective means to improve performance where the assessment focuses on content knowledge is likely to be direct instruction. In the longer term, or where assessment focuses on conceptual understanding, metacognitive or strategic approaches are more likely to be effective.

CHAPTER FIVE

Implications

This section of the review places the findings in context. Some strengths and limitations of the review are identified, then implications are drawn out for different users.

5.1 Strengths and limitations of this systematic review

A clear strength of the review is its use of systematic reviewing techniques based on EPPI-Centre procedures and techniques which aim to make the processes of systematic reviewing more transparent.

A further strength of the review is its relevance to current policy and practice, and the involvement of potential users of the review. In particular, one of the aims of the review was to identify issues of implementation across schools in terms of the development of pupils learning capabilities.

The findings of the review broadly confirm the findings of earlier reviews in this area. Some inconsistencies have emerged, particularly in relation to how such learning capabilities should be developed. Thus the findings of this review suggest that the teaching of learning skills may need to be made explicit as well as embedded in the curriculum; previous reviews have suggested that an embedded approach was preferable. Another issue raised by this review is the age groups for which such teaching is appropriate. Previous reviews have not reached a consensus, with some suggesting that such teaching is most effective with older learners. The implication of this review is that its goal is to develop more effective attributions, and working with younger learners may be more beneficial.

The limitations of the review derive from the breadth and complexity of the concepts of learning skills and the development of learning capabilities. In order to cope with the scale of the task and the range of possible literature, a number of choices had to be made about how to focus the review. One aspect of this focus was the need to avoid repeating areas covered in other EPPI-

Centre reviews: for example, the Modern Foreign Languages review on ‘the role of prior knowledge in uni-directional listening comprehension’ and the Assessment review group’s (unpublished) work on Peer and Self-Assessment. Therefore the findings and implications of other reviews should therefore be borne in mind when reading this review, including the previous Thinking Skills review, which looked at approaches to effective teaching and learning, and the evidence for impact on learners (Higgins, 2004) which found the following:

- There is evidence of a positive impact on pupils’ attainment in both curriculum and non-curriculum measures, and some evidence that pupils can translate this learning to other contexts. However, improvements may not be apparent immediately.
- The impact may not be even across all groups of pupils; there may be greater impact on low-attaining pupils, particularly when using metacognitive strategies.
- There is some evidence that pupils benefit from explicit training in the use of thinking skills strategies and approaches.
- The role of the teacher is important in establishing collaborative group work and effective patterns of talk, and in eliciting pupils’ responses.
- Provision of guidelines for the implementation and evaluation of thinking skills in classrooms based on research evidence would enable schools to make informed choices.
- When introducing interventions that focus on improving specific cognitive strategies, it could be more efficient to target particular groups of pupils and identify the most appropriate times for development. However, interventions aimed at developing a classroom ethos conducive to making learning more explicit and fostering dialogue about teaching and learning, can be promoted at any time.

- There may be a significant delay before attainment becomes apparent in tests and exams.

A further limitation arises from the specific focus of the in-depth review on interventions which aimed explicitly to develop pupils' learning capabilities through the use of metacognitive or self-regulatory approaches in at least three schools. Although this produced a manageable number of studies for synthesis, it necessarily reduced the scope of the review. This may have omitted other studies findings relevant to the broader aims of the review.

5.2 Implications

5.2.1 Policy

At policy level, specific consideration of the development of learning skills and capabilities as part of the curriculum needs to include explicit advice that such development should not only be embedded in the curriculum, but also taught in such a way that this is explicit to pupils. Opportunities to achieve this should be identified in the early stages of schooling as well as for older pupils. It should also be recognized that it can be difficult to assess the impact of such approaches in both the short term and in terms of the development of a learner's identity over time. Further research is needed to identify what would be the most appropriate learning outcomes to judge the effectiveness of such interventions (James and Brown, 2005). Any such research needs to identify both short-term and longer-term indicators which can be related both to attainment in the curriculum and to learners' meaningful participation in learning.

5.2.2 Practice

While there are approaches which can be used effectively by teachers in classrooms in schools to develop pupils' learning skills and capabilities, research findings need to be 'translated' (Toth *et al.*, 2000), rather than simply applied to school settings. There is a reported tension between teachers adhering closely to the *format* of a programme and having the deeper understanding and critical distance necessary to adapt the *ideas* to context (Dusenbury *et al.*, 2003). It is therefore important that teachers understand the principles underpinning approaches which seek to develop pupils' learning skills and capabilities (Hattie *et al.*, 1996). This is so that, as different approaches are used and adapted, in various learning contexts, they achieve the aims or intentions underpinning the approach. The planning of professional development to support teachers in using these approaches is therefore both essential and challenging, if development in schools is to be sustained beyond an initial innovative phase.

5.2.3 Research

This review has been conducted as part of a series of reviews of education research supported by the EPPI-Centre. Other completed reviews have much to say about the development of pupils learning skills and capabilities. Further work is needed to relate the findings of this review to the findings and implications of other related reviews.

The findings of this review illustrate the complex nature of the learning outcomes needed to judge the effectiveness of interventions to improve learning skills and capabilities (see James and Brown, 2005). Further research is needed to identify both short-term and longer-term outcome indicators which can be related both to attainment in the curriculum and to participation in learning.

CHAPTER SIX

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Appendix 1.1: Authorship of this report

This work is the report of a systematic review conducted by the Thinking Skills review group.

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Conflicts of interest

The Review Group is not aware of any conflicts of interest for any members of the Review, Steering or Advisory Groups.

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Appendix 2.1: Inclusion and exclusion criteria

Inclusion criteria

We will include studies which:

1a. Are about teaching approaches where the goal is to develop pupils' learning capabilities

1b. Contain description of the teaching approach

1c. Are not about published thinking skills approaches

1d. Are not focused solely on peer- or self-assessment

2. Are set in a school or school and are concerned with the general school population

3. Are concerned with learners in the phases of schooling (4-19)

4. Contain empirical classroom research with data or evidence (such as on pupil outcomes, classroom processes, teacher role)

5. Are written in English

6. Were published after 1993

Exclusion criteria

We will exclude studies which:

1a. Are not about developing pupils' learning capabilities

1b. Do not contain description of the teaching approach with data or evidence

1c. Are about published thinking skills approaches

1d. Are focused solely on peer- or self-assessment

2a. Are not set in a school or schools (e.g. laboratory studies)

2b. Study only a particular sub-group of pupils (e.g. contain data only from those identified as having special educational needs)

3a. Are not concerned with learners in the phases of schooling (4-19).

3b. Do not have a mean age of pupils between 4 and 19

4. Are editorials, commentaries, position papers, book reviews, policy documents, resources, guides, manuals, bibliographies, or theoretical, methodological and philosophical papers

5. Are not written in English

6. Were published before 1994

Appendix 2.2: Search strategy for electronic databases

The electronic search strategy was based on the systematic application of selected search terms to a number of databases accessible through the internet. The three gateways used were Ingenta Connect, CSA Illumina Online Computer Library Center (OCLC) First Search and the British Education Index. An indication of the range of databases and journals accessible through these portals can be found below.

Ingenta Connect

<http://www.ingentaconnect.com/>

1,018 publications in Social Sciences and 414 publications in Psychology/Psychiatry in electronic content with access to full text of 229 Education specific publications, including the following:

- Assessment in Education: Principles, Policy and Practice
- British Educational Research Journal
- British Journal of Educational Psychology
- British Journal of Educational Studies
- British Journal of Educational Technology
- British Journal of Sociology of Education
- Cambridge Journal of Education
- Computers and Education
- Curriculum Inquiry
- Curriculum Journal, The
- Early Childhood Education Journal
- Early Childhood Research Quarterly
- Early Years: Journal of International Research and Development
- Education and Information Technologies
- Education, Communication and Information
- Educational Psychology
- Educational Psychology in Practice
- Educational Psychology Review
- Educational Research
- Educational Review
- Educational Studies
- Educational Studies in Mathematics
- European Journal of Education
- Gender and Education
- Instructional Science
- International Journal of Computers for Mathematical Learning
- International Journal of Early Years Education
- International Journal of Educational Research
- International Journal of Inclusive Education
- International Journal of Mathematical Education in Science and Technology
- International Journal of Qualitative Studies in Education
- International Journal of Science and Mathematics Education

International Journal of Science Education
Journal of Computer Assisted Learning
Journal of Curriculum Studies
Journal of Education for Teaching: International Research and Pedagogy
Journal of Philosophy of Education
Journal of Research in Reading
Journal of Science Education and Technology
Learning and Individual Differences
Learning and Instruction
Learning and Motivation
Learning Environments Research
London Review of Education
Oxford Review of Education
Reading Psychology
Research in Science Education
Research in Science & Technological Education
Research Papers in Education
Scandinavian Journal of Educational Research
School Leadership and Management
Social Psychology of Education
Sociology of Education
Welsh Journal of Education
Westminster Studies in Education

CSA Illumina Social Science databases

<http://www.csa.com/>

Specialises in publishing and distributing, in print and electronically, 100 bibliographic and full-text databases and journals in four primary editorial areas: natural sciences, social sciences, arts and humanities, and technology. Access to databases in the Social Sciences includes the following:

ASSIA: Applied Social Sciences Index and Abstracts
Communication Abstracts
Communication Studies: A SAGE Full-Text Collection
Education: A SAGE Full-Text Collection
ERIC
FRANCIS
IBSS: International Bibliography of the Social Sciences
LISA: Library and Information Science Abstracts
PsycARTICLES
PsycBOOKS
Psychology: A SAGE Full-Text Collection
PsycINFO
Social Services Abstracts
Sociological Abstracts
Sociology: A SAGE Full-Text Collection

OCLC First Search

<http://www.oclc.org/firstsearch/>

OCLC First Search delivers bibliographic records and library holdings from WorldCat, electronic journals from Electronic Collections Online, with access to more than 72 databases, including:

ArticleFirst
Dissertation Abstracts Online
Electronic Books
Electronic Collections Online
Education Abstracts
Education Index
ERIC
PsycARTICLES
PsycBOOKS
PsycFIRST

PsycINFO 1887
SIRS Researcher
Sociological Abstracts
Social Sciences Abstracts
Social Sciences Index
WorldCat (The OCLC Online Union Catalog)
WorldCat Dissertations and Theses (WorldCatDissertations)

British Education Index

<http://www.leeds.ac.uk/bei/>

The British Education Index (BEI) is designed to aid the identification of appropriate literature by people investigating aspects of education or training. The Index provides details about the contents of various literature sources: over 300 education and training journals published in the British Isles, similar report and conference literature, and texts in the Education-line collection.

Search terms

The search terms 'self-regulation', 'metacognition', 'metacognitive' and 'formative assessment' were applied to these databases in combination with other terms such as 'school' and 'strategy use' or 'strategies' to identify potential sources of information for the review. Where possible, search terms were used in combination, such as by using Boolean operators. Specific authors' names were also used as search terms where their work was regularly found in earlier searches. A number of specific journals were electronically handsearched to check that the search strategy was revealing appropriate literature systematically.

Table A2 provides a record of the search terms used and the number of articles of reports identified.

Table A2 Search terms

Database	Date searched	Search terms	Hits/for screening	Text file	Endnote file/ no. of refs/ date merged	Who
Ingenta connect	17/05/05	Metacognition AND school	30 / 15	Search1.doc	30/05/05	SG/SH
Ingenta connect	17/05/05	"self regulation" OR Self-regulation AND school	63 / 11	Search1.doc	30/05/05	SG/SH
Ingenta connect	17/05/05	Formative AND assessment	47 / 9	Search1.doc	30/05/05	SG/SH
BIDS	28/05/05	Metacognition AND school	4 / 3	Search2.doc	30/05/05	SG/SH
BIDS	28/05/05	Metacognition AND strategies	4 / 3	Search2.doc	30/05/05	SG/SH
Ingenta connect	28/05/05	Metacognit* AND strategies	195 / 27	Search2.doc	30/05/05	SG/SH
Ingenta connect	28/05/05	"self regulation" OR Self-regulation AND school	85 / 19	Search2.doc	30/05/05	SG/SH
BEI	28/05/05	Formative AND assessment	56 / 13	Search2.doc	30/05/05	SG/SH
BEI	28/05/05	"Self regulation" OR Self-regulation AND school	4/1	Search2.doc	30/05/05	SG/SH
BEI	28/05/05	Metacognit\$	11/2	Search2.doc	30/05/05	SG/SH
CSA Illumina	28/05/05	Metacognit* AND school AND self-regulation	487 / 71	Search2.doc	30/05/05	SG/SH
CSA Illumina	30/05/05	Metacognit* AND school AND formative assessment	13 / 2	Search3.doc	30/05/05	SG/SH
CSA Illumina	30/05/05	Metacognit* AND school AND cognitive strategies	125 / 25	Search3.doc	30/05/05	SG/SH
CSA Illumina	30/05/05	Self-regulation AND school	35 / 8	Search3.doc	30/05/05	SG/SH
CSA Illumina	30/05/05	Formative AND assessment	28 / 4	Search3.doc	30/05/05	SG/SH
OCLC First Search	11/06/06	Self-regulation AND school	147 / 8	Search4.doc	30/05/05	SG/SH
OCLC First Search	11/06/06	Metacognit* AND school	30 / 8	Search4.doc	30/05/05	SG/SH
Ingenta connect	12/05/05	Metacognit* AND reflection	15 / 1	Search5.doc	30/05/05	SG/SH
Ingenta connect	12/05/05	Journal search - British Journal of Educational Psychology 1999 - present	- /6	Search5.doc	30/05/05	SG/SH
Ingenta connect	20/06/05	Author search	- /8	Search6.doc	30/05/05	SG/SH
Ingenta connect	25/06/05	Author search	- /1	Search7.doc	30/05/05	SG/SH
Ingenta connect	25/06/05	Journal search - Learning and Individual Differences 1997 - present	- /3	Search7.doc	30/05/05	SG/SH
Ingenta connect	25/06/05	Journal search - Learning and Instruction 1997 - present	- /16	Search7.doc	30/05/05	SG/SH
Totals (Hits/Retrieved)			1379/264			

Review-specific keywords

Section A: The research sample

A.1 How many schools involved?

A.1.1 Detail

A.2 How many teachers from these schools were involved?

A.2.1 Detail

A.3 How many classes?

A.3.1 Detail

A.4 How many pupils?

A.4.1 Detail

Section B: Teaching grouping

B.1 How were the pupils grouped for teaching?

B.1.1 Usual class

B.1.2 Set/Banded

B.1.3 Mixed attainment/ability

B.1.4 Grouping for study

B.1.5 Not specified

B.2 Which pupil groups are included in the reporting of findings?

B.2.1 All

B.2.2 Gifted and talented

B.2.3 EAL

B.2.4 Low attainers

B.2.5 Gender breakdown

B.2.6 Other (Please specify.)

Section C: Teacher

C.1 Who was the teacher?

C.1.2 Specialist teacher

C.1.3 Teacher as researcher (school staff)

C.1.4 Researcher as teacher (HEI staff)

C.1.5 Outside expert (e.g. consultant)

C.1.6 Other (Please specify.)

Section D: Type of data

D.1 What type of data was collected?

D.1.2 Qualitative (please specify)

D.1.3 Pupil attainment: curriculum

D.1.4 Pupil attainment: non-curriculum

D.1.5 Pupil attitude/beliefs/dispositions

D.1.6 Teacher attitude/beliefs/dispositions

D.1.7 Other (Please specify.)

Section E: Medium/Vehicle

E.1 What is the medium/vehicle of the learning skills approach/strategy

E.1.2 ICT

E.1.3 Writing

E.1.4 Verbalising (e.g. think-aloud)

E.1.5 Other (Please specify.)

Section F: Focus of intervention (Moseley et al., 2005)

F.1 What is the focus of the intervention?

F.1.2 Physical

F.1.3 Cognitive; Building Understanding

F.1.4 Cognitive; Information Gathering

F.1.5 Cognitive; Productive Building

F.1.6 Emotional

Appendix 4.1: Comparison of studies in systematic map and in-depth review

Country of origin (mutually exclusive)	Number of studies in systematic map (N = 80)	Number of studies in in-depth review (N = 10)
Austria	8	0
Belgium	2	2
Canada	2	0
Croatia	1	1
Cyprus	2	0
Finland	3	1
France	1	0
Germany	1	0
Greece	1	0
Israel	7	1
Italy	2	0
Latvia	1	1
Netherlands	3	0
New Zealand	2	0
Singapore	2	0
Slovenia	1	0
Spain	2	0
Taiwan	2	0
UK	12	1
USA	25	3
Total	80	10

School setting (not mutually exclusive)	Number of studies in systematic map (N = 80)	Number of studies in in-depth review (N = 10)*
5-10 year olds	39	8
11-16 year olds	54	4
17-20 year olds	1	1
Total	94	13

*Totals are greater than 10 as studies included more than one year group.

Aspects of learning (not mutually exclusive)	Number of studies in systematic map (N = 80)	Number of studies in in-depth review (N = 10)*
Physical aspects	2	1
Information gathering	18	2
Building understanding	34	5
Productive thinking	27	3
Emotional aspects	12	2
Total	113	13

Appendix 4.2: Details of studies in in-depth review

Adey P, Robertson A, Venville G (2002) Effects of a cognitive acceleration programme on year 1 pupils. *British Journal of Educational Psychology* 72: 1-25

This study was undertaken in the UK with 5-6 year-olds with activities designed to promote cognitive conflict and encourage social construction and metacognition over one school year.

Results: The experimental group overall made significantly greater gains in cognitive development over the period of the experiment than the controls, in both direct (effect size 0.47) and transfer (effect size 0.43) tests, although when genders were considered separately, experimental boys' greater gains than controls did not reach significance. There was no interaction with various social and linguistic variables.

Conclusion: In the context of this study, a cognitive intervention programme can have a significant immediate effect on the rate of children's cognitive development. Further work will investigate the longevity of this effect.

De Corte E, Verschaffel L, Van De Ven A (2001) Improving text comprehension strategies in upper primary school children: a design experiment. *British Journal of Educational Psychology* 71: 531-559

Background: With respect to the acquisition of competence in reading, new standards for primary education stress more than before the importance of learning and teaching cognitive and metacognitive strategies that facilitate text comprehension. Therefore, there is a need to design a research-based instructional approach to strategic reading comprehension.

Aims: The design experiment aimed at developing, implementing and evaluating a research-based, but also practically applicable learning environment for enhancing skilled strategy use in upper primary school children when reading a text. Four text comprehension strategies (activating prior knowledge, clarifying difficult words, making a schematic representation of the text, and formulating the main idea) and a metacognitive strategy (regulating one's own reading process) were trained through a variety of highly interactive instructional techniques (modelling, whole class discussion, and small group work in the format of reciprocal teaching).

Sample: Participants in the study were four experimental fifth-grade classes (79 children) and eight comparable control classes (149 pupils).

Method: The effects of the learning environment were measured using a pre-test/post-test retention design. Multilevel hierarchical linear regression models were used to analyse the quantitative data of a Reading Strategy Test, a standardised Reading Comprehension Test, a Reading Attitude Scale, a Transfer Test and an interview about strategy use during reading.

Results: The data of the Reading Strategy Test, the Transfer Test and the interviews about strategy use showed that the experimental group out-performed the control group in terms of the strategy adoption and application during text reading. While the experimental group also scored higher on the Reading Comprehension Test than the control group, the difference was not significant.

Conclusions: This design experiment shows that it is possible to foster pupils' use and transfer of strategic reading comprehension skills in regular classrooms by immersing them in a powerful learning environment.

Desoete A, Roeyers H, De Clercq A (2003) Can offline metacognition enhance mathematical problem solving? *Journal of Educational Psychology* 95: 188-200

The effectiveness of a short metacognitive intervention combined with algorithmic cognitive instruction was assessed in an elementary school setting. Two hundred and thirty-seven (237) third-grade children were randomly assigned to a five-session metacognitive strategy instruction, an algorithmic direct cognitive instruction, a motivational program, a quantitative-relational condition, or a spelling condition. Children in the metacognitive program achieved significant gains in trained metacognitive skills compared with the four other conditions. Moreover, the children in the metacognitive program performed better on trained cognitive skills than children in the algorithmic condition, with a follow-up effect on domain-specific mathematics problem-solving knowledge. Despite the consistency of findings, no generalisation effects were found on transfer of cognitive learning.

Guterman E, Boxall W (2002) Teachers' voices on integrating MCAG into Reading Assessment Tasks. *Reading* 36: 38-43

The paper is an attempt to address on behalf of the teacher of reading, some pedagogically significant aspects of metacognition. A study was designed to test the effect of using Metacognitive Awareness Guidance (MCAG) in reading assessment tasks given to nine-year-old pupils (fourth grade in Israel). MCAG addresses five basic habits of mind (HOM) through questions and activities. The rationale for applying it was influenced by Vygotsky's notion of the 'zone of proximal development'. After the study ended, each teacher whose class was part of the treatment group was interviewed. The purpose of the interviews was to gain the teachers' perspectives, thoughts and opinions on applying MCAG to assessment tasks in reading: its role and effects on learner performance and outcomes; and its influence on their daily teaching and learning activities. Their reactions related to four aspects: the use of self-talk, the use of metacognitive learning strategies, the written MCAG, and integrating habits of mind into reading assessment tasks. The implications of the findings are discussed.

Kolic-Vehovec S (2002) Self-monitoring and attribution training with poor readers. *Studia Psychologica* 44: 57-68

Kolic-Vehovec examined the effects of the self-monitoring and attribution training on accuracy and fluency of reading, as well as reading comprehension and reading attribution in 60 second-grade poor readers (age 7-8 yrs). The participants were divided into three experimental groups and one control group. One experimental

group was encouraged to carry out self-monitoring and self-correction by token-economy. The second group was instructed to attribute reading success to effort and ability, and failure to lack of effort. The third experimental group was made to follow a combination of self-monitoring and attribution training, while the control group practised reading without feedback. All students showed improvement in reading fluency and comprehension. Self-monitoring training, as well as attribution training and their combination, improved reading accuracy. Changes toward more internal attribution were obtained only in the experimental groups with explicit attribution training being applied.

Olina Z, Sullivan HJ (2004) Student self-evaluation, teacher evaluation and learner performance. *Educational Technology Research and Development* 52: 5-22

A total of 341 Latvian students and eight teachers participated in this study of student self-evaluation and teacher evaluation. Students completed a 12-lesson teacher-directed instructional programme on conducting and writing a report of their own experimental research. Sixteen classes were randomly assigned to one of four treatment conditions: (1) no in-program evaluation, (2) self-evaluation and revision at the research design and draft final report stages, (3) teacher evaluation and student revision at both stages, and (4) self-plus-teacher evaluation and student revision at both stages. Students in the teacher-evaluation and self-plus-teacher evaluation conditions received significantly higher ratings from an independent rater on their final research reports. However, students under the self-evaluation conditions had greater confidence in their ability to conduct future experiments.

Toth EE, Klahr D, Chen Z (2000) Bridging research and practice: a cognitively based classroom intervention for teaching experimentation skills to elementary school children. *Cognition and Instruction* 18: 423-459

This describes the first cycle of a multiyear research project aimed at establishing a common ground between educationally relevant psychological research and educational practice. The authors translated a theoretically motivated and laboratory-based instructional procedure into a classroom intervention. Seventy-seven (77) students (mean age 10 yrs) participated from four fourth-grade classrooms in Pennsylvania. The research design included a set of nested pre-instruction and post-instruction measures. This intervention produced significant gains in fourth-grade students' ability to create controlled experiments, provide valid justifications for

their experiments, and evaluate experiments designed by others. It also raised questions about how students understand sources of error during experimentation and how that understanding is related to their level of certainty about conclusions that are supported by the experimental outcomes. The authors view this report as part of a continuing research cycle that includes three phases: (1) use-inspired, basic research in the laboratory; (2) classroom verification of the laboratory findings; and (3) follow-up applied (classroom) and basic (laboratory) research.

Vauras M et al. (1999) Motivational vulnerability as a challenge for educational interventions: a conceptual framework for education. International Journal of Educational Research 31: 515-531

The focus of this study was on the question, 'Are there differences among young (third grade) students who are poor learners in their metacognitive (in)competence and motivational vulnerability that are crucial for better self-regulation?' This question was studied in an intervention context, where an effort was made mindfully to implement teaching methods that have been found to be effective in promoting strategic learning. The subjects were reading comprehension (in environmental science) and mathematical problem-solving. The results suggest there is a need for more coordinated, long-term analyses of transactional, strategy-focused instruction that (a) extends over a long period of time, (b) moves from innovative to more conventional settings as students' cognitive and motivational competence increases, (c) is based on students' own, personal and meaningful experiences and competencies, and (d) moves from individual to collaborative, shared and multiple transaction. There also is a need to train students in the use of cognitive and metacognitive strategies, emotional coping, and motivation strategies that promote self-regulation.

White BY, Frederiksen JR Inquiry, modeling and metacognition: making science accessible to all students. Cognition and Instruction 16: 3-118

Reports on the instructional trials of the Thinker Tools Inquiry curriculum by three teachers in urban 7th-9th grade classrooms in the USA. The curriculum centres around a metacognitive model of research, called the Inquiry Cycle, and a metacognitive process, called Reflective Assessment (RA), in which students reflect on their own and each other's inquiry. The authors collaborated with the teachers to create this computer enhanced, middle school science curriculum that engages students in learning about and reflecting on the processes of scientific inquiry as they construct increasingly complex models

of force and motion phenomena. A controlled comparison was made to determine the impact of including the RA. The curriculum proved successful and students' performance improved significantly on both physics and inquiry assessments. Adding the RA to the curriculum was beneficial for low-achieving students. Performance on their research projects and inquiry test was significantly closer to that of high-achieving students than was the case for controls. This approach was beneficial to both low achieving students and high-achieving students. Examples of scaffolded inquiry activities, instructions for the mass project, and an example of a student's project report and self-assessment are appended.

Williams W et al. (2002) Practical intelligence for school: developing metacognitive sources of achievement in adolescence. Developmental Review 22: 162-210

In this study based in the USA the researchers sought to boost school achievement by creating an intervention that would develop practical intelligence for school in middle-school students. The research team worked with teachers in schools in Connecticut and Massachusetts over a two-year period. Teachers were trained to deliver a five-part programme developed to inculcate practical intelligence by emphasising five sources of metacognitive awareness: knowing why, knowing self, knowing differences, knowing process, and revisiting. A broad range of assessments was administered in a pre-post design both to the children receiving the practical intelligence programme and to matched control children. We found that the programme successfully enhanced both practical and academic skills in each of the target skill areas (reading, writing, homework and test-taking) in children from diverse socioeconomic backgrounds attending diverse types of schools. These results are discussed in terms of the acquisition of cognitive and metacognitive insights during adolescence and the promise such insights hold for enhancing adolescent achievement over and above traditional g-based approaches to learning. Finally, the trade-offs between ecologically based and laboratory-based interventions are discussed.

Item ID	Study	What are the results of the study as reported by authors?
IT13509	De Corte <i>et al.</i> (2001) Improving text comprehension strategies in upper primary school children: a design experiment	Significant gains were made by the experimental pupils in strategy use and these were retained in the retention test (Figure 4, p 547), but these gains were not found in the reading comprehension test (Figure 6, p 550) or the reading attitude test (Figure 7, p 551). Transfer was demonstrated for the experimental group. Lower-scoring pupils made greater gains in strategy use than higher scoring ones on the post-test, although not on the retention and transfer tests (Figure 5, p 549). More comprehension strategies were reported by the experimental group (Table 5, p 553). The fidelity of implementation was high except for the role of the learner as group leader (52%). Teacher content-oriented interventions were largely directed at the control of strategy implementation (53%). In 16% of these interventions, teachers provided the answers and in 24% stimulated pupils' thinking. Teachers were generally positive about the intervention (p 554).
IT16621	Adey <i>et al.</i> (2002) Effects of a cognitive acceleration programme on Year 1 pupils	'The simplest question to ask about the effect of the intervention is 'Did it work, in the sense of increasing the rate of cognitive development in the CA classes relative to the control classes?! The answer is yes, it did' (p 13). Effect sizes 0.43 and 0.47 (conservation and drawing). Main effect for teachers on post scores.
IT24029	Olina and Sullivan (2004) Student self-evaluation, teacher evaluation and learner performance	Students in the teacher-evaluation and self-plus-teacher evaluation conditions received significantly higher ratings from an independent rater on their final research reports. There were no significant differences between the treatment groups on the post-test. Overall, students in both groups with the self-evaluation component reported more positive attitudes toward the programme on the attitude survey and had greater confidence in their ability to conduct future experiments than students in the teacher-evaluation and the no-evaluation groups. However, when specifically asked about their attitudes toward the two evaluation strategies on the attitude survey and during focus groups, both students and teachers indicated that they liked teacher evaluation better and thought that it improved student research projects to a greater extent than student self-evaluation.
IT26598	Guterman and Boxall (2002) Teachers' voices on integrating MCAG into Reading Assessment Tasks	Teachers present the view that the introduction of 'self-talk' has been a memorable element of the intervention for themselves and for the pupils, who continue to use it in other contexts.
IT26649	Kolic-Vehovec (2002) Self-monitoring and attribution training with poor readers	Two main findings are reported: 1. Reading accuracy can be improved by self-monitoring training as well as by attribution training. 2. Only attribution training produced a significant change in attributions toward more internal attributions for reading comprehension. In addition, while improvement in reading fluency was achieved in all groups and the control group obtained the same level of improvement as those in the self-monitoring group, improvements in accuracy did not occur in the control group. Attribution training in conjunction with self-monitoring training did not enhance reading to any superior degree than self-monitoring training alone.

Item ID	Study	What are the results of the study as reported by authors?
IT26653	Toth <i>et al.</i> (2000) Bridging research and practice: a cognitively based classroom intervention for teaching experimentation skills to elementary school children	Expository instruction embedded in exploratory and application experiments is an effective method to teach control of variables strategy (CVS). The ability to perform CVS in specific contexts can be improved relatively rapidly and through experience or experimentation but robust use of CVS, including the ability to explain the process, is dependent on instruction. An interesting anomaly is that the most initially competent students in the use of CVS become less certain of the outcomes of experiments, a development that is attributed by the authors to the 'other errors' which occur in real classrooms and group work, such as measurement or random errors, which became apparent to the more competent students who had mastery of CVS.
IT26655	Desoete <i>et al.</i> (2003) Can offline metacognition enhance mathematical problem solving?	1. Children in the metacognitive group had significantly higher post-test mathematical problem-solving scores (trained cognitive content).
IT26600	Williams <i>et al.</i> (2002) Practical intelligence for school: developing metacognitive source of achievement in adolescence	2. Children in the metacognitive group had higher post-test prediction scores than children in the other four groups. In the other groups, there was no change in ability to predict.
IT26660	White and Frederiksen (1998) Inquiry, modelling and metacognition: making science accessible to all students White and Frederiksen (1998) Inquiry, modelling and metacognition: making science accessible to all students White and Frederiksen (1998) Inquiry, modelling and metacognition: making science accessible to all students	3. Metacognitive group outperformed control on evaluation (non-trained metacognitive content) but no differences were found among the five groups on tasks requiring non-trained cognitive content. 4. Children in the metacognitive group performed better than children in the other four groups on the follow-up measure.

The results of this systematic review are available in four formats:

SUMMARY

Explains the purpose of the review and the main messages from the research evidence

REPORT

Describes the background and the findings of the review(s) but without full technical details of the methods used

TECHNICAL REPORT

Includes the background, main findings, and full technical details of the review

DATABASES

Access to codings describing each research study included in the review

These can be downloaded or accessed at <http://eppi.ioe.ac.uk/reel/>

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