Learning together
GTC NETWORKS

Behaviour for learning

Engaging with research

GTC
General Teaching Council
for England

Contents

Background

Are you in your first years of teaching? Do you want to make sure that what you do in your classroom is based on strong evidence about what works?

Like most of us, you are looking for proven teaching strategies and methods that you can use in your classroom. But being in your early years of teaching, you may also be anxious about keeping classroom order, which can make trying new things tricky. You need to have good grounds for believing that what you do is likely to have successful learning outcomes for your pupils.

That's why the GTC decided to bring together some of the cumulative findings from research in this evidence 'anthology'. Our aim was to bring you sound evidence of effective teaching and learning behaviours for both primary and secondary phases.

What this anthology provides

Of course, you will continue to acquire knowledge of learning and teaching and of your subjects throughout your professional career, and you will find much in the research literature to support your professional learning.

In this anthology we start with the fundamental issue of teacher beliefs: what do effective teachers believe? We then go on to look at what effective teachers actually do. Based on their beliefs, what do effective teachers do to promote learning?

We have examined the evidence to find answers to each of these questions and you will find that several important themes keep cropping up throughout the anthology. Keep an eye open for them, because they are important.

The focus on teacher beliefs and classroom strategies was drawn from a theoretical framework underpinning research into effective teachers of numeracy that is summarised in one of our Research of the Month (RoM) features. The selection of classroom strategies was based on sound evidence about links between the ways in which teachers behave and pupil behaviour which is closely linked to learning.

Each page of this anthology finishes with a brief note that tells you where the evidence synthesis is taken from. These will mostly list the titles of the relevant RoM summaries. You can find full references (see page 37) for the studies on which each RoM is based, links to the summaries themselves and any other references at the end of this anthology. You can also find out more about how we used the evidence base for this anthology in the section on 'How do we know this?' (see page 27).

Many sections have an Evidence box that tells you which RoMs to look for for further information and evidence on the RoM website at **www.gtce.org.uk/ResearchOf TheMonth**

Research of the Month

Making research accessible

The GTC's Research of the Month makes the key findings of academic research studies accessible to teachers. All the studies featured are chosen by the RoM team from the Centre for the Use of Research and Evidence in Education (Curee) for their relevance to classroom practice and the quality of their evidence is carefully appraised.

There are now over forty RoMs, and the Curee team have sifted through them to find strands of evidence about teachers, teaching and learning with the potential to support your work as a newcomer to the profession.

As well as the full RoM summary itself, look out also for the 'research tasters', bite-sized summaries with busy teachers in mind.

In 2009, we plan to rename RoM as Research for Teachers, but the principles of RoM will remain.

Section 1
What effective teachers believe

Your beliefs about learning are the foundation upon which you make choices about how to teach.

We know from research that some beliefs are deep-seated and 'taken-for-granted', rather than conscious decisions. Such unconscious beliefs are rarely questioned and can have a profound and lasting effect on how you act.

What beliefs do teachers hold that help them to promote pupil learning?

Beliefs act as a filter for noticing and categorising information. They determine how you interpret new information and react to it, whether the new input comes from your pupils' responses to a learning activity, from research, or from theory.

Teachers have been found to have strong beliefs about such issues as:

- whether a pupil's ability to learn is fixed or can be changed
- whether learners benefit more from working with others or from working individually
- appropriate ways to respond to learners' mistakes and how this might encourage or discourage them from taking risks
- the promotion of positive beliefs amongst pupils.

Can you change your beliefs?

Changing your beliefs isn't easy, but it is possible. It's certainly worthwhile if you become aware of evidence mounting up that doesn't fit your world view. Doing action research or getting involved in coaching, and especially watching and analysing video footage of your teaching, can help you uncover and examine your beliefs – and make big changes to your practice. Monitoring and tracking your pupils' progress can also lead to helpful and evidence-informed reflection on your own practice and beliefs.

Evidence box

The evidence on this page is mainly rooted in these RoMs.

- Effective teachers of numeracy
- Teachers and school-based research
- Making the difference: teaching and learning strategies in successful multi-ethnic schools

> **"Changing your beliefs isn't easy, but it is possible"**

What do effective teachers believe about pupils' ability?

Which of these two alternatives do you believe?

A person's ability in a given area is fixed within certain limits.
or
A person's ability in a given area can be extended.

How might a belief about either viewpoint affect the way you approach teaching and learning?

The evidence from several studies suggests that if you have expectations that all pupils have the ability to learn, you are likely to be more successful in promoting high standards than teachers who believe that ability is fixed – they consequently have low expectations.

According to the research, teachers who believed that the ability of pupils in low sets was limited actually taught in ways that played a part in depressing these pupils' attainment. Those teachers had low expectations of 'low-ability' pupils and taught in heavily structured ways that were unhelpful when pupils needed to use their knowledge in unfamiliar contexts. With the best of intentions, these teachers used:

- a great deal of repetition, practice and 'rote' learning;
- very little discussion;
- a series of closed questions that funnelled pupils unthinkingly towards particular responses; and
- procedures to help pupils reach a 'correct answer' that relied more on using memory than on understanding.

If a pupil persistently failed to grasp a concept, teachers who were positive that all pupils had the ability to learn tried new approaches to overcome this.

Teachers who believed in fixed ability were likely to attribute this lack of success to the pupil: for example, they may have believed that the pupil was not ready to learn a concept. These teachers then tended to return to practising skills learned earlier. They may also, again with the best of intentions, have set pupils tasks that were too easy and lacked challenge, because they did not want their pupils to become discouraged.

On the other hand, the research shows how effective teachers:

- tried to understand what their pupils already knew or believed;
- adjusted or changed their teaching to address particular misunderstandings; and
- persisted in trying a variety of approaches.

Effective teachers in these studies generally believed that activities should challenge all children, not just the most able. As one mathematics teacher put it:

"… I have the same expectations for all the children, I think about it as not so much what the children are doing as what they have the potential to do."

When pupil tasks were open-ended and motivating, teachers were often surprised by just how much their pupils could achieve. This in turn led to higher expectations for the future.

Evidence box
The evidence on this page is rooted in these RoMs.

- Effective teachers of numeracy
- Making the difference: teaching and learning strategies in successful multiethnic schools
- Inside the literacy hour
- Effective literacy teaching in the first years of school
- Inclusion and pupil achievement
- ICT for teaching and learning
- Consulting pupils about teaching and learning
- Grouping pupils and students – what difference does the type of grouping make to teaching and learning in schools?
- Experiencing secondary school mathematics

"Activities should challenge all children, not just the most able."

What do effective teachers believe about pupils working with others?

Do pupils learn better when they can discuss their work within groups of other pupils?

Or do pupils learn better when they work on their own, uninterrupted by interactions with others and made to think for themselves?

If you are inclined towards one or the other of these beliefs, you are likely to favour different strategies for organising learning in your classroom.

There is not one single 'right way' of grouping pupils for learning and most teachers use a range of grouping strategies. But there is good evidence that particularly effective teachers believe that structuring co-operative group work is an effective learning strategy. They use this strategy to a larger extent than most, and studies have found positive effects on student achievement.

For example, more effective teachers of mathematics were convinced of the value of pupil discussion with their peers (and with the teacher) about all aspects of mathematics. They believed that group discussion:

- improved pupils' awareness of the relationships between numbers and of different methods of calculation; and
- helped to make pupil assumptions explicit and uncover their misconceptions, which could then be addressed.

Some less effective mathematics teachers believed that individual, practical problem-solving activity was the best approach to help pupils learn mathematics. One result of this belief was that these teachers rarely intervened to compare the effectiveness of different pupil approaches. Because the pupils worked individually, they did not become aware of others' approaches, thus narrowing pupils' sense of possibilities.

Some teachers used what the researchers called a 'transmission' approach. They believed it was important to teach standard procedures and techniques for calculating and for pupils to practise these techniques individually. They rarely asked pupils to work within groups. The study found that their pupils made relatively slow progress compared with the others.

Later pages in this anthology offer more evidence about how you can promote effective group work (see page 17) and structure small-group discussion (see page 19).

Evidence box

The evidence on this page is rooted in these RoMs.

- Effective teachers of numeracy
- Effective literacy teaching in the first years of school

There is a great deal of additional evidence (see page 37 References) on the effectiveness of structured collaborative learning, some of which is summarised online.

> **"Effective teachers believe that structuring co-operative group work is an effective learning strategy"**

What do effective teachers believe about responding to pupil errors?

Learning something new always involves a lack of control and the probability of making errors, so it can feel a risky business. All but the very youngest pupils fear making a fool of themselves in front of others. As a recently qualified teacher, you'll be especially aware of how vulnerable this learning process can feel, so you'll be able to empathise with your pupils, as they encounter the risky process of learning every day.

According to the research, effective teachers believe that pupils can learn a lot from mistakes and learn most when they take the risk of exposing their ideas to others' scrutiny. In these studies, effective teachers in mathematics and science assessed work carefully and listened to discussion so as to diagnose the thinking that lay underneath pupils' errors. They then explicitly discussed these misconceptions and errors with pupils to improve understanding.

What might this mean in practice?

Few pupils are prepared to take the risk of exposing their ideas if they feel it is not safe to do so. So it is vital that you create a safe classroom environment for discussing ideas and for learning. The research shows how effective teachers created a positive ethos in the classroom and a 'can-do' attitude amongst their pupils. They:

- praised pupils for their effort, attention and achievements;
- taught them to recognise and celebrate other children's achievements;
- prevented misbehaviour by pleasantly redirecting pupils' attention to aspects of their work as soon as they appeared to be distracted; and
- treated guesses and intuitive hunches with respect, as worthy hypotheses that could later be checked by experimentation or analysis.

In later pages in this anthology you'll find more detail on how effective teachers make it safe for pupils to expose their ideas for discussion (see page 19) and find appropriate ways to respond to pupils' mistakes (see page 23).

Evidence box

The evidence on this page is rooted in these RoMs.

- Effective teachers of numeracy
- Learning science – transforming pupils' everyday ideas about science into scientific thinking
- Enquiry-based learning, cognitive acceleration and the spiral curriculum: Jerome Bruner's constructivist view of teaching and learning

> **"You'll be able to empathise with your pupils as they encounter the risky process of learning"**

How do effective teachers promote pupils' confidence and self-belief?

In the studies featured in the Research of the Month website, effective teachers believed in the importance of promoting pupil self-confidence. In order to do this, they praised pupils, gave them information about their work that highlighted its positive qualities, and showed that they valued effort.

But the evidence shows that building self-confidence is about more than praise. The research suggests that you need to give specific, helpful advice on what pupils can do to improve. Instead of comparing pupils, teachers in these studies encouraged mutual support and insisted that they listen to one another.

They also:
- scaffolded pupils' work by using explanations, demonstrations, stories and analogies to help them understand relevant language, concepts and skills;
- used a collaborative, questioning approach to learning; and
- listened to pupils and valued their contributions to discussion.

When consulted, pupils said that their confidence in their ability to learn was strongly affected by:
- their perceptions of assessment;
- receiving praise;
- having someone to talk to about their learning; and
- their relationships with friends and families.

Assessment and rewards

Pupils felt more confident about their ability to learn when they understood how assessment could help them make progress. Where the purposes of assessment were not clear, tests just made pupils more conscious of what they could *not* do than what they could do.

Receiving praise from teachers and parents improved pupils' self-esteem and their willingness to work hard, but the way in which praise and rewards were given was important.

Young pupils seemed happy to receive merits or reward stickers in class or during assemblies, but secondary students often found public rewards embarrassing. Pupils of all ages appreciated letters of congratulation sent home to their parents, positive comments written on their work and praise and encouragement in annual reports.

The evidence seems clear that if you demonstrate your own belief in your pupils and encourage them to do their best, this will boost your pupils' self-confidence and self-esteem. Confidence seems to be catching.

You might wish to read a case study (see case study 1 page 28) of how a teacher improved the confidence of Year 6 pupils in spelling.

Evidence box
The evidence on this page is rooted in many RoMs and their linked case studies, but especially in these RoMs.
- Consulting pupils about teaching and learning
- Raising standards through classroom assessment
- Effective literacy teaching in the first years of school

> **"Building self-confidence is about more than praise"**

What are some of the implications of the evidence about teacher beliefs for your teaching?

So how might the evidence about the beliefs of effective teachers affect you? Here are some questions and ideas that you might like to consider in thinking abut how to use this evidence.

- **The evidence highlights the importance of a belief in the elasticity of pupils' ability.**
  What kinds of tasks offer pupils only limited options to show what they can do?
  What kinds of tasks might offer pupils opportunities to surprise themselves (and you)?

- **The evidence highlights the importance of structuring group work.**
  What beliefs guide your current approaches to group work?
  How might these beliefs make you likely to feel when, for example, the noise level in the classroom rises?
  Would talking to a colleague help you disentangle beliefs about behaviour and learning?

- **The evidence suggests that pupils' mistakes can be an indicator of confidence in the learning process and a useful learning tool.**
  How have your beliefs about giving feedback to pupils been shaped by your own experiences of receiving feedback from others?
  How might you use mistakes sensitively to promote the process of learning?

- The evidence suggests that beliefs can be deeply rooted.
  When you notice new and surprising evidence, how do you weigh that against your own experience to date and that of others?
  Have you thought about getting a colleague to observe the way you approach a particular aspect of teaching in the classroom to test your practice and beliefs against the evidence?

Section 2
What effective teachers do to promote pupil learning

The first part of this anthology highlighted some of the beliefs of effective teachers. How do these beliefs translate into action?

The following pages highlight some of what effective teachers do to promote pupil learning. We look at three main areas of action for which the evidence of improved pupil learning is both plentiful and sound:

- improving pupils' thinking skills;
- supporting collaborative pupil learning; and
- providing assessment that promotes learning.

The evidence for this section is rooted in many RoMs and also draws on wider research. You will find more specific information in the 'Evidence box' on each page.

Thinking skills

How do teachers challenge their pupils to extend their understanding and to think and to use their imaginations?

Evidence about teaching thinking skills emphasises the importance of encouraging pupils to learn about their learning and to be able to transfer learning from one situation into another. This strand of research and practice is sometimes called cognitive acceleration or referred to as thinking skills.

Collaborative group work

How do teachers who believe that learning takes place when pupils discuss and think more deeply about their work support co-operative learning?

Evidence shows that pupils need support and structure in order to hold effective discussions about their work. This strand of research and practice is sometimes called collaborative learning. Because this type of learning always involves bringing more than one perspective or 'logic' to bear on a topic it is also often referred to as dialogic learning.

Assessment for learning

How do effective teachers use assessment to inform their teaching and to improve their pupils' learning?
Such teachers involve pupils in the process of assessing their own learning by giving them the tools they need to take charge of their learning and identifying the steps they need to take to make improvements. This strand of research and practice is often referred to as assessment for learning.

In the next few pages we outline these three approaches for you in more detail, starting with thinking skills.

Thinking skills approaches

How do thinking skills approaches help students to reach higher standards?

The past twenty years have seen a good deal of research into how pupil learning can be accelerated. The range of approaches that has been developed is called 'thinking skills.'

Some approaches use specific subjects to deliver general thinking skills. CASE (cognitive acceleration in science), CAME (mathematics) and 'Thinking through…' (for example, geography) fall into this category. Others involve explicit and dedicated lessons in thinking skills. A third group aims to embed thinking skills across the curriculum.

They all share a core of similar techniques for developing thinking skills which we explore further on the next few pages. These are:

- preparation for the task – often known as concrete preparation;
- the setting of a challenge that contains surprises or ideas in tension that perplex or puzzle pupils to make them think – sometimes called cognitive conflict;
- collaborative work with other pupils to solve the challenge – sometimes called social construction of knowledge;
- sharing thinking aloud about their own thinking to raise pupils' awareness of what's involved – sometimes called metacognition; and
- using skills and insights that have just been acquired in one context to consider a problem in a new context – often called bridging.

The process always involves pupils working with others to make their thinking explicit, learn from each other and construct a deeper understanding from their separate insights. For example, one two-year programme aimed to increase students' understanding in science. It relied heavily on discussion amongst groups of students to create a new, joint understanding. The students discussed cause and effect, their reasons for making particular predictions, experimental evidence and scientific principles. Their performance in tests at the end of the research period improved and so did their GCSE grades.

You might wish to read a case study (see case study 2 page 30) on improving pupils' thinking in a primary school.

Evidence box

The evidence on this page is rooted in these RoMs.

- Effective teachers of numeracy
- Improving learning through cognitive intervention

How can you provoke your students to think?

The approaches used in cognitive acceleration, or thinking skills, owe much to the Russian psychologist, Lev Vygotsky. He was fascinated by children's thinking and believed that they learned best in social situations where their curiosity was aroused by something they perceived as strange or perplexing.

Concrete preparation

To make the most of such challenges pupils need to be prepared. Getting pupils ready to make the most out of a task is sometimes called concrete preparation. To achieve this, you need to:

- recap relevant aspects of what pupils have already learned;
- highlight and clarify the meaning of essential vocabulary through discussion with the pupils; and
- help pupils to become familiar with the task and what they have to do.

Concrete preparation is important in making sure pupils understand the initial problem. Unless you ensure that the terms and vocabulary have a real meaning for pupils, a problem may not be seen as a problem. "To someone who has never seen a hat or a rabbit, it is not interesting to see a rabbit pulled out of a hat. For all she or he knows, hats are precisely the place where rabbits live."

Setting a cognitive challenge

When you use thinking skills approaches, you need to set pupils a cognitive challenge: a challenge that makes them think.

This can be a challenge to someone's usual way of thinking or perceiving the world. It may introduce new information that does not fit with previous experience. The uncertainty arouses curiosity and makes your pupils think. The tasks you set should be interesting and challenging, but achievable with the help of others.

In Vygotsky's experiments with young children, he would challenge his subjects' thinking by introducing obstacles that made it impossible for them to solve the task in their usual way.

In one example of cognitive challenge a Key Stage 1 teacher deliberately introduced shared characteristics to make the task of sorting different objects more complex. She asked her pupils to sort plastic models of animals in a variety of ways by placing them within two hoops. During the process, pupils were placing all the blue animals in one hoop and all the mammoths in another – until they came across a blue mammoth. They were perplexed as to where to put it and discussed various options. Eventually, one child suggested overlapping the hoops and placing the blue mammoth in the overlapping section, so that it was in both hoops.

In a further example from a secondary school science lesson, pupils investigated the effects of different variables (length, width and type of material) on the note produced when they blew across the top of a tube. The cognitive challenge here was about which variable was the key factor.

Social construction of learning

Once the pupils have been set the task, they work together to solve the challenge, supported by each other and you as the teacher. This process is called social construction, because conversation between the pupils and the teachers helps them to build new knowledge and understanding. By engaging in discussion with others, children create a 'dialogue' within themselves in which they check and refine their own thinking.

For example, one study found that secondary science students were more motivated to learn if they were set a task which required them to solve a problem from a real-life context by collaborative discussion. Pupils were less enthusiastic if they received precise instructions from the teacher to carry out a task designed solely to convey a particular point.

> **"In collaboration the child can always do more than he can do independently."**
>
> Lev Vygotsky

Metacognition

Whilst pupils are working together on a task you can prompt them to say what they are thinking and why. This process of articulating their thoughts leads pupils to become more consciously aware of their own thinking. This awareness of thinking is called metacognition. The discussions pupils hold whilst tackling the task may well lead naturally in this direction as they explain their thinking to each other.

But sometimes their talk will leave their thinking quite implicit. You can encourage improved metacognition by asking pupils to reflect on their learning after the task is completed, during a plenary session.

You might wish to read a case study (see case study 3 page 31) of how teachers from a North East secondary school used debriefing to stimulate metacognition.

Where does the evidence come from?
The evidence for the above is rooted in the following RoMs:

- Social interaction as a means of constructing learning: the impact of Lev Vygotsky's ideas on teaching and learning
- Improving learning through cognitive intervention
- Learning science – transforming students' everyday ideas about science into scientific thinking

How can you help pupils use what they know in new situations?

The final stage involved in accelerating learning is bridging, which is defined as the conscious transfer of a reasoning pattern from its initial context to a new context.

All too often, learning is specific to a situation. Pupils grasp new skills in one situation, but do not make generalisations that help the skills to transfer to other contexts. This can happen even if the context seems quite closely related. For example, in one study, children in Brazil who often sold fruit on the streets were presented with three types of problem:

- the first set of problems were just like the buying and selling transactions with which the children were familiar;
- a second set of problems were similar but involved different types of goods; and
- a third set of questions removed the context of the problem altogether and set abstract sums like 65 + 49.

The children answered almost all the first set of problems correctly, but only three quarters of the second set of problems. They scored an average of less than 40% on the decontextualised questions.

Although the children had mastered some specific numerical techniques, they did not understand the underlying mathematical principles and so were unable to transfer the techniques to different contexts.

So understanding why things work – or developing a practical theory – is crucial to transfer. You will find that plenary sessions offer you an opportunity to broaden your pupils' understanding by connecting what they have just learned to other situations.

Another method of bridging is simply to offer an example of a similar situation to pupils and give them a few moments to discuss differences and similarities between that situation and the original problem in pairs. It helps pupils to make links between contexts if they have some time for discussion.

Alternatively, you could ask pupils to bring the new insights, skills and knowledge they have acquired from one context to bear on another problem in a new context. The new context could be from within the same topic, from another subject or from everyday life.

For example, in a science lesson, pupils had to control variables as they investigated objects falling under gravity. The teacher reminded pupils of a previous lesson in which they had had to plan an investigation into the conditions necessary for growing seeds. The discussion of the strategies they had previously used to control variables was an example of bridging.

Where does the evidence come from?
The evidence on this page is rooted in the following RoMs:

- Improving learning through cognitive intervention
- Social interaction as a means of constructing learning: the impact of Lev Vygotsky's ideas on teaching and learning

Implications of the evidence about thinking skills approaches for your teaching

So how might you act on the evidence from the last few pages about thinking skills?

- The evidence shows that it is important to make sure that you and your pupils share an understanding of the vocabulary used to explain or set a task.
  How might you plan to pay enough attention to the meaning of specialist vocabulary during your introduction to a topic?
  How can you check your pupils' understanding of a task?

- The evidence suggests that real-life problems and surprises can provoke pupils to think.
  How comfortable do you feel about challenging pupils and allowing them to struggle?
  Would a belief that this process can be beneficial to pupils' understanding in the long term help you to resist the temptation to step in and help?

- The evidence is clear about the value of pupils thinking aloud, so they can find out and compare what they and others think and move towards new understandings.
  In which circumstances could you encourage this process of thinking aloud by modelling it for pupils and by praising pupils specifically when they share their thoughts?
  How can you help pupils to understand that a suggestion that does not work can tell you as much as a suggestion that does work?

- Extending learning across a variety of contexts helps pupils' understanding.
  How could you encourage pupils to identify everyday contexts to which new knowledge might apply?

> **"Uncertainty arouses curiosity and makes your pupils think"**

Collaborative group work

Why use collaborative group work and small group discussion?

There is strong research evidence that collaborative learning can effectively promote student understanding, increase motivation to learn and enhance competence and self-esteem.

But you can't just seat pupils in groups and expect them to work together productively. When pupils are sitting in a group but there is no specific requirement for them to work together, they are likely to work individually. So you need to give them a reason to work together. Many studies have found that it is necessary to teach interpersonal and small group skills explicitly to help pupils interact well and get the most out of collaborative learning.

It also helps to structure the group discussions so that each pupil is exposed to a variety of viewpoints. (That's because the process of becoming aware of and discussing different viewpoints really helps pupils to learn.) We've used the evidence to highlight some ways of structuring discussions (see page 18) for student learning.

Some pupils find it hard to formulate and express coherent arguments during small-group discussions. These pupils may get distracted or frustrated and withdraw from the task, especially if a group leader emerges who does not listen well. There is good evidence that simple techniques to promote turn-taking and improve listening (see page 19) really help promote students' learning.

Evidence box

The evidence on this page is rooted in these RoMs.

- Social interaction as a means of constructing learning: the impact of Lev Vygotsky's ideas on teaching and learning
- ICT for teaching and learning
- Inside the literacy hour
- Teachers and school-based research

There is a good deal of evidence from other sources about the effectiveness of collaborative group-work and discussion for pupils' learning and we have used some of the findings on the following pages.

How can you help children improve the quality of their collaborative work?

To ensure that pupils collaborate, you have to put them in a situation that *requires* them to interact and cooperate in order to complete the task or solve the problem. In collaborative group work, you will be establishing activities that require pupils to:

- work together as a group;
- exchange ideas and resources;
- contribute to group discussions;
- challenge others' reasons and understandings;
- discuss alternatives; and
- accept responsibility for the group's decisions.

The purpose of the task may be to make sense of a range of information, to prepare a group presentation, or to solve a problem that has a variety of possible solutions. The stimulus for discussion could be visual or text based, but it is helpful if you present a group with a stimulus that offers information from different viewpoints and which is likely to provoke a variety of opinions from within the group.

For example, there are many possibilities for discussion in geography stimulated by pictures of disasters such as the floods at Boscastle or Lynmouth, houses falling into the sea due to coastal erosion, or the effects of the tsunami on Sri Lanka and Indonesia. What could or should be done to minimise such happenings in the future?

In history, pupils studying the Tudors could compare quotes from English courtiers and foreign ambassadors on Queen Elizabeth 1 as part of their work on facts and opinions.

A picture of a local park or swimming pool with a newspaper headline threatening closure could prompt lively debate in English, before pupils write letters to relevant authorities.

Pupils need specific training and support from teachers to get the most out of cooperative group learning. You need to teach students to:

- ask questions;
- be active and persistent in seeking help from their peers;
- give help that is detailed; and
- check that the help given is understood by the recipient.

You can help pupils to learn how to do this by modelling the types of verbal exchanges that encourage pupils to express ideas, explain reasons and solicit help. Here are some of the skills you will wish to encourage amongst pupils, followed by comments or questions that exemplify them.

- Reflecting meaning – "It sounds as though…"
- Challenging and probing thinking – "What makes you think..?"
- Offering tentative suggestions – "Have you thought about…?"
- Focusing on key issues – "What have you decided is the main problem here?"
- Focusing on solutions – "What might you need to do now to find the solution?"
- Validating efforts and ideas – "What an interesting suggestion!"
- Encouraging consensus – "Have you discussed this with the others?"
- Clarifying options – "So you've decided you could try it this way or that way …"
- Reframing statements to help pupils consider an alternative view – "On the one hand, I hear you saying…but on the other hand, you seem to…"
- Seeking other opinions – "What do you think?"

When teachers support small group discussion, their language tends to be more personal, friendly and supportive than it is in whole-class settings, when they tend to spend more time directing, lecturing and disciplining students. So you may wish to adopt an informal style of verbal interaction with pupils when you want to support their discussions.

You might wish to read a case study (see case study 4 page 32) on teaching children how to reason together.

Evidence box
The evidence for this section is rooted in the RoM on Teachers and school-based research and in two studies by Gillies (2004, 2005). (See references, page 37)

What techniques can you use to promote and structure small group discussion?

The small-group discussions needed for effective collaborative work need to last several minutes – long enough for all students to have the opportunity to contribute. The time required will increase with the size of the group and the complexity of the task.

You can compose groups from clusters of friends and deliberately include pupils with a range of abilities. Group size can vary from two to eight students. Pairs allow deep discussion, but may not cover a range of views. Larger groups tend to have a greater diversity of opinions, which helps discussion, but they are more likely to be dominated by a few individuals than smaller groups.

Here are some ways in which you can structure small group discussion and increase the variety of viewpoints that pupils will encounter.

Talking sticks and tokens

Any group will have more and less vociferous members. To make sure that people listen to one another in turn, you can use a 'talking stick'. Only the person who holds the talking stick can speak. Teachers have to keep to this rule, too! The talking stick can be handed round the group so everyone speaks in turn, or simply passed to a group member who wishes to speak next. Another way of making sure everyone gets a turn to speak is to give each group member three tokens. Each token represents one opportunity to speak and is dropped into a bowl in the centre when the turn has been taken.

Envoying

Each group of pupils is given a different task, which they discuss. After an agreed time, the pupils are mixed up so that each new group contains one member from each of the original groups. (You can do this by asking members of each original group to number themselves and then ask all the pupils with the same number to form a new group. It works well with five groups of six and then six groups of five, for example.) During the second group discussion, each member of the group acts as an envoy to report on their original group task.

Snowballing

In a 'snowball' exercise, pairs of students discuss a question or idea and agree on their views. Then they join with another pair to share what they have discussed and aim to reach agreement. These groups of four join with another couple of pairs to share their views.

Jigsawing

In a jigsaw exercise, each member of a group is given one small aspect of a task or topic to study (so they are really working individually to start with). Then each pupil who has read a particular aspect of the work joins others who have studied the same material and they discuss the material together. After the discussion, each student returns to their original group and teaches their part to the other members.

Evidence box
The evidence for this section comes from two systematic reviews (see page 37 for references) (Bennett et al, 2004, 2005) of the use and nature of small group discussions in science.

Implications of the evidence about collaborative learning for your teaching

So how might you act on the evidence from the last few pages about collaborative learning?

- It is important that pupils share expectations and understand clear guidelines on how to behave during group discussions.
  We've provided some examples of effective techniques but there are many more. What have your colleagues found to be effective ways of negotiating agreed rules of behaviour with their classes? You may be able to build on their work with your students.

- There is much evidence of the value of truly collaborative learning.
  What types of task have you found are most productive for group discussion that uses the perspectives of all group members?

- The ability to ask open-ended questions, to allow sufficient time for thought before gathering answers and to promote extended responses by asking for reasons and explanations all help teachers to promote effective collaborative learning. How do you model these skills for your pupils?

- The evidence suggests that pupils can learn much from encountering a variety of different viewpoints.
  Could you use envoying or snowballing strategies to structure discussion beyond friendship groups and to enable pupils to become aware of a wider range of opinions?

> **"Put your pupils in a situation that *requires* them to interact and cooperate"**

Assessment for learning

How can you use assessment for learning?

Gathering accurate information about each pupil's learning and using this to adjust teaching so that it matches pupils' needs better is at the very heart of effective teaching. This process is called formative assessment, or assessment for learning. The evidence that formative assessment raises standards is strong and extensive.

One systematic review of hundreds of research papers on assessment showed that, although the use of assessment to improve teaching and learning could be highly effective, it was relatively rare. Types of assessment that emphasised marks and grades, compared one pupil against another, or measured pupils' achievement at a given time against externally agreed standards, were much more common.

The review found that formative assessment led to substantial learning gains, especially among low-attaining pupils and those with learning difficulties, if the teachers in the studies:

- improved two-way feedback between pupils and teachers by:
  - improving questioning and the quality of classroom dialogue; and
  - changing the way in which they marked work;
- ensured that they adjusted their teaching to take account of what they had learned about their pupils from the assessment process; and
- helped pupils to develop self-assessment skills and thus to become more independent learners.

Evidence box
The evidence on this page is rooted in these RoMs:

- Raising standards through classroom assessment
- Assessment for learning: putting it into practice

> **“Accurate information about each pupil's learning ... is at the very heart of effective teaching”**

How can you use different questioning techniques to improve classroom dialogue?

Using assessment to improve learning depends on improving the quality of the dialogue between you and your pupils, so you can understand where your pupils really are and then help them to move forwards.

Teachers often leave less than a second after asking a question before asking another question or answering their own question, if no answer is given by a pupil. The only sort of questions that can be answered in such a short time are those needing little thought, so this short 'wait time' results in superficial classroom dialogue. Such exchanges can appear to raise the energy level in the classroom and many teachers mistakenly believe that asking a series of closed, quick-fire questions increases the pace at which pupils work. The practice is deeply embedded in most teachers' repertoire of techniques and it is difficult to change.

Although it can be helpful to use questioning to find out what pupils know, according to the evidence the key functions of really effective questioning are to:

- provoke pupils to think; and
- elicit information that the teacher needs.

The aim is one of thoughtful, continuous improvement, rather than getting it right first time. If you give pupils a wait time of several seconds it allows them time to think. It also enables all pupils to be ready to answer. All answers, whether right or wrong, can be discussed and used to develop understanding. According to the evidence, effective questioning is a key element of good quality, whole-class interactive teaching.

Teachers trying out more effective questioning techniques found it useful to:

- take time to frame questions that were worth asking because they developed pupil understanding;
- extend the silence after asking a question to allow pupils to think;
- discourage the practice of using 'hands up' to indicate that a pupil knows the answer and instead, expect everyone to be prepared to answer, possibly after discussion in pairs; and
- ask pupils to explain the reasons for their answers.

Pupils could take time to adjust to the new style of questioning, but came to realise that learning depended less on their capacity to spot the right answer and more on their readiness to express and discuss their own understanding.

You can find an example of the way in which effective science teachers used questions and discussion to assess their pupils and then to tailor their teaching more closely to their pupils' needs on page 33.

Evidence box

The evidence on this page is rooted in these RoMs.

- Raising standards through classroom assessment
- Assessment for learning: putting it into practice

How can you mark work so as to improve pupil attainment?

The original research found that the most effective feedback to pupils made them think. This was best achieved by making comments that:

- identified what had been done well;
- identified what still needed improvement; and
- gave guidance on how to make that improvement.

Making this manageable

The follow up research found that teachers needed to plan opportunities for pupils to follow up and act on comments, for example, by using some lesson time to allow pupils to redraft their work.

Teachers in the follow up study also monitored pupils' responses to comments. Rather than trawling through books to check pupils had followed up her comments, one teacher stuck a comment sheet at the back of her pupils' exercise books. She used the left-hand side of the sheet for her own comments and asked pupils to indicate on the right-hand side where in their books they had responded to her comments.

The evidence showed that the widespread practice of giving marks and grades for work judged pupils' work but did not explain to them how they could *improve* it. Moreover, it emphasised competition and tended to discourage pupils who did relatively badly.

When the classroom culture focused on rewarding high quality work and emphasising pupils' relative position in the class, pupils looked for ways to obtain the best marks and avoided putting themselves in situations where they might fail. Low achievers often learned that they always did badly and concluded that there was no point in trying. The overall result was to increase the extent of under-achievement.

When both grades and comments were given, pupils were found to focus more attention on their grades. They often ignored the written comments that could have helped them to improve. So the researchers recommended using comment-only marking and not awarding grades at all.

Some teachers were nervous about this, fearing that pupils, parents, or Ofsted inspectors might react unfavourably. But negative reactions to comment-only marking were very rare. The comments seemed to help parents, as well as pupils, focus on the learning issues, rather than on trying to interpret a grade or mark.

Effective marking and good dialogue with pupils helped teachers to find out more about their pupils' learning and to use this as a basis for planning learning objectives that matched learners' needs; the key to making assessment formative rather than summative.

Evidence box

The evidence on this page is rooted in these RoMs.

- Raising standards through classroom assessment
- Assessment for learning: putting it into practice

How can you use assessment to help pupils become more independent learners?

Effective formative assessment actively involved pupils in the assessment process and helped them to develop skills for peer and self-assessment.

Improving pupils' understanding of assessment

To gain any measure of control over whether or not they achieve a learning goal, pupils need to understand both the goal and what they need to do to achieve it. Showing pupils an example of 'one I made earlier' helps them to recognise when they have succeeded.

You can help pupils to get a clearer picture of what they are aiming for by letting them discuss several examples of finished work and discovering in the process what it is about a finished product that makes it good (or not so good). This process uncovers the assessment criteria that teachers use but that are usually invisible to pupils.

Scaffolding

You can make it easier for pupils to reach their learning goals by splitting up a big task into several smaller ones and providing support such as prompting questions. This process is called scaffolding and can be used for a variety of complex tasks, such as writing a story, or designing an experiment.

But an important aspect of scaffolding is that it is eventually removed. You can take pupils through this process by giving them fewer prompting questions as they gain experience of a task. You can also foster your pupils' independence by explicitly teaching them how they can split big tasks up into smaller tasks for themselves.

Peer assessment

Peer assessment can be an effective way to help pupils understand their learning goals and how to meet them and to develop the detachment required for self-assessment. In peer assessment, pupils:

- used the same language;
- were likely to interrupt an explanation they did not understand;
- accepted criticisms more readily;
- were motivated to work more carefully;
- could provide each other with models of achievement;
- learned by teaching one another; and
- had the opportunity to clarify what they understood and this improved their communication with their teacher about their learning.

Peer-assessment activities gave teachers time to observe, reflect and frame helpful interventions. You might wish to read a case study (see case study 6 page 30) on peer- and self-assessment in creative writing.

Teachers used a variety of strategies to develop their pupils' peer- and self-assessment skills. One simple method was to ask pupils to indicate whether they thought they had a good, partial or little understanding of a topic using a green, amber or red 'traffic light' code. The teacher then paired up the pupils self-rated as amber and green so they could help each other improve their work and worked with the remaining group of red pupils.

Evidence box

The evidence on this page is rooted in these RoMs.

- Raising standards through classroom assessment
- Assessment for learning: putting it into practice
- Effective literacy teaching in the first years of school

Implications of the evidence about assessment for learning for your teaching

So how might you act on the evidence from the last few pages about assessment for learning?

- Effective teachers know not only where they want to get to, but understand where their pupils are starting from.
  To what extent might you extend your use of day-to-day assessment to discover exactly where your pupils are getting lost?
  Might marking fewer items (or a smaller range of issues) in greater depth help you to understand this process?

- Effective teachers help pupils understand the criteria by which they can recognise quality in a piece of work.
  Might it empower pupils to take more responsibility for their own learning if you gave them a series of examples to compare and analyse?
  Could you design check sheets for pupils to use so that they can begin to assess and edit their own work?

- Teachers were often worried about how others would react to comment-only marking.
  Might it help to discuss this issue with colleagues, pupils and parents, so that everyone understands why this process is useful?

> **“Effective marking and good dialogue with pupils helped teachers to find out more about their pupils’ learning”**

Section 3
How we know this

We considered a number of possible conceptual models for this anthology. We decided that what was most likely to be helpful to you as practitioners in the early years of your profession was an adaptation and simplification of the one used within the RoM on 'Effective teachers of numeracy'.

In this, Askew and his colleagues explained a model of teaching and learning based around what teachers believe, know and do and how these areas interact with one another. The model was based on a wealth of empirical evidence and also developed from early work by Schulman on pedagogical content knowledge (PCK).

Schulman's notion of PCK emphasised not only the importance of teachers mastering the subject they teach, but also of understanding how the content fits together and how to present it in such a way that this is meaningful to students.

In addition, we read through the existing RoMs and found that a number of aspects of teaching and learning emerged consistently from the findings of different reports. We used these frequently emerging issues to help us select materials for the anthology, since the RoM resource is too wide-ranging for any anthology to cover the whole of it comprehensively.

Thus, the anthology is based on and structured around a strong theoretical, empirically based model of teaching and learning and also grounded in research findings from within existing RoMs.

In addition, we drew from certain other high quality studies which were not (yet) part of the RoM resource, but were relevant to the issues identified within RoMs. These were selected particularly to provide details that could help you put the findings into practice.

You can see the sources of evidence we used in the Evidence boxes. The sections on references (see page 37) and Where can I find out more online? (see page 36) will help you to follow up in more detail, if you wish to do so.

Some case studies of effective teachers at work

We have included a variety of independent case studies that show how teachers have implemented effective strategies for learning, based on our model of what effective teachers believe and what they do about teaching and learning.
They illustrate how you can boost children's confidence, use thinking skills strategies to improve their levels of achievement and support your pupils so that they can take part productively in small group discussions.

The last two case studies (pages 33 and 35) illustrate aspects of assessment for learning. The first shows how teachers found out more about their pupils' starting points and used this as a basis for planning work; the second describes how a class of older pupils used peer and self-assessment to improve story writing.

All the Research of the Month summaries include a number of independent case studies of this type. They are worth looking at because they are all based in everyday classroom activity – so they can help us to see how we might adapt some of the evidence for our own contexts.

Case study 1

Improving spelling confidence

We chose this case study because it provides an example of how a teacher boosted her pupils' confidence with spelling by encouraging a 'can-do' attitude. (The need to build pupil confidence is discussed on page 9.)

The study focused on seven Year 6 pupils who displayed haphazard spelling, low self esteem, little enthusiasm for writing and below average writing skills. These pupils were identified as failing to make as much progress as their peers. They were taught literacy with a group of seven Year 5 pupils who had similar attitudes and ability.

Before the study, feedback in the form of weekly spelling tests had had a demoralising effect on these pupils and did not help them identify their weaknesses. The pupils were taught to use a different, specific way of learning spelling – the Dilt 'magical spelling' or visual memory strategy. The strategy is based on the way 'good' spellers spell. Good spellers write or think of a word and then check it against a 'dictionary' they have in their visual memory. If the word is the same as the one in their 'visual dictionary' they get a feeling that tells them it is correct.

The magical spelling strategy formed part of the spelling focus within the literacy hour several times each week. The teacher taught five or six spellings a week using the following format:.

1 The teacher held a card with the correct spelling written in lower case letters.
2 The pupils imagined something 'good' whilst looking at the word.
3 The teacher then held the card to her left and encouraged the pupils to look at the spelling, whilst maintaining the good feelings.
4 The teacher slowly removed the card from view, but encouraged the pupils to keep picturing the word.
5 The procedure was repeated, but when the card was removed, the pupils were asked to write down the word.

6 Next they were asked to decide whether they thought they had spelled the word correctly.
7 Finally the pupils checked the word, marking each correct letter with a tick – helping the pupils to reflect on the "hard spots" within mis-spelt words and giving pupils the opportunity to analyse where their particular spelling difficulties lay.

The pupils were also given dictations to assess their spelling accuracy and emphasise the good feeling being promoted within the magical spelling sessions.

The teacher reported improved enthusiasm from the group – the pupils became increasingly positive about the literacy hour and much more willing to write. The children reported feeling much more positive about learning spelling. For example, one girl before the study had said:

> "I'm a mediocre speller. It sometimes worries me. I may not get a good job if I don't spell well. If there are lots of mistakes in my work I feel ashamed."

At the end of the study, the same girl said:

> "I like learning my spellings the new way – magical spelling. It's easier to remember them. I can see the words in the air."

The teacher thought the spelling strategy contributed to the pupils' improved self- esteem and performance because:
- the strategy emphasised to the pupils that they were acquiring a very effective strategy for learning to spell – they believed it was helping them;
- marking their own spellings gave the pupils responsibility for their own learning; and
- having only five or six words to learn meant the pupils felt they were succeeding more often, reinforcing their belief that the method was working.

Factors other than the specific spelling strategy may also have played a part in increasing the pupils' confidence. For example, the teachers' enthusiasm for the project and belief in the strategy and in the pupils' ability to learn, the smaller group size, and the more relaxed atmosphere may all have helped to make the strategy effective.

Reference

Howells, A. (2002) *Improving classroom practice – Focus spelling* Best Practice Research Scholarship (BPRS) research project.

Case study 2

Improving pupils' thinking in the primary school

We chose this case study because it exemplifies how different thinking skills strategies were successfully applied in one primary school. This links to the discussion of thinking skills on page 12.

The project aimed to develop effective thinking strategies across the curriculum and it was closely linked with the five thinking skills of the national curriculum 2000. The school used a number of strategies, including:

- the use of thinking logs in which children could record questions, ideas, mind maps and personal reflections;
- reading and discussing stories and poems in the literacy hour that had been designed to prompt philosophical discussion and higher order thinking;
- discussions in the numeracy hour aimed at improving pupils' understanding of what they had learned (metacognition) in mathematics;
- the use of pupil questioning, mind mapping and conceptual thinking in science;
- promoting discussion to develop thinking skills in PSHE and citizenship;
- applying 'Thinking through art' to develop visual literacy and creative thinking; and
- the inclusion of a thinking skills strategy in plans for all lessons.

Findings from this research project indicated that it improved pupils' skills in:

- listening;
- questioning and enquiry;
- critical reading;
- communicating ideas;
- self-expression;
- verbal reasoning;
- creative thinking;
- concept-building and mapping; and
- co-operative discussion.

The study also reported that the approach improved pupils' self-esteem and level of achievement and made them more aware of issues in citizenship. It also boosted teachers' professional confidence and self-esteem.

For the full report see: The Queen's Beacon School thinking skills project, R Fisher, Summary paper for the TTA/DfEE, Teacher Research Conference, March 2001.

Case study 3

Using 'debriefing' in a North East secondary school

This study shows how debriefing was used with secondary school pupils to stimulate metacognition, which is discussed on page 14.

Debriefing was a strategy used to get pupils to talk about their solutions to geography tasks and to explain how they carried out the tasks. The activity was aimed at metacognition and was designed for pupils from Year 7 to Year 10.

The features of the debriefing activity were that the teacher:

- made the point of the lesson explicit;
- asked a high number of open questions;
- prompted pupils by asking them to go on, so that many pupils gave lengthy responses that justified their answers to questions;
- made frequent references to concepts such as cause, effect and planning and to learning skills;
- summarised the discussion and learning for the pupils;
- made connections between learning outcomes and other contexts (bridging), offering analogies from pupils' everyday lives; and
- gave evaluative feedback to pupils by the teacher and other pupils.

Pupil discussion was usually animated. When asked their opinions about the lessons, pupils made the following comments.

- On using the strategy in literacy: "For writing essays and stuff, you have the reasons, the background and the trigger reasons, it can help you…arrange an essay and write it."

- When asked whether she minded if her friends corrected her: "No …I'm not bothered……if you don't (listen) you just do it wrong next time."

- When asked whether it helped to make the point of the lesson explicit: "Yeah because then we understand what we're doing and why we're doing it."

- General comments:
  - "We learnt how to group things together and see what might affect other things."
  - "It's like we're relearning things that we've done in the past that we've been learning over two years"
  - "What's good is like when other people put up arguments (so) you can see everyone's different point of view."

Reference
Evans, E., Kinninment, D., McGrane, J. and Riches, A. (1999) *De-briefing: pupils' learning and teacher planning*, Teacher Research Grant (TRG) summary. Available at: **www.tda.gov.uk/upload/resources/pdf/t/tta99-11.pdf**

Case study 4

Teaching children how to reason together

We chose this case study because it shows how teachers helped to create and foster effective classroom discussion among students by developing systematic rules for discussion with their pupils. This is discussed on page 14.

The study involved eleven Year 2 classes (aged 6-7 years) and their teachers. In six classes, the teachers implemented a programme of lessons designed to improve the children's spoken language skills. In five control classes, teachers and pupils pursued their normal activities.

All the schools involved had low levels of academic achievement, a high proportion of pupils from low income families and many pupils who spoke English as an additional language.

The teachers, with the help of the researchers, generated a programme of lessons designed to improve the children's skills in talking and listening in groups. Early lessons in the six-month programme focused on raising an awareness of the importance of talk while developing skills such as listening, sharing information and co-operating. Later lessons encouraged critical argument for and against different cases and applied the approach to various curriculum subjects, including history and geography.

The pupils were usually placed in groups of three, but sometimes pairs and larger groups were used, depending on the specific task. Each group was of mixed ability, which enabled each group to include a fluent reader and writer. The children had opportunities to practise giving and asking for reasons and discussing alternative ideas. Everyone in the group was invited and encouraged to contribute. The classes created and agreed a set of ground rules for discussion that would help them to reach a group consensus. These included, for example, that the group:

- shares all relevant information;
- expects people to give reasons for their ideas;
- considers all contributions with respect;
- accepts challenges;
- discusses alternatives before taking a decision is taken;
- tries to reach agreement; and
- takes responsibility for decisions.

Some of the key features of the lessons were:

- teachers made the learning objectives for group talk explicit in their introduction;
- teachers directly taught the class skills such as asking questions;
- the teacher focused the class on the quality of their talk, intervened to support groups during discussion and acted as a model when talking to the class; and
- groups reflected on the quality of their talk in plenary sessions.

The pupils in the target group learned to involve each other, listen carefully to what was said and to respond constructively, even if their response was a challenge. This group of pupils asked more questions and gave reasons more often than the children in the control group. The target group children also completed more puzzles correctly on a reasoning test after the programme than before.

The control group children's interactions did not show a similar pattern of change.

Reference

Wegerif, R., Littleton, K., Dawes, L., Mercer, N. and Rowe, D. (2004) *Widening access to educational opportunities through teaching children how to reason together* Westminster Studies in Education Vol. 27, No. 2.
An online digest of this study is available at:
www.standards.dfes.gov.uk/research/themes/speakandlisten/wegerif_access/

Case study 5

Using diagnostic probes to identify pupils' understanding in science

We chose this case study because it gives an example of how teachers discovered and took careful note of their pupils' preconceptions so as to identify what they needed to learn and the order in which they might learn it best. This links to the discussion about using assessment to help learning on page 21.

The teachers created tools, or diagnostic probes, to help them identify pupils' understanding within particular areas of science. They then used this information to plan how to teach the topic by breaking it down into a series of steps. The study involved 200 Year 7, 8 and 9 pupils with a wide range of ability.

The teachers reviewed previous research on children's understanding in particular areas of science and identified typical ideas and misconceptions often held by pupils. They then developed questions or probes to address these areas of frequent difficulty and tried them out with a small group of pupils before refining them for use with the main group of pupils.

Developing the 'Earth in space and gravity' diagnostic probes

The review of previous research on pupils' understanding of the Earth in space and gravity, for example, revealed:

- a clear pattern of development in pupils' ideas from a flat earth to a spherical model;
- gravity pulls objects down – this may be in conflict with the idea of pulling towards the centre of mass;
- gravity does not exist in space;
- the universe takes the form of a sphere made of all the other objects lying outside the solar system; and
- great confusion exists regarding the sizes and distances of objects in the universe.

The teachers created the following five probes for the earth in space and gravity topic to probe their own pupils' understanding.

Models – the probe involved the use of a range of different sized balls to probe the problems children have with scale in the universe – in particular the solar system.

Order – this involved the use of a card sort in which pupils were asked to sequence bodies (sun, galaxy, solar system etc) in order of size. This was to identify the ideas pupils have about the orders of size of bodies and systems in the universe.

Solar system – this involved the use of a card activity in which pupils could choose bodies (star, planet, comet, galaxy, milky way and so on) that they would find in our solar system. This was used to identify what pupils knew and believed about the objects present in the solar system.

Gravity (ball) – pupils were provided with a diagram and asked to explain what would happen when a ball was released in different places. This was intended to identify the ideas that pupils had about why objects fall.

Gravity (objects) – pupils were provided with a diagram on which different objects were shown around the earth and they were asked to explain what would happen when the objects were released. This was used to identify the ideas that pupils have about the effect of gravity on different objects.

When the teachers used the earth in space and gravity probes with the pupils, they found that many of the pupils:

- found it very hard to understand scale when thinking about the universe and found three dimensional models even harder to use than two dimensional diagrams;
- believed that the solar system is the largest system in the universe and that galaxies and other stars would be found in our solar system;
- did not associate objects falling under gravity with mass; and
- believed that gravity does not exist in space.

Learning sequences

Having found out what the pupils did and did not know about a particular science topic, the teachers recognised that the pupils had to go through some significant steps in learning.

They developed a sequence of possible learning routes through the topic. For example, for the Earth in space and gravity topic, they taught first, that objects fall, then that objects with mass fall, then that gravity acts over a distance. They also looked at the behaviour of falling objects on the earth before considering the behaviour of objects falling on the moon.

The place of diagnostic probes in teaching

The teachers recognised the diagnostic probes they developed could be used for many purposes, including:

- measuring pupils' initial understanding prior to teaching a topic;
- challenging and stimulating thought during teaching;
- evaluating the teaching of a topic at the end of the topic;
- informing colleagues of the ideas that pupils may hold about a topic;
- helping teachers to review and develop schemes of work;
- helping teachers to set targets for individuals and groups of pupils; and
- challenging teachers' own thinking and understanding.

Reference:
Nixon, D., Kirk, H. and Needham, R. Brooksbank School, Elland, West Yorkshire (1998) *The use of 'diagnostic probes' to aid teaching and learning in science.*
www.tda.gov.uk/upload/resources/pdf/t/tta99-03.pdf

Case study 6

Peer- and self-assessment in creative writing

We chose this case study because it illustrates how asking pupils to work with a partner to assess each other's work in a structured way can have a positive impact on their understanding, performance, motivation and self esteem.

Two Year 8 classes – an above average and a below average literacy set – took part in the study. The pupils worked on producing a short story. This was an extended project, which spanned several weeks.

The teacher developed the creative writing project in the following sequence.

1 The pupils chose "Writing Buddies" with whom they would work for the whole project.
2 They were helped to compose assessment criteria based on work they had done previously on the genre.
3 The writing buddies were encouraged to work together on planning before the writing process began, by explaining their ideas and swapping outline plans.
4 During writing, partners read each other's work at frequent intervals and were encouraged to question and constructively criticise the writing, using the assessment criteria as a reference.
5 The pupils were asked to write an assessment of their own and their partner's finished story, referring directly to their agreed assessment criteria.
6 The pupils assigned a national curriculum level using a checklist to help them, having previously practised using level descriptions to make assessments of model texts.

The teacher found in her evaluation of the impact of the project that:

- assessments made before and after the project showed clear gains in achievement for all pupils;
- pupils' attitudes were very positive and many felt that the project had increased their self-esteem as writers;
- the continual discussions about stylistic issues during the writing process provided a useful context for teaching input on grammar and structure when individuals needed this;
- pupils felt that they gained a greater understanding of what constitutes quality in writing and were able to apply this to their own work;
- most pupils were very accurate in the levels they assigned to their work; and
- the pupils' behaviour was exemplary, even where problems might have been expected.

Reference

Rachel Swaffield, *Self-assessment in creative writing*

Find out more online

The Research of the Month resource summarises key research studies in the field of teaching and learning and we have not drawn from all the RoMs in this anthology. All the RoMs we ave used here are listed in the references below with direct web-links to the summaries and reference to the studies on which they are based.

You can find other RoMs by going to:
www.gtce.org.uk/research/romtopics/

A variety of other research evidence is available on line.

The DCFS Research Informed Practice Site (Trips) provides accessible digests of research in plain language. You can search over one hundred summaries by theme, subject, author or keyword at **www.standards.dfes.gov.uk/research/**

Learning Exchange Online, run by the National College of School Leadership, allows you access to two-page summaries of research. Go to: **www.ncsl.org.uk/networked/networked-leo-search.cfm**

The Centre for the Use of Research and Evidence in Education (Curee) works to support and develop teachers' and policy makers' access to and use of educational research. The team from Curee choose, appraise and write the RoMs and the other research summaries mentioned above. The Curee website is packed with information about useful research for teachers and includes a useful links page to other educational organisations. Click on: **www.curee-paccts.com**

References

Here is the full list of **Research of the Month summaries** on which this anthology is based and their web links, plus the studies on which they are based.

ICT for teaching and learning
www.gtce.org.uk/research/romtopics/rom_curriculum/ict_mar01
Moseley, D., Higgins, S., et al. (1999) *Ways forward with ICT: effective pedagogy using information and communications technology for literacy and numeracy in primary schools* Newcastle upon Tyne: University of Newcastle

Raising standards through classroom assessment
www.gtce.org.uk/research/romtopics/rom_teachingandlearning/assess_may01
Black, P. and Wiliam, D. (1998) *Inside the Black Box* London: King's College, University of London

Improving learning through cognitive intervention
www.gtce.org.uk/research/romtopics/rom_teachingandlearning/case_jun01
Adey, P. and Shayer, M. (1994) *Really raising standards* London: Routledge

Making the difference: teaching and learning strategies in successful multi-ethnic schools
www.gtce.org.uk/research/romtopics/rom_inclusion/multiethnic_schools_sep01
Blair, M. and Bourne, J. with Coffin, C., Creese, A. and Kenner, C. (1998) Research Report RR59: *Making the difference: teaching and learning strategies in successful multi-ethnic schools* London: DfEE

Inside the literacy hour
www.gtce.org.uk/research/romtopics/rom_curriculum/literacy_feb02
This RoM was based on two studies:
Fisher, R., Lewis, M. and Davis, B. (2000) *An investigation into the implementation of a literacy hour in small rural schools* Plymouth: University of Plymouth

Fisher, R. (2000) Changing teacher practice: *A report of changes in the practice of teachers in England following the introduction of a national literacy strategy* Plymouth: University of Plymouth

Researching effective pedagogy in the early years
www.gtce.org.uk/research/romtopics/rom_curriculum/early_years_jan03
Siraj-Blatchford, I. Sylva, K., et al. (2002) Research Report RR356: *Researching effective pedagogy in the early years* London: DfES

Effective teachers of numeracy
www.gtce.org.uk/research/romtopics/rom_curriculum/numeracy_apr03
Askew, M., Brown, M., Rhodes, V., Johnson, D. and Wiliam, D. (1997) *Effective teachers of numeracy: Report of a study carried out for the Teacher Training Agency* London: King's College, University of London

Teachers and school-based research
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