Metacognition and self-regulation approaches aim to help pupils think about their own learning more explicitly, often by teaching them specific strategies for planning, monitoring and evaluating their learning. Interventions are usually designed to give pupils a repertoire of strategies to choose from and the skills to select the most suitable strategy for a given learning task.

Self-regulated learning can be broken into three essential components:

- cognition - the mental process involved in knowing, understanding, and learning;
- metacognition - often defined as ‘learning to learn’; and
- motivation - willingness to engage our metacognitive and cognitive skills.

How effective is it?
Metacognition and self-regulation approaches have consistently high levels of impact, with pupils making an average of seven months’ additional progress.

These strategies are usually more effective when taught in collaborative groups so that learners can support each other and make their thinking explicit through discussion.

The potential impact of these approaches is high, but can be difficult to achieve in practice as they require pupils to take greater responsibility for their learning and develop their understanding of what is required to succeed.

The evidence indicates that teaching these strategies can be particularly effective for low achieving and older pupils.

How secure is the evidence?
A number of systematic reviews and meta-analyses have consistently found strategies related to metacognition and self-regulation to have large positive impacts. Most studies have looked at the impact on English or mathematics, though there is some evidence from other subject areas like science, suggesting that the approach is likely to be widely applicable.

The approaches that have been tested tend to involve applying self-regulation strategies to specific tasks involving subject knowledge, rather than learning generic ‘thinking skills’.

The EEF has evaluated a number of programmes that seek to improve ‘learning to learn’ skills. The majority have found positive impacts, although smaller in size (around 2 months’ progress on average) than the average seen in the wider evidence base. For three of these programmes there were indications that they were particularly beneficial for pupils from low income families.

A 2014 study, Improving Writing Quality, used a structured programme of writing development based on a self-regulation strategy. The evaluation found gains, on average, of an additional nine months’ progress, suggesting that the high average impact of self-regulation strategies is achievable in English schools.

Guidance report
The EEF has published guidance on applying the evidence on metacognition and self-regulation in the classroom. The guidance report can be found here.

What are the costs?
Overall, costs are estimated as very low. Many studies report the benefits of professional development for teachers, and using an inquiry approach where teachers actively evaluate strategies and approaches as they learn to use them in their teaching. Most projects are estimated as costing under £80 per pupil, including the necessary professional development for teachers.
Metacognition and self-regulation: What should I consider?

Before you implement this strategy in your learning environment, consider the following:

1. Which explicit strategies can you teach your pupils to help them plan, monitor, and evaluate specific aspects of their learning?
2. How can you give them opportunities to use these strategies with support, and then independently?
3. How can you ensure you set an appropriate level of challenge to develop pupils' self-regulation and metacognition in relation to specific learning tasks?
4. In the classroom, how can you promote and develop metacognitive talk related to your lesson objectives?
5. What professional development is needed to develop your knowledge and understanding of these approaches? Have you considered professional development interventions which have been shown to have an impact in other schools?
Technical Appendix

Definition

Metacognition and self-regulation approaches (sometimes known as ‘learning to learn’) aim to improve learning by getting learners to think about their own learning more explicitly so as to take increased responsibility for their own achievement.

Metacognition involves consciously planning, monitoring and evaluating your own learning. It is often considered to have two dimensions: knowledge (or the extent to which a learner is aware of and can articulate metacognitive strategies) and skillfulness (actual capacity in managing learning or capability at putting these strategies into practice). Approaches usually focus on teaching pupils specific strategies to set goals, and monitor and evaluate their own academic development in relation to particular learning tasks and activities, covering all aspects of thinking from basic skills such as recall, to more complex thinking such as evaluation and synthesis. Self-regulation relates to metacognitive skillfulness but also involves managing one’s own motivation towards learning and the development of dispositions such as resilience and perseverance.

In practical terms, the intention is often to provide pupils with a repertoire of strategies to choose from during learning activities, this often involves Feedback on use of different strategies. Approaches also frequently involve Collaborative learning activities and techniques.

Search terms: Metacognition; executive function; self-regulation, learning strategies

Evidence Rating

Overall, the evidence is rated as extensive. There are eleven meta-analyses with seven undertaken in the last 10 years. These are mainly from experimental studies which were often undertaken in schools and which evaluated impact on pupil attainment as well as more general cognitive outcomes, with some exploration of the causes of any identified heterogeneity. The underlying studies, however, vary in quality. Most of the estimates of impact are high. The majority of the pooled effects from the meta-analyses fall in the range 0.44 to 0.71 (a range of less than a third of a standard deviation). However the range of effects from newer meta-analyses is more varied (0.30 to 0.90), and recent single studies have not consistently achieved the gains presented in the meta-analyses.

Additional Cost Information

The main financial cost of implementing a metacognition and self-regulation approach will be the cost of professional development for the teachers. The average cost of professional development in EEF-funded programmes is well under £80 per pupil.

A number of EEF projects have been commissioned in this area. The cost of the Using Self-Regulation to Improve Writing programme, which aimed to improve pupils’ writing by promoting self-regulation, cost £52 per pupil; Thinking Talking Doing Science was estimated at £26 per pupil; Philosophy for Children cost £16 per pupil per year.
References

   Instructional Interventions Affecting Critical Thinking Skills and Dispositions: A Stage 1 Meta-Analysis.
   Review of Educational Research 78.4 pp 1102-1134.
   (2008)

2. Chiu, C.W.T. (Abstract)
   Synthesizing Metacognitive Interventions: What Training Characteristics Can Improve Reading Performance?
   Paper presented at the Annual Meeting of the American Educational Research Association San Diego, CA
   (1998)

3. Crawford, C. & Skipp, A
   LIT Programme Evaluation Report and Executive Summary
   EEF, London
   (2014)

4. de Boer, H., Donker, A. S., & van der Werf, M. P. (Abstract)
   Effects of the attributes of educational interventions on students' academic performance: A meta-analysis.
   Review of Educational Research, 84(4), 509-545.
   (2014)

   How can primary school students learn selfregulated learning strategies most effectively? A meta-analysis on self-regulation training programmes.
   (2008)

   Effectiveness of learning strategy instruction on academic performance: A meta-analysis.
   (2014)

7. Dorsett, R., Rienzo, C., Rolfe, H., Burns, H., Robertson, B., Thorpe, B. & and Wall, K.
   Mind the Gap Evaluation Report and Executive Summary
   EEF, London
   (2014)

   The effects of metacognitive strategies on reading comprehension: a quantitative synthesis and the empirical investigation
   Doctoral dissertation, University of Durham
   (2003)

9. Gorard et al.
   Philosophy for Children (P4C) Evaluation Report
   EEF, London
   (2015)

    Let's think secondary science: Evaluation report and executive summary
    EEF, London
    (2016)

    A meta-analysis of the impact of the implementation of thinking skills approaches on pupils.
    Research Evidence in Education Library. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.
    (2005)

    Can Comprehension be taught? A Quantitative Synthesis of “Metacognitive Studies.”
    Educational Researcher, 17.9 pp 5-8.
    (1988)

13. Hanley, Slavin & Elliott
    Thinking Doing Talking Science Evaluation Report
    EEF, London
    (2015)

14. Jacob, R., & Parkinson, J.
    The Potential for School-Based Interventions That Target Executive Function to Improve Academic Achievement A Review.
    Review of Educational Research
    (2015)
1 Klauer, K.J. & Phye, G.D.  (Abstract  )
Review of Educational Research, 78.1 pp 85-123.
(2008)

2 Moteram, G., Choudry, S., Kalambouka, A., Hutcheson, G., & Barton, A.
ReflectED: Evaluation Report and Executive Summary
EEF, London
(2016)

3 Perry, V., Albeg, L., & Tung, C.
Journal of Behavioral Education, 21(3), 217-229
(2012)

4 Torgerson, D., Torgerson, C. Ainsworth, H. Buckley, H. M Heaps, C. Hewitt, C. & Mitchell, N.
Improving Writing Quality Evaluation Report and Executive Summary
EEF, London
(2014)

5 Zheng, L.  (Abstract  )
The effectiveness of self-regulated learning scaffolds on academic performance in computer-based learning environments: a meta-analysis
Asia Pacific Education Review, 17(2), 187-202
(2016)

6 Losinski, M., Cuenca-Carlino, Y., Zablocki, M., & Teagarden, J.  (Abstract  )
Examining the efficacy of self-regulated strategy development for students with emotional or behavioral disorders: A meta-analysis.
Behavioral Disorders, 40(1), 52-67
(2014)

7 NIESR
Changing Mindsets Evaluation Report
EEF, London
(2015)

8 Schunk, D.H
Educational Psychology Review, 20.4 pp 463-467.
(2008)

9 Trzcinski, B., Reid, R., & Graham, S.
Teaching young students strategies for planning and drafting stories: The impact of self-regulated strategy development.
(2009)
## Summary of effects

### Meta-analyses

<table>
<thead>
<tr>
<th>Study Description</th>
<th>Effect size</th>
<th>FSM effect size</th>
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</thead>
<tbody>
<tr>
<td>Chiu, C.W.T., (1998)</td>
<td>0.67</td>
<td>-</td>
</tr>
<tr>
<td>de Boer, H., Donker, A. S., &amp; van der Werf, M. P. (2014)</td>
<td>0.57</td>
<td>-</td>
</tr>
<tr>
<td>Dignath, C., Buettner, G. &amp; Langfeldt, H. (2008)</td>
<td>0.62</td>
<td>-</td>
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<tr>
<td>Donker, A. S., De Boer, H., Kostons, D., Dignath van Ewijk, C. C., &amp; Van der Werf, M. P. C. (2014)</td>
<td>0.66</td>
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<tr>
<td>Fauzan, N. (2003)</td>
<td>0.50</td>
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<td>Haller, E.P., Child, D.A. &amp; Walberg, H.J. (1988)</td>
<td>0.71</td>
<td>-</td>
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<tr>
<td>Higgins, S., Hall, E., Baumfield, V., &amp; Moseley, D. (2005)</td>
<td>0.62</td>
<td>-</td>
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<tr>
<td>Klauser, K.J. &amp; Phye, G.D. (2008)</td>
<td>0.69</td>
<td>-</td>
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<tr>
<td>Losinski, M., Cuenca-Carlsino, Y., Zablocki, M., &amp; Teagarden, J. (2014)</td>
<td>0.90</td>
<td>- (pupils with emotional and behavioural needs)</td>
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<td>Zheng, L. (2016)</td>
<td>0.44</td>
<td>-</td>
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### Single Studies

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<th>Study Description</th>
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<th>FSM effect size</th>
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<td>Crawford, C. &amp; Skipp, A (2014)</td>
<td>0.09</td>
<td>-</td>
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<tr>
<td>Dorsett, R., Rienzo, C., Rolfe, H., Burns, H., Robertson, B., Thorpe, B. &amp; Wall, K (2014)</td>
<td>-0.14</td>
<td>-</td>
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<tr>
<td>Gorard et al. (2015)</td>
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<td>- Reading</td>
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<tr>
<td></td>
<td>0.13</td>
<td>- Maths</td>
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<tr>
<td>Hanley, P., Bohnke, J.R., Slavin, B., Elliott, L., &amp; Croudace, T. (2016)</td>
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<td>Hanley, Slavin &amp; Elliott (2015)</td>
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<td>0.38</td>
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<td>Moteram, G., Choudry, S., Kalamabouka, A., Hutcheson, G., &amp; Barton, A. (2016)</td>
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<td>NIESR (2015)</td>
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<td>Torgerson, D., Torgerson, C. Ainsworth, H. Buckley, H. M Heaps, C. Hewitt, C. &amp; Mitchell, N. (2014)</td>
<td>0.74</td>
<td>1.60</td>
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<td>Tracy, B., Reid, R., &amp; Graham, S (2009)</td>
<td>0.47</td>
<td>- Writing</td>
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| Weighted mean                                                                   | 0.54        |

The right hand column provides detail on the specific outcome measures or, if in brackets, details of the intervention or control group.

## Meta-analyses abstracts
For more information, tools & supporting resources, please visit: https://educationendowmentfoundation.org.uk/
To assess the effect of "metacognitive" instruction on reading comprehension, 20 studies, with a total student population of 1,553, were compiled and quantitatively synthesized. For 115 effect sizes, or contrasts of experimental and control groups' performance, the mean effect size was .71, which indicates a substantial effect. In this compilation of studies, metacognitive instruction was found particularly effective for junior high students (seventh and eighth grades). Among the metacognitive skills, awareness of textual inconsistency and the use of self-questioning as both a monitoring and a regulating strategy were most effective. Reinforcement was the most effective teaching strategy.

Executive Summary Methods: Relevant studies in the area of thinking skills were obtained by systematically searching a number of online databases of educational research literature, by identifying references in reviews and other relevant books and reports, and from contacts with expertise in this area. Twenty-six of the studies identified for this review were obtained from the database which resulted from the first thinking skills review (Higgins et al., 2004); a further three resulted from updating the original search and applying the more stringent criteria required for a quantitative synthesis. Studies were selected for the meta-analysis if they had sufficient quantitative data to calculate an effect size (relative to a control or comparison group of pupils) and if the number of research subjects was greater than 10. Effect sizes were calculated from the reported data and combined statistically using quantitative synthesis. Results: twenty-nine studies were identified which contained quantitative data on pupils' attainment and attitudes suitable for meta-analysis. The studies come from a range of countries around the world with half set in the US or UK. The studies broadly cover the ages of compulsory schooling (5–16) and include studies set in both primary and secondary schools. A number of named thinking skills interventions are included, such as Feuerstein's instrumental enrichment (FIE) and cognitive acceleration through science education (CASE) as well as studies which report a more general thinking skills approach (such as the development of metacognitive strategies). The quantitative synthesis indicates that thinking skills programmes and approaches are effective in improving the performance on tests of cognitive measures (such as Raven's progressive matrices) with an overall effect size of 0.62. (This effect would move a class ranked at 50th place in a league table of 100 similar classes to 26th or a percentile gain of 24 points.) However, these approaches also have a considerable impact on curricular outcomes with the same effect size of 0.62. The overall effect size (including cognitive, curricular and affective measures) was 0.74. Conclusions: Overall, the quantitative synthesis indicates that, when thinking skills programmes and approaches are used in schools, they are effective in improving pupils' performance on a range of tested outcomes (relative to those who did not receive thinking skills interventions). The magnitude of the gains found appears to be important when compared with the reported effect sizes of other educational interventions. This review found an overall mean effect of 0.62 for the main (cognitive) effect of each of the included studies, larger than the mean of Hattie's vast database of meta-analyses at 0.4 (Hattie, 1999) but very similar to the overall figure reported by Marzano (1998, p 76) of 0.65 for interventions across the knowledge, cognitive, metacognitive and self-system domains. In particular, our study identified metacognitive interventions as having relatively greater impact, similar to Marzano's study. Looking at a smaller part of our review, Feuerstein's instrumental enrichment is one of the most extensively researched thinking skills programme. Our results broadly concur with those of Romney and Samuels (2001), whose meta-analysis found moderate overall effects and an effect size of 0.43 on reasoning ability (p 28). Our findings were of the same order, with an overall effect size of 0.58 (one main effect from each of seven studies included) and an effect size of 0.52 on tests of reasoning (one main effect from four studies). There is some indication that the impact of thinking skills programmes and approaches may vary according to subject. In our analysis there was relatively greater impact on tests of mathematics (0.89) and science (0.78), compared with reading (0.4).

Researchers have examined inductive reasoning to identify different cognitive processes when participants deal with inductive problems. This article presents a prescriptive theory of inductive reasoning that identifies cognitive processing using a procedural strategy for making comparisons. It is hypothesized that training in the use of the procedural inductive reasoning strategy will improve cognitive functioning in terms of (a) increased fluid intelligence performance and (b) better academic learning of classroom subject matter. The review and meta-analysis summarizes the results of 74 training experiments with nearly 3,600 children. Both hypotheses are confirmed. Further, two moderating effects were observed: training effects on intelligence test performance increased over time, and positive problem solving transfer to academic learning is greater than transfer to intelligence test performance. The results cannot be explained by placebo or test-coaching effects. It is concluded that the proposed strategy is theoretically and educationally promising and that children of a broad age range and intellectual capacity benefit with such training.

Two previous reviews have indicated that self-regulated strategy instruction (SRSD) is an evidence-based practice that can improve the writing skills of students with emotional and behavioral disorders. The purpose of this meta-analysis is to extend the findings and analytic methods of previous reviews by examining published studies regarding SRSD, analyzing the findings of both single-case and group designs using a common effect size metric (Hedges' g), and applying methods to address publication bias. In addition, the present meta-analysis examined the difference in treatment effect due to differences in moderating variables. Sixteen of the 20 studies examined met inclusion criteria based on the Council for Exceptional Children's Standards for Evidence-Based Practices in Special Education. Results indicated that SRSD interventions had large effect sizes across three dependent variables (i.e., essay elements, quality, and word count), and treatment effects were significant for study design and race/ethnicity. Type of instruction, intervention agent, and gender did not significantly predict response to SRSD instruction. Also the results showed limited risk of bias in the tendency of journals to publish only positive findings. Based on these findings, implications for future research and teaching with SRSD are discussed.

This meta-analysis examined research on the effects of self-regulated learning scaffolds on academic performance in computer-based learning environments from 2004 to 2015. A total of 29 articles met inclusion criteria and were included in the final analysis with a total sample size of 2648 students. Moderator analyses were performed using a random effects model that focused on the three main areas of scaffold characteristics (including the mechanism, functions, delivery forms, mode, and number of scaffolds); how to promote self-regulated learning by scaffolds; demographics of the selected studies (including sample groups, sample size, learning domain, research settings, and types of computer-based learning environments); and research methodological features (including research methods, types of research design, types of organization for treatment, and duration of treatment). Findings revealed that self-regulated learning scaffolds in computer-based learning environments generally produced a significantly positive effect on academic performance (ES = 0.438). It is also suggested that both domain-general and domain-specific scaffolds can support the entire process of self-regulated learning since they demonstrated substantial effects on academic performance. Different impacts of various studies and their methodological features are presented and discussed.