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Thinking Skills:
adding challenge to the curriculum

A guide for teachers of able children,
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'We learn most effectively when we think things through for ourselves.' (Scottish CCC, 1996)
'A good teacher makes you think, even when you don't want to.' Tom, aged 10

In recent years almost every curriculum report has emphasised the need to promote thinking and reasoning in the curriculum. At the same time teachers and researchers have demonstrated that thinking can be developed using a variety of approaches and programmes of study (McGuiness 1999). Effective implementation of the curriculum throughout primary and secondary years requires the development of effective forms of thinking. The 5-14 guidelines for Scotland makes this explicit, for example English Language (p3) states that pupils should be provided with opportunities for 'speculating, hypothesizing, discovering, reflecting, generalizing, synthesising, classifying, evaluating', while Expressive Arts (p2) aims to 'promote pupils' cognitive development by including questioning, reasoning, problem solving and decision making; creative, imaginative, divergent thinking ...' The Mathematics and Environmental Studies guidelines emphasise problem solving and investigative skills. The 5-14 curriculum require pupils to reflect critically not only on their learning but also their values. The assumption is that thinking and reasoning can help pupils 'identify, review and evaluate the values they and society hold and recognise that these affect thoughts and actions' (first aim of PSD 5-14). In England the rationale for the revised National Curriculum (1999) states that thinking skills are essential in 'learning how to learn'. Teaching thinking is not viewed as a marginal activity but as an essential foundation on which to build a love of learning. But what thinking do we need to teach, and how do we provide the challenge in the curriculum that will develop the thinking skills of our most able pupils?

What are thinking skills?

If learning is making sense of experience, and thinking is how we learn, then improving pupils' thinking skills will help them to make more sense of their learning and their lives. Thinking skills enable pupils to turn experience into learning. They focus on 'knowing how' rather than 'knowing that', on learning how to learn.

Thinking skills are not an addition to the curriculum but are embedded in all subjects in the curriculum. They are present in all good teaching and learning. They are the foundation of personal development as well as making an important contribution to social and economic development by helping to develop students who have the capacity to think and act creatively, to meet challenges positively and effectively, and show initiative and enterprise in how they think and learn. The development of thinking skills within the curriculum will help able pupils beyond school to benefit from opportunities for lifelong learning.

Among the following thinking skills described in this guide are:

Thinking skills	Cognitive goals (Bloom 1956)
information-processing skills	knowledge
enquiry and problem solving skills	comprehension and application
critical thinking and reasoning skills	analysis
creative thinking skills	synthesis
evaluation skills	evaluation

In addition to these cognitive skills we need to help able children to develop what many psychologists believe to be a key element in human intelligence, the kinds of higher order thinking involved in metacognition.

We know that able children do best in classrooms where the work is intellectually challenging ('Work that makes your brain hurt,' as Jody aged six put it). Such work will involve the child exercising both cognitive and metacognitive skills. So how do we help pupils develop these skills?

Creating challenge

The most basic teaching strategy for day to day work in a mixed-ability classroom is differentiation, that is providing of a range of educational activities to meet the range of capabilities. Different can mean expecting more, like the teacher who says of her abler pupils: 'I don't want one question/answer/solution, I want at least three!' However simply providing more of the same is not always motivating for an able child. Few things are more frustrating to an able child than to held back doing routine work before moving on to a more stimulating task. As one able child complained about being given another worksheet on which he had to practice what he already knew: 'I can do this in my sleep. Its like a dream ... except its a nightmare!' Unfortunately he had a teacher who had the habit of giving children who finished more of the same, when what her able pupil wanted was a fresh cognitive challenge.

Extension activity for more able pupils will not be challenging if it is:

- more practice at the same work, eg 'Go on to the next page'
- additional work that is not reviewed or rewarded eg 'Do some more'
- unfocused, open-ended activity eg 'See what you can find out ...'

Able pupils need opportunities both to engage in independent learning and to work with others. Evidence suggests that more able pupils are particularly stimulated and challenged when they are given opportunities to engage in independent learning, following for example their own research projects and investigations with teacher support and feedback (1). One such child was ten year-old Max, who complained that the homework he was being given too easy. After some discussion about what sort of personal project he would like to do he was given his own homework book and proceeded over the next six weeks, in addition to other homework tasks, to write his first novel, showing and discussing each new chapter with his teacher and eventually publishing the book in the school for others to

read and review.

When planning extension tasks we need to consider the kinds of abilities we wish to develop in pupils. The following thinking skills can be developed through extension tasks that challenge the more able:

1. Finding out
Information-processing skills enable pupils to:
- locate, collect and recall relevant information
- interpret information to show they understand relevant concepts and ideas
- analyse information eg sort, classify, sequence, compare and contrast
- understand relationships eg part/whole relationships

Able children can develop expertise by researching and presenting a small project on any chosen topic. Offer challenge by expecting them to know or find out more than you know. Help them to identify where they might look, or who might help them to find out about subjects or topics of interest. Give them a difficult text to analyse, or two sources of evidence to compare and contrast or a challenging subject for research using the Internet.

2. Asking questions
Enquiry skills enable pupils to:
- ask relevant questions
- pose and define problems
- plan what to do and ways to research,
- predict outcomes and test conclusions or improve ideas

Provide opportunities for pupils to ask questions. Choose a topic, challenging text or mysterious artefact and see how many questions they can generate. Create an enquiring environment in your classroom by valuing, displaying and discussing their questions. Pose your own challenging questions to encourage curiosity and creative thinking eg 'How would you improve the human body?'

3. Reasoning who, what, why, how, where and when
Reasoning skills (critical thinking) enable pupils to:
- give reasons for opinions
- draw inferences and make deductions
- use precise language to explain what they think
- justify beliefs by the use of reasons and/or evidence

Ask them to think of as many reasons as they can for...eg recycling waste materials, coming to school etc. Ask them to summarise a book or film into 50 words. Ask them to find reasons for historical events eg 'Why did the evacuation of Dunkirk take place?' Encourage reasoning and problem posing in maths eg 'If the answer is 48, what is the question? Explain the different and most interesting ways of arriving at that answer.'

4. Thinking new ideas
Creative thinking skills enable pupils to:
- generate and extend ideas
- suggest possible hypotheses
- apply imagination to their thinking
- look for alternatives in explanations and outcomes

Ask them open-ended questions, such as 'Would you rather be ... (a bird or fish, child or grown-up etc.), or to hypothesise: 'What if ...? ', 'Why is...?', 'What could you do...?'; or to speculate about a hypothetical situation: 'Imagine the world without any trees, how would this affect our lives?'; to look at things in a different way, for example: 'What designs can you make from cobwebs?'; or to apply imagination to what they already know, such as the ten year old who wrote her own sequel to the book she had just read - *Wuthering Heights*.

5. Making judgements
Evaluation skills enable pupils to:
- evaluate information
- judge the value of what they read, hear and do
- develop criteria for judging their own and other's work
- have confidence in their personal judgements, forming their own points of view

Ask them to judge and evaluate what they read eg by doing a PMI: What are the Plus points, Minus points and Interesting points about a given book or website? Ask them for up to 10 things that make eg a good book, a good friend, a good teacher, a good writer etc. - then rank them in order of importance. Discuss a controversial item in the news and ask them to write a letter expressing their point of view (see the Newswise website: www.dialogueworks.co.uk).

Making space to think

The following teaching strategies have been found to be successful in helping able pupils to extend their thinking. They invite children to think more widely, more deeply and more slowly about the topic in hand.

Pause for thought
Remember 'wait time 1 and 2', by providing at least three seconds of thinking time:
1. After you have asked a question, pause to allow pupils time to collect their thoughts.
2. After a pupil response, pause to show you are thinking and allowing others to think.

Think-pair-share
Allow individual thinking time, ask them to discuss their ideas with a partner, then share these in class discussion.

Probe
Ask 'follow-ups' to probe their understanding eg 'Why?' 'Do you agree?' 'Tell me more' 'Give an example' 'Can you elaborate?' 'How did you arrive at that answer?'

Withhold judgement
Respond to answers in a non-judgemental fashion to encourage further thinking eg 'Thank you' 'That's interesting' 'Who agrees or disagrees?' Invite a range of responses eg 'There is not one right answer, think of alternatives'

Play devil's advocate
Present an alternative point of view and challenge pupils to respond to it eg by saying 'Do you agree or disagree with this view?' 'Explain why', 'What are your reasons?'

Encourage questioning
Invite pupils to ask questions, or to write down questions that puzzle them. Value any genuine and challenging questions. Display them to show you value them, find time to share and discuss them.

Think about thinking
Ask pupils to think about their thinking and learning eg 'What thinking have you been doing?' 'What have you found hard?' 'What have you learnt?' These kinds of questions develop what many researchers now believe to be the key to higher order thinking and intelligence - metacognition.(2)

There has been a growing recognition that metacognition or self awareness 'including awareness of ourselves as learners, helps us to learn more effectively' (3). But as Anna, an able child aged 9, says: 'The hardest kind of thinking is thinking about thinking'. So what is metacognition and what can we do to foster it in the classroom?

Metacognition - what is it?

The term metacognition refers to 'an individual's own awareness and consideration of his or her cognitive processes and strategies'.(4) It refers to that uniquely human capacity of people to not just think and know, but to think about their own thinking and knowing. Vygotsky was one of the first to realise that conscious reflective control and deliberate mastery were essential factors in school learning. (5) He suggested there were two factors in the development of knowledge, first its automatic unconscious acquisition followed by a gradual increase in active conscious control over that knowledge, which essentially marked a separation between cognitive and metacognitive aspects of performance. If we can bring the process of learning to a conscious level, we can help able children to be more aware of their own thought processes and help them to gain control or mastery over the organisation of their learning.

   Effective learning means not just gaining information and integrating it into an existing knowledge base, it also involves directing the pupils' attention to what has been assimi-lated and the relationship between the new information and what is already known, so they are aware when something new has actually been learned. How do we help able pupils to actively engage in thinking about their thinking and learning?

Researchers have identified a number of metacognitive strategies that pupils should to be taught if they are to become successful and independent learners.(6) These involve the learner:

- asking questions eg 'What is the problem?'
- planning eg 'What do I need to do?'
- monitoring eg 'How am I doing?'
- checking eg 'Is it going to plan?'
- revising eg 'What do I need to change?'
- self testing eg 'How can I test it to see if it has worked?'

These strategies are best developed through dialogue with others. It is through 'learning conversations' with teachers or with other students that such strategies are learnt and understood. These conversations are particularly effective when carried out in pairs or groups where different ways of interpreting a learning experience can be explored to mutual benefit. Adults, especially teachers, can play a key role in encouraging this metacognitive awareness in children through asking pupils to explain the successes and difficulties they have had with problems. Such discussion of the thinking and problem-solving processes that children engage in is what researchers have called 'meta-learning'.(7)

Many able children are good at talking about what they know and what they do not know, what they can do and what they cannot do, and will help them gain the knowledge or understanding they need. One researcher found that very able children could 'describe in detail how they managed their mental learning resources and what they did to improve their learning strategies. (They) ... also knew about the importance of involving the whole self - intellect, emotion, and body - in their learning'.(8) But not all able children find this easy, and nor does metacognitive awareness in able children necessarily show itself in speed of thought. Creativity is not related to quickness of thinking. Indeed evidence suggests that children with high IQs tend to be slower not faster than those with lower IQs in creative problem solving, but given time show more insight and success. (9)

Able children vary in their ability to solve problems and to learn from experience. These individual differences are related not only to differences of intelligence and of experience (including the experience of being taught) but also to differences in the use of metacognitive processes. Four metacognitive processes seem to be especially important in solving problems. These involve recognising the problem; representing the problem and comparing it with others; planning how to proceed, deciding steps, resources and targets; and evaluating progress and solutions.

Many problems can be solved by cognitive methods alone such as applying a set rule, for example in doing sums or editing a text for correct punctuation. To solve such problems the child needs to know how to define the problem and then select an appropriate strategy or rule. However many problems in learning (and in life) are ill-structured, complex and made 'messy' by containing different variables. Many important problems have no simple solution. What does the child do when they don't know what to do? What is needed then is not just the application of knowledge but also the application of metacognitive skills. These skills develop with age but they also develop through practice, and they show themselves in different levels of awareness:

Tacit use: children make decisions without really thinking about them

Aware use: children become consciously aware of a strategy or decision-making process

Strategic use: children organise their thinking by selecting strategies for decision-making

Reflective use: children reflect on thinking, before, during and after the process, pondering on progress and how to improve

One way of teaching for metacognition is to ask metacognitive questions. In doing so the aim is to model the questions we want children to ask themselves in their own thinking. The following are some examples of metacognitive questions:

Some metacognitive questions to raise levels of awareness:

1. Describe your thinking

- What kind of thinking did you do?
- What do you call this kind of thinking?
- Was this kind of thinking ....? (name a kind of thinking)

2. Describe how you did your thinking

- How did you do this thinking?
- What did you think about? Why?
- Did you have a plan (or strategy)?

3. Evaluate your thinking

- Was your thinking good? Why?
- Did you have a good plan (or strategy)?
- How could you improve your thinking next time?

Posting a list of metacognitive questions on the wall can help to remind children of the sorts of questions they can ask themselves.

Getting children to think about thinking is not an easy task, but is a complex teaching skill that depends on three key factors:

- the tasks given to pupils must be worth serious thought
- the thinking and reasoning of pupils must be valued
- time must be given for debriefing and review

Able pupils thrive on problems that are challenging. A teacher who spoon-feeds information to an able child is short-circuiting the opportunity to develop thinking. As one teacher said; 'Never tell an able child what they can work out or find out for themselves'. There is considerable skill and art in providing challenges to thinking for an able child. Types of task that provide both cognitive and metacognitive challenge include open-ended investigations where there is a range of possible outcomes; difficult, novel or puzzling tasks, such as those with more than one possible solution; and those which involve evaluating different points of view, such as class debates or philosophical discussion (10).

Much of the challenge to the thinking of able children will come through talk with the

teacher. Able pupils need teachers who ask Socratic questions that move their thinking from the literal or concrete level ('What is the answer?') to the abstract or conceptual level ('What is the idea...?'). Able children need to be exposed to different points of view, to beware of absolutes, to evaluate evidence and weigh arguments. They need to perceive the relations between things, to understand the organising ideas or 'big' concepts and connect these to other subjects and everyday life. They need to be engaged not only in challenging activities but also in 'learning conversations' with teachers and others that help them to become more effective learners capable of taking responsibility for developing their own intelligence.

One way to offer able children the challenge of a 'learning conversation' is through teaching other children, or being taught by older peers, as illustrated in the following case study:

David (4.8 years)
David was exceptionally able at maths. With the agreement of his parents all David's maths lessons were with the higher ability group from Year 2 (6+ years). This worked well as David was socially mature and benefited from more challenging work alongside older peers. As David said: 'Its good to do things that are really hard, not just keep doing the same things over again.'

Leo (8.5 years)
An alternative strategy was used with Leo (8.5 years), a very able child who was shy and socially immature. An older child (aged 11 years) became his personal mentor for maths and worked alongside Leo on problems that were challenging for both of them. Leo was also made mentor to a younger able pupil, which helped to bolster his confidence and social skills, as well as involving him in challenging 'learning conversations'. As Leo said: 'Trying to teach someone else is one of the hardest things to do!'

The Able Pupil coordinator in the school comments: 'We know with able pupils one size does not fit all. We need to fit the strategy to the child. We try to give them extra help through working alongside older or more able pupils, and also the challenge of learning to help the less able.'

Able pupils often find it easy to produce answers that are technically or factually correct, but much more difficult to explain the answer. Many teachers have found that peer coaching is more effective than explanations from the teacher because the words that able pupils use are often more effective in helping them and others to understand. Leaving children to puzzle things through is not always easy. As one teacher reports: 'One of the hardest things is not telling your able pupils the right answer, but getting them to share their ideas.' Setting aside time for debriefing and review at the end of a session is one way to show you value your pupils' thinking and reasoning.

Time for debriefing and review

To help children 'unpack' their thinking and reasoning requires a high proportion of open or Socratic questions, for example questions that:

- assess awareness of learning (What have you learnt? What have you found out? What did you find hard? What did you do well? What do you need to learn/do next?),
- probe attitudes and feelings (What do you like doing/learning? What do you feel good/ not good about ...? What do you feel proud of?)
- encourage target-setting (What do you need to do better? What would help you? What are your targets?).

Here a teacher asks questions that probe an able ten year old's understanding of the writing process (11):

Teacher: What five hints would you give a younger child to help them become a good writer?

Child: Well, firstly I would say talk to someone first about your ideas, and try to get some ideas from them. Write it in rough first, because you can al ways change it later. Once you've written it look at the words and change all the boring words into unboring words. How many is that?

Teacher: That's three I think. Can you think of two more?

Child: Always do your writing when it is not too noisy, so you can hear yourself think. And read it through afterwards to try to find your mistakes before the teacher does!

Teacher: Why is it good for children to learn to write?

Child: Well one reason is to help them get a better job, because if you can't write you can't even apply for a job. I guess that's the best reason.

Teacher: Are there other reasons?

Child: You can write things down to remember them, and you can write stuff for other people. I'd like to be a good writer so I can write stories for my children.

Teacher: What could you do to improve your writing - to become a better writer?

Child: Read it through afterwards to see if it makes sense, and think of some more interesting words. A lot of my writing is quite boring ... sometimes when I read it I almost fall asleep!

It is worth setting time aside each day, or after each lesson, for this kind of discussion. Time is needed for probing questions and for lengthy responses that characterise extended thinking about learning. The skill of the teacher is to help pupils link what they have done to 'big' concepts and important ideas about their learning, as well as connecting what they have done to other subjects, and to everyday life. This process can be extended through pupils writing their own learning logs, in special 'Think Books' or everyday jotters.

Here Anna, an able ten year old, writes in her 'thinking book' her thoughts after a class discussion on 'Why did God not make us perfect?'

I know why God did not make us perfect, if he did we would simply be more angels. God wanted humans to be people who could make their own choices, not saints who were so perfect that they obeyed his every wish. I think that God gives us life like a test. If you pass you go to a higher level. If you fail you take the test again . So if you lead a good life you are born again in a higher position. If you just aren't good enough you stay in the same position. If you lead a wicked life you are demoted to an animal or plant, and stay as that for a lifetime as punishment, then you are given another go at the test. When/if you reach the highest level, and still lead a good life (which gets harder to do as you get richer and more important) you are admitted to heaven. That explains why there are so few angels that we know of. (12)

Every child is able in different ways. Be flexible in your teaching style. Remember that with high ability pupils you will expect different, more divergent outcomes and answers from the tasks you set. Accept they may need a different pace or quality of activity to sustain and extend their thinking.

   High ability children not only need to be challenged in their thinking and learning, they also need as much praise and encouragement as other pupils. As Andrew, an able ten year old wrote in his learning log: 'I may be clever at my work but I'm a bit lazy at times. When I know it matters I try harder.'

Notes

1. Scottish Office (1993) *The Education of Able Pupils P6-S2: A Report by HM Inspectors of Schools*, p10.
2. Metcalfe J. & Shimamura A.P. (1996) *Metacognition; Knowing about Knowing*, Cambridge. Mass: MIT Press
3. Scottish Consultative Council on the Curriculum (1996) *Teaching for Effective Learning* Dundee
4. Flavell J. (1979) Metacognition and cognitive monitoring: A new area of cognitive-developmental enquiry, *American Psychologist* , 34, 906-911
5. Vygotsky, L.S, (1962), *Thought and Language,* Cambridge: MIT Press
6 Nisbet J. & Shucksmith J. (1986) *Learning Strategies*, London: Routledge
7 Metacognition has been linked to improved achievement in reading and writing (Wray D. (1994), *Literacy and Awareness*, Hodder and Wray D. & Lewis M.(1997) *Extending Literacy: children reading and writing non-fiction,* Routledge), as well as science and mathematics (Adey P. & Shayer M. (1994) *Really Raising Standards: Cognitive inter vention and academic achievement,* Routledge). As Wood says, 'Viewed in this way, learning is taking place on at least two levels: the child is learning about the task, developing 'local expertise'; and he is also learning how to structure his own learning and reasoning' (Wood D (1988), *How Children Think and Learn:* Blackwell, p77). It is this second level that involves metacognition and transfer of learning. See also Fisher R. (1998) 'Thinking about Thinking: Developing Metacognition in Children', in *Early Child Development and Care*, Vol 141, pp1-13.
8 Freeman J. (1991) *Gifted Children Growing Up*, London: Cassell
9 Davison, J.E., Deuser, R. & Sternberg, R. J. (1996) 'The Role of Metacognition in Problem
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    Solving', in Metcalfe J. & Shimamura A.P. op cit.
10 For an introduction to Philosophy for Children see Fisher R. (1998) *Teaching Thinking:*

Philosophical Enquiry in the Classroom (Cassell) and Fisher R. (1996/9) *Stories for Thinking* series for 5-12 year olds (Nash Pollock).

11 These and other questions that involve pupils in assessing writing are listed in Fisher R. & Williams M. (eds) (2000) *Unlocking Literacy: A Guide for Teachers* (David Fulton) p76-7.

12   From Fisher R. (1998) *Teaching Thinking* (Cassell) p242

Further reading

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